Mapping Lisbon Agriculture (1898-1911)

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Keywords: Agriculture statistics, Beginning of XX Century, Cartographical analysis, Food provision, GIS, Historical cartography; Lisbon; Urban agriculture history; Water management

1. Abstract

Lisbon municipality testified the existence of urban agriculture in the beginning of twentieth century. In addition, food was also supplied by other territories. Drawing on the case study of Lisbon this paper aims to provide an analysis of the production and consumption of potato, olive, olive oil, wine, fresh vegetables and fruits. These crops and products depended on specific location, size and shape of territorial arrangements, as well as on associated water provision elements, which together determined a specific Lisbon urban agriculture map.

This analysis comprises an historical account of specific Lisbon’s statistical and cartographical information, produced for Lisbon between 1898 and 1911. The results of the analysis provide an overview of the relationship between food production and consumption, as well as an outlook over the urban form and territorial solutions that assured specific urban agricultural options and water provision solution, for the period of time under analysis. Finally, this study confirms that in the begging of XX century Lisbon was not self-sufficient in terms of food provision, for the specific products under analysis.

2. Introduction

Together with the demographic growth in the past Century, witnessed by Lisbon, the capital of Portugal, significant social and economic changes did also take place (see for example Cordovil, 1993; Martins, 1997; Silva, 1997). These contributed to the establishment of specific ways of life, labour preferences and alimentary diets. As pointed by several authors, (see Lains e Sousa, 1998; Justino, 1989, Matoso, 2011) the rural way of life that has tailed Portuguese society until 1900 seems to have prevailed until 1950, but also demonstrating significant production growth (Lains, 2003). It must be noted that the majority of these works were conducted over historical statistics accounts.

In what concerns to Lisbon territory, historical statistics accounts provide interesting outlooks over the agricultural production and consumption within this territory for the period under analysis (see for example Lains e Sousa, 1998). However, as also confirmed by Lains and Sousa (1998) the statistic sources are limited in terms of food products, surveyed years and covered municipalities.

By examining in what ways Lisbon and its inhabitants were involved in urban agriculture, for the period of time under analysis, this investigation aims to reflect on how much was Lisbon self-sufficient in terms of food provision, at a time when: i) great part of the District of Lisbon population was agricultural workers; ii) only 16% of land was urbanized (built areas); approximately 41% of land was used for agriculture purpose; and iv) most of the land, approximately 42%, was left without indication of any use. Moreover, it is aimed to: (i)
identify which agriculture products were produced in Lisbon; (ii) Which agriculture products were consumed in Lisbon; (iii) What was the balance between food production and consumption; and (iv) Where were these products cultivated in Lisbon?

The use of historical cartography has already been attested as a useful source to access food production and access to land (Bjorklund, 2010). In what concerns to Lisbon, Marat-Mendes (2011) analysis over historical cartography has also provided support to identify for the western region of Lisbon’s Territory, the agricultural intensification that occurred between XIX and XX Centuries and its relation to practices of water management. Moreover, this study has also confirmed that land use in such territory respected a competition of access to water, which determined the shape, size and location of the different farms throughout this territory.

It is based on the assumption that historical cartography constitutes an important contribution to the understanding of historical urban agriculture, that the present paper, while focusing on the Lisbon Municipality area, circa 1900, introduces the results of an ongoing investigation that aims to articulate data from historical statistical accounts and from historical cartography.

Moreover, this research focuses its analysis on the agriculture, but also on a number of water elements, which enabled the agriculture production in Lisbon. As argued by Marat-Mendes (2011), Barthlel and Isendahl (2013) the analysis of agriculture cannot be dissociated from any analysis of water management, in order to better ascertain the practices that have contributed to integrate urban agriculture as part of the urban activity, during eras of energy scarcity, and then contribute to the resilience of cities. Therefore this paper aims also to elucidate what was the relationship between urban agriculture and the use of water in Lisbon in about 1900. The results of this study allow to elucidate the importance of the urban green spaces for the making of urban form (Marat-Mendes et al, 2014), as also argued by Walmsley (1995). Furthermore, urban green spaces, as perceived in this paper, should include not only public green spaces but also urban agricultural land.

In order to respond to the several questions above identified this paper is structured in five parts. Following this brief introduction, the second part describes the concepts, sources and methods that have been used to access Lisbon Agriculture between 1989 and 1911, throughout a mapping of the agricultural provision areas within Lisbon Municipality. The third part makes use of available historical statistics data regarding population, food production, food consumption and the diet at that time. The fourth part provides new data analysis based on a visual characterization of Lisbon urban agriculture against water use, comparing two cartographic sources. The final part discusses the results obtained from the analysis of the different sources is provided.

2. Concepts, Sources and Method

2.1. Urban agriculture and Hinterland

In the context of a discussion regarding urban agriculture it is important to clarify the different concepts of space that are under analysis. Urban agriculture is defined by agriculture that took place within the limits of an urban municipality, in this case Lisbon Municipality.

Urban agriculture in Lisbon took place within three categories of space: i) vegetable gardens, where several fresh vegetable products were cultivated; ii) ploughed lands that could be cultivated with cereals or potatoes, for example; and iii) the remaining agriculture land which was labelled according to the specific type of crops that were cultivated in such areas (including olive trees, trees and vineyards). The typologies of urban form that have sustained
these two categories of space in Lisbon between 1898 and 1911 will be also identified. Moreover, it is important to underline that these are the same categories that one will find in the hinterland of Lisbon, i.e. in the territory that partly belonged to Lisbon and Setúbal Districts, from which it is believed that food supply in Lisbon depended on.

2.2. Statistical, photographic and cartographic historical sources

To consider food production and consumption as well as to determine cross-reference between different sources two main statistical historical documents were used. These relate to agriculture statistics produced in 1914 (DGE, 1914) and the study elaborated by Simão de Martel about the food provision of low classes and its relationship with labour (Martel, 1911). Complementary information regarding number of population, number of households and area covered by the municipality was gathered by the Census from 1900. The visualization of Lisbon urban agriculture between 1898 and 1911 has called for a brief portrait of the agriculture life that took place in Lisbon for the period of time under analysis. The pictures that have informed such portrait were identified at the Arquivo Fotográfico da Câmara Municipal de Lisboa\(^1\) (see figure 2). The analysis offered in this paper was built upon the analysis of two historic cartographic sources. The first one refers to the Carta dos Arredores de Lisboa\(^2\) (CEM, 1893-1932), which was produced by the Portuguese militaries between 1896 and 1932 in a total of 85 charts, elaborated at 1:20.000 scale. The study required, for the municipality of Lisbon, the analysis of six charts, which covered the territory under analysis. These were charts number 1, 2, 6, 7, 11 and 12, elaborated between 1898 and 1902. The second one refers to O Levantamento da Planta de Lisboa\(^3\), conducted by Engineer Júlio António Vieira da Silva Pinto, between 1904 and 1911. This plan for Lisbon was produced for the Municipality of Lisbon, at scale 1:1.000 and comprised a total of 249 charts. The detail offered by this cartography grants makes from this plan one the most notable urban cartographic sources of Lisbon for the period of time under analysis.

2.3. Method

This study took the following three-step approach: (1) Selection of the territory under analysis and that corresponds to Lisbon Municipality (Figure 1); (2) Analysis of the historical statistics accounts on agriculture, but also of historical cartographic materials; and (3) Use the results of the analysis of the two types of sources (statistical and cartographical) to evaluate possible correspondences between agriculture uses, food provision and food consumption for Lisbon in the beginning of the XX century.

The analysis elaborated in step two involved the elaboration of five tasks:

1) Analysis of the historical agricultural statistics and production of a summary table.
2) Analysis of the survey elaborated by Martel (1911) and compile information in a table.
3) Analysis of the historical cartography produced for Lisbon and its environments at 1:20.000 scale (CEM, 1893-1932)
4) Systematization of a database of water elements, farms, crops and agriculture uses (see figures 4 and 5).
5) Analysis of Silva Pinto (1904-1911) cartography against CEM (1893-1932) cartography in order to visualize possible correspondences between agriculture and water uses for Lisbon in 1900.

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\(^1\) Photographic Archive of Lisbon City Council (English translation by the authors).
\(^2\) Chart of Lisbon Surroundings (English translation by the authors).
\(^3\) The survey of Lisbon plan (English translation by the authors).
The two analysed cartographic sources present different scales and different details of analysis. While the Silva Pinto offers greater detail on the relationship between land use and water, the absence of a proper legend inhibits however the identification of the agriculture crop under analysis. In addition, the CEM cartography offers a rich legend that allows one to identify the several crops and their distribution over the territory. Moreover, water elements were also identified. A library of crops according to the results of this analysis was therefore elaborated, such as a legend proposal for Silva Pinto charts.

The designations employed in the CEM charts legend allowed us to identify the different water and crops elements, which compose the libraries of information, used in this investigation. However, those designations find several possible translations, either in Portuguese or in English. Therefore, such designations are presented in this article in the original Portuguese language as in CEM charts, and translated into English assuming that there can be other possible translations.

![Figure 1 – Lisbon cartography (left side: CEM, right side: Silva Pinto).](image)


<table>
<thead>
<tr>
<th>Crops and products</th>
<th>Statistics (1905-1911)</th>
<th>S. Martel (consumption LX 1911)</th>
<th>Cartography (crops 1898-1902, 1904-1911)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Consumption</td>
<td>Production</td>
<td></td>
</tr>
<tr>
<td>OLIVE</td>
<td>Olive</td>
<td>Olive</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Olive Oil</td>
<td>Olive Oil (Estimated)</td>
<td>Butter and Olive Oil</td>
</tr>
<tr>
<td>POTATOES</td>
<td>Potatoes</td>
<td>Potatoes</td>
<td>Potatoes and Rice</td>
</tr>
<tr>
<td>VEGETABLES</td>
<td>-</td>
<td>-</td>
<td>Vegetables</td>
</tr>
<tr>
<td>FRUITS</td>
<td>Fruit</td>
<td>Fruit</td>
<td>Fruit</td>
</tr>
<tr>
<td>WINE</td>
<td>Wine</td>
<td>Wine</td>
<td>Wine</td>
</tr>
</tbody>
</table>

Table 1 – Crops and products identified in the analysed sources.
3. Lisbon historical portrait

Figure 2 – Portraits of agriculture life in Lisbon.
This section provides a brief historical portrait of Lisbon relying on historical literature, statistical information and contemporary photographs (see figure 2).

### 3.1. Food and water in Lisbon

The 1900 census shows that the 87.70 km² of surface that corresponded to Lisbon municipal area, concentrated 356,099 inhabitants in 77,805 households. The population increase of the capital came to be confirmed in the next census (1911), where 435,059 inhabitants were recorded, which means an increase of 22%. Among these inhabitants, the Water Company of Lisbon (CAL), founded in 1868 with the aim of meeting the needs of water supply for human consumption, indicated, for the year 1900, 45,156 consumers to 14,205 channelled buildings with a total consumption of 8,415,656 m³ of water (Pinto, 1989), particularly from the Alviela channel, whose water arrived in Lisbon in 1880. The constant lack of water that affected Lisbon led King John V, in 1731, to order the construction of the Águas-Livres Aqueduct (a project by Manuel da Maia and Custódio Vieira), allowing the conduction of 810,000 litters of water per day to be shared by approximately 100,000 inhabitants, circa 1835 (Montenegro, 1895). For all those that were not supplied by the water network the city provided free water from the public fountains. The majority of the population paid to the galegos (water carriers) the carrying of 25 litter barrels at a cost of 20 Réis. In 1868 there were in Lisbon 26 fountains with 97 spouts (48 for water carriers, 40 to individuals and nine to fill barrels), six public wells and 1200 private wells (Montenegro, 1895).

In 1903 it was published the first survey of the hygienic conditions of the main settlements of Portugal (CMSOPCI, 1903) that, among other important data, informed about the quality of the water for human consumption. As stated by this survey, the water carried by the Águas-Livres aqueduct and by the Alviela channel was of good quality, but the water provided by Lisbon wells was, generally, of poor quality. These waters served mainly for washing and for agriculture, particularly for the irrigation of the varied cultures of the vegetable gardens (plots of cereals such as maize and rye, beans, pumpkins, cabbages planted sprouts or around the land (Ribeiro, 1989a) and orchards, once the remaining crops were generally planted in dry land. In Loures, for example, the lower area was composed of fertile land that was covered by several cultures that were irrigated only by the water from wells (Ribeiro, 1989b). It is important to recall that at that time, sewage was also utilized in the agriculture. In addition,
that this did not enter on sewer pipes, that was daily transported in cars for temporary deposits in the bank of the Tagus River and removed from the urban area for these agricultural areas (Gomes, 1871).

From the 5,016,267 residents in the Portuguese mainland inhabitants recorded in the early twentieth century, approximately 61% were agricultural workers (98,574 individuals in the District of Lisbon). The Agricultural Statistics published in 1914 indicates potatoes, olives and fresh fruits as the products produced within the area of Lisbon. The Carta dos Arredores de Lisboa (CEM, 1898-1902) shows that the location of the cultivation of vineyards (figure 9). As Simão de Martel informed, the daily consumption of wine was about 271g per capita (Martel, 1911). People who lived in the capital consumed much of this food. Olive, for example, entered in the meals of the agriculture staff, was transformed into oil, served for seasoning meals as much for lighting; the year against-crop, the oil production could be summed half, a third or a quarter of that was produced in the previous year (Ribeiro, 1989b). The work of Simão de Martel, published in 1911, resulted in a report with the compilation of data collected a few years earlier in a questionnaire format and presented in the hygiene section of the XV International Congress of Medicine (1906) and to the Minister of Development (1907), to inform about the "Lisbon and Paris feed and the feed in Portugal outside of the big cities". Martel concluded that the daily consumption of the inhabitants of Lisbon comes to 460g of wheat bread, 23g of noodles, potatoes or rice 140g, 126g fresh fruit, fresh vegetables 200g, 70g of dried beans vegetables, eggs 20g, 130g of milk, butter 27g and 35g of sugar. Regarding the consumption of meat, we have 118g of lamb, horse or beef but, since the price of beef was too high, about 340.3 Reis/kg (Martel, 1911), people also consumed 33g of pork and 42g of fish that was usually cod fish, which has come to occupy a prominent place in the Lisbon's gastronomy since 1870 (Mattoso, 2011).

In Lisbon the lower classes had the habit of going to the vegetable gardens on the days off. Belonging to the nobility these famous vegetable gardens were located in farms around the capital, nearby Chelas, and from Arroios to Portela (Carapinha, 2009) (figure 9). In the end, a "chop-house" supplied food and drinks (Carapinha, 2009). The delights of these big lunches were the fish that was bought in the 24th July Market to the women that come from the north of Portugal. Fried and served with abundant salad, it gave the name to the citizens born in the capital. As an alternative to this "going to the vegetable gardens" or Sunday-tour in the Passeio Público (Lisbon main garden), the poorest classes also spent their savings in fairs (Belem, Santos, Eduardo VII Park, Campo Grande, Luz), who brought a bit of day-to-day of the provincial way of life to the city. The fair established since 1778 in Campo Grande was the busiest, because there everyone could find cattle, tableware, crafts, food and drinks. For these fairs, the "hillbilly" came out from the city around (from Calçada de Carriche to Mafra) to bring in cars pulled by animals or in baskets on their backs, the vegetables produced on their lands. In return, the manure from their animals, mixed with the waste of their crops, filled the baskets again to fertilize their land (Dias, 2002).

3.2. Food production and consumption in Lisbon

This section offers information on food production and consumption for Lisbon in 1905. However, the data available for the number of population refers to the Census of 1900 (DGEPN, 1905), which estimated 356,009 inhabitants. This was the value considered for the calculation of the total population estimated consumption introduced in table 2.

Six types of food products were considered for this analysis. These included: potato, olive, olive oil, wine, fresh vegetables and fruit. The Agricultural Statistics (DGE, 1914) provides information about the production and the consumption of olive and fruit. On what concerns to potato and wine the information about production and the consumption is provided by other
sources (DGEPN, 1906). Regarding olive oil, information for this product was estimated based on data from 1916 onwards. Consumption of food products was determined by information gathered in 1907 by Simão de Martel (Martel, 1911). Moreover, Martel (1911) indicates that children consume fifty percent less than adults. However, there is no information about the number of children in Lisbon for the period of time under analysis. Thus table 2 exhibits the total population estimated consumption in its last column, without differentiating children consumption.

Table 2 presents also the balance between consumption and production of four products (potato, olive, olive oil and fruit), allowing to estimate the approximated value of products which were needed from outside Lisbon Municipality (imports).

### Table 2 – Food production and consumption in Lisbon (1905).

<table>
<thead>
<tr>
<th>Crops and Products</th>
<th>Production (Kg/year) (a)</th>
<th>Consumption (Kg/year) (b)</th>
<th>Imports (Kg/year) (c)</th>
<th>Per capita consumption (Kg/day) (d)</th>
<th>Total population estimated consumption (Kg/day) (e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potato</td>
<td>172,735,00</td>
<td>18,133,657,00</td>
<td>17,920,966,00</td>
<td>0,14**</td>
<td>49,841,26</td>
</tr>
<tr>
<td>Olive</td>
<td>155,648,00</td>
<td>893,368,00</td>
<td>737,720,00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Olive oil</td>
<td>15,374,10*</td>
<td>3,511,543,00*</td>
<td>3,496,168,89</td>
<td>0,03***</td>
<td>10,680,27</td>
</tr>
<tr>
<td>Wine</td>
<td>1,033,565,00</td>
<td>46,950,680,06</td>
<td>45,917,115,06</td>
<td>0,27</td>
<td>96,122,43</td>
</tr>
<tr>
<td>Fresh Vegetables</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0,2</td>
<td>71,201,80</td>
</tr>
<tr>
<td>Fruit</td>
<td>228,570,00</td>
<td>14,411,398,00</td>
<td>14,182,828,00</td>
<td>0,13</td>
<td>46,281,17</td>
</tr>
</tbody>
</table>

Sources and formulas: a, b (DGE, 1914; DGEPN, 1906); d (Martel, 1911); *estimated values IN +; **this includes rice; ***this includes butter.

c = b – a (In the case of Potatoes c = e – a)
e = d x 356.009 (Number of inhabitants in Lisbon in 1900, DGEPN, 1905)

### 4. Lisbon visualization

This section provides the visualization of urban agriculture in Lisbon through the analysis of two cartographic sources (CEM, 1896-1905; SILVA PINTO, 1904-1911, shown at figure 1). First it will be provided a general over view about the types of farms, water elements and crops in Lisbon present in CEM cartography, and accounted with GIS; Second, it presents a detailed illustration of each crop type in the Municipality of Lisbon, present in CEM cartography and delimitated with GIS; Complementary, it presents a comparison of each type of crops in the two cartographic sources, in coincident locations.

#### 4.1. Farms, water elements and crops in Lisbon in the beginning of XX century

The municipality of Lisbon included several types of elements related to agriculture around 1900 that can be identified in CEM cartography: water supply elements, farms and cultivated land (crops). The cultivated soil was covering more than 40% of the entire municipality (table 3).

Amongst the farms there were royal farms, walled farms and not walled farms, totalizing, according to CEM Charts, 172 units. Wells and tanks represented water elements which were present in all these farms and that have supplied them with water for agriculture. Four farms were Royal (Belém, Ajuda, Tapada da Ajuda and Necessidades) and at least seven were walled (see figure 4 [image 1]).
Concerning water supply, seven types of water elements were identified from CEM charts legend (see figure 3): aqueducts, including underground aqueducts (*aquedutos*), fountains of type 1 (*chafarizes*), fountains type 2 (*fontes*), tanks (*tanques*), springs (*nascentes*), water reservoirs (*mães de água*), and wells (*poços*). According to Lemos (1900-1909) *chafarizes* would differ from *fontes*, because of the number of taps available. *Chafarizes* had more than one tap.

Five agricultural crops were identified in Lisbon from the CEM charts legend: olive groves (*olivais*), ploughed lands (*terras lavradas*), trees (*árvores*), vegetable gardens (*hortas*), and vineyards (*vinhas*) (see figure 3). Gardens, pine woods and woods in general are other land uses identified in the charts in Lisbon, however, these do not appear in the statistics concerning Lisbon production and consumption (see table 1). Ploughed land was the most extensive agricultural surface, followed by olive groves and vineyards (see table 3 and figure 5 [images 1,2,4]). From the 8 700 hectares of Lisbon Municipality, more than 3 000 hectares were of cultivated land. The delimitation of crops was done according to the location of the symbols for each crop, thus the agricultural surface in reality might be considerable higher.

### Table 3 – Water elements and crops identified in Lisbon.

<table>
<thead>
<tr>
<th>Water Elements (units)</th>
<th>Wells</th>
<th>Fountains 1</th>
<th>Aqueducts</th>
<th>Water Reservoirs</th>
<th>Fountains 2</th>
<th>Tanks</th>
<th>Springs</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>182</td>
<td>22</td>
<td>13</td>
<td>99</td>
<td>33</td>
<td>13</td>
<td>8</td>
<td>370</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Crops (ha)</th>
<th>Olive trees</th>
<th>Ploughed lands</th>
<th>Trees</th>
<th>Vegetable gardens</th>
<th>Vineyards</th>
<th>Estimated Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>680</td>
<td>1447</td>
<td>237</td>
<td>170</td>
<td>652</td>
<td>3.186</td>
</tr>
</tbody>
</table>

Source: Geo-referenced map (IN+ and DINÂMIA’CET-IUL MEMO Team).

Figure 3 – Vizualization of water elements and crops simbology as informed by the cartography.

### 4.2. Mapping Lisbon Agriculture with GIS

The following images resume the GIS analysis effectuated for seven water elements, three types of farms and seven types of crops production identified from CEM chartography (1896-1905). The relationship between all these elements is organised as indicated in figures 4 and 5.
Figure 4 – Water elements farms vs. walled and Royal farms, topography, crops and vegetable gardens.

Source: Geo-referenced map (IN+ and DINÂMIA’CET-IUL) based on CEM (1898-1902).

Figure 5 – Water elements and farms vs. olive trees, ploughed lands, trees and vineyards.
4.3. Confrontation of two historical cartographic sources

After knowing the general distribution of crops in the municipality of Lisbon, in the beginning of the XX century, the second cartographic source (Silva Pinto, 1904-1911) was used to explore with greater detail the presence and representation of agricultural land uses in this territory, and its relation with water infrastructures.

Through the analysis of the territory and CEM mosaic for Lisbon, twelve Silva Pinto charts (figure 6) were selected by criteria of high correspondence with CEM charts in terms of crops and of presence of relevant water elements. The selected charts were used to map urban agriculture and to illustrate the relation between crops and water elements. Twelve “windows” were then extracted from Silva Pinto selected charts and compared with the respective CEM representation.

Figure 6 – Location of selected Silva Pinto charts (in red) over CEM cartography.

It should be considered that the two used cartographic sources differ in scale but also in purpose, therefore their visual comparison shows that the correspondence of land uses between these two sources is not always verifiable. Moreover, while CEM charts offer a detailed legend, for the Silva Pinto charts it was not possible to identify until today any legend. Thus, when possible, the CEM charts supported the reading of Silva Pinto charts, allowing the proposal of a legend on what relates to some crops (olive groves, ploughed lands, trees, vegetable gardens and vineyards) (see figure 10).
Figure 7 – Olive groves and ploughed lands.
Source: CEM (1898-1902) – 1 (chart 2), 3 (chart 7), 5 (chart 7), 7 (chart 6), SILVA PINTO (1904-1911) – 2 (chart 6G), 4 (chart 6L), 6 (chart 5P), 8 (chart 14P)

1, 2, 3, 4 - Trees
5, 6, 7, 8 - Vineyards

Figure 8 – Trees and vineyards.
The images above (figure 7-9) represent a selection of two pairs of “windows” per each crop, extracted from the two cartographic sources, for the same location. In the case of the “vegetable gardens” four pairs of images were used illustrating relevant areas of urban agriculture.

Olivais and Entrecampos were areas of concentration of vegetable gardens in the two cartographic sources (figure 9); however the more representative fields are not always spatially coincident in the two sources, and therefore more charts were used to illustrate this crop.

Figure 9 – Vegetable gardens.
5. Discussion and results

5.1 Cartography analysis results

This research has confirmed the opportunity of the use of historical cartography to the understanding of historical urban agriculture in Lisbon in 1900.

After mapping Lisbon Agriculture with GIS, at the scale of the entire municipality of Lisbon, based on CEM (1893-1932) it was possible to provide a comparing visualization of crops and water elements in a second historical cartographic source (Pinto, 1904-1911). This comparison was conducted at the scale of agricultural fields.

This analysis confirms that in the municipality of Lisbon there was agricultural production covering a significant part of this territory. However, there was also the presence of “empty areas” which, if used for agriculture purpose, could have contributed to increase agriculture production.

Lisbon visualization provided in section four allowed clarifying part of the unknown legend of the Silva Pinto (1904-1911) cartography, for the five analysed crops. This legend (figure 10) provides information for further research. For vineyards, trees (orchards of fruit trees) and vegetable gardens, there is an undoubtable identification of the graphical information at the Silva Pinto charts. However, that does not happens for ploughed lands, as these corresponded also to not cultivate land. Identification and selection of ploughed lands (figure 7) was based exclusively in the information given by CEM charts.

The high detail of the Silva Pinto charts helps to arrive to the proposed legend, for example on what concerns to fields of olive trees, where the delimitation of roads with small trees, designed one per one, indicates that the contiguous field is an olive grove (see Olive groves in figure 10).

<table>
<thead>
<tr>
<th>Olive groves</th>
<th>Trees (Orchards)</th>
<th>Ploughed lands</th>
<th>Vegetable gardens</th>
<th>Vineyards</th>
</tr>
</thead>
</table>

Source: Silva Pinto (1904-1911)

Figure 10 – Crops legend for Silva Pinto charts.

The eventual correspondence between the two types of charts, as conducted for crops allowing the proposal of a legend (Figure 10), was not possible for the water elements. These elements were not represented by a symbol in Silva Pinto charts (1904-1911) and, instead, were represented with their form. Thus, this paper does not present any legend for water elements for Silva Pinto charts.

Figure 7 [images 1 and 2] and figure 8 [images 1 and 2] allow identifying a correspondence between the locations of tanks in the two cartographic sources. These locations are presented with more detail in figure 11[image 1] and 11[image 2].

In the case of the image 6 of figure 7 (zoomed in figure 11 [image 3]), while in Silva Pinto several wells appear in the backyard of houses, these are not pointed in CEM charts. Such
lack of correspondence is not surprising, since not only there is a time lag between the charts, but also Silva Pinto charts present higher detail.

On another hand, underground aqueducts consist on a type of water infrastructures only visible at CEM charts (see for example figure 7 and 8 [image 3 and 4]), probably due to the military purposes of this cartographic source.

![Figure 11 – Examples of water elements in Silva Pinto charts.](image)

6. Conclusions

A visualization of Lisbon agriculture circa 1900 was provided in this paper, although its accounting was conditioned by the available sources.

The adopted methodology confirmed that the use of statistical and cartographic information is complementary to better illustrate urban agricultural in Lisbon.

As information is not always similar in these different sources, the comparing exercise offers specific difficulties. For example, land uses in the cartography do not always correspond to the same crops and products in the statistics. Moreover, the periods covered by statistics do not always fit with the years of available charts.

Through the crossing of different sources this paper proposes a legend for the Silva Pinto charts, which can be useful for further research. As verified in this legend for crops, and in the

| 1 | 2 | Source: SILVA PINTO (1904-1911)  
|---|---|-----------------------------  
| 1 | Chart 6G, Water tanks and ditches | 2 | Chart 3D, Water tanks and ditches | 3 | Chart 8F, Wells and tank |
attempt of producing a legend for water elements, the two identified cartographic sources proved to be complementary.

The study of the relation between water elements and agricultural land uses is also provided in this paper. This study identified some of the agriculture products cultivated in Lisbon in the beginning of the XX century. Their location was mapped.

A balance between food production and consumption for certain products was elaborated, providing new data about imports for potato, olive, olive oil and fruit. It was verified that Lisbon was not self-sufficient in the provision of these products, neither in the provision of fresh vegetables and wine. It was verified also that the absence of statistical information does not allow to fully characterizing the diet in Lisbon circa 1900.

This paper broadens the concept of urban agriculture, while considering three categories of spaces (vegetable gardens, ploughed lands and the remaining agriculture land). It also broadens the concept of urban green spaces, while including the identified categories of spaces of urban agriculture.

Finally, this study illustrates where urban agriculture was located in Lisbon, and how it was related to water elements within the municipality in the beginning of the XX Century.

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Acknowledgments

The authors are thankful to the Portuguese Science Foundation that with the grant PTDC/EMS-ENE/20197/2012 financed this research. The authors are also thankful to Nuno Gomes who has prepared the geo referenced map. The authors are also thankful to the
Instituto Geográfico Português and to the Archives of Câmara Municipal de Lisboa for the use of cartography and photography, respectively.