Family Horticulture as Precursory Activity for Social Developement: Social Structure and Soil Analysis for a Sustainable Production

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Abstract

The objective of this work is to present orchard planning in peri-urban soils of Escobar (Buenos Aires province), in the framework of the Phase 3 Orchards Project of the NGO A Roof for my Country. Feminization of agriculture is displayed after studying growers profile. Growersaresensitized by the needto consider the qualityof the soil, and the need forsoil analysisof theirsmall farmsto detectlimiting factors andthe risk of pollutants enteringthetrophicchain. Routine analysis were performed to evaluate the productive conditions, and heavy metals Cd, Cr, Cu, Ni, Pb and Zn were also analyzed, as they may be hazardous for human health. Soil analysis showed appropiate fertility conditions, but producers should take into account other limiting factors related to their precarious accomodation. Soil average and maximum contents of heavy metals resulted acceptable as stipulated by the argentine and international guidelines.

Keywords: Urban horticulture, social developement, soil analysis, heavy metals

1. Introduction

Poverty continues to persist in many countries throughout the world despite improvements in the global trade regime and significant enhancement in agricultural productivity through the green revolution technologies (Barghouti et al., 2004).

In many countries, urban and peri-urban agriculture (UPA) keeps unrecognized in agricultural policies and urban planning. Growers often operate without permissions and since it is officially "invisible", the sector receives no public assistance or oversight in many cities (FAO, 2014a). The incidence of poverty is typically severe among small and marginal farmers. Policy innovations should stimulate market mechanisms to develop small farmers organization for the purpose of overcoming the problems of economies of scale and improving their access to markets and information. FAO (2014a) enhances the role of UPA, which can be defined as the growing of plants and the raising of animals within and around cities. It provides food products from different types of crops (grains, root crops, vegetables, mushrooms and fruits), animals (poultry, rabbits, goats, sheep, cattle, pigs, etc.) as well as non-food products (e.g. aromatic and medicinal herbs, ornamental plants, tree products).

Environmental planning and management should influence policy-design conclusions that may enable better integration of urban farming into the on-going process of megacity development (Hussaina & Hanischa, 2014).
A new FAO land cover product: the "Global Land Cover-SHARE" (FAO, 2014b), represents the most-reliable global view of planetary land cover assembled to-date.

The class Artificial Surfaces is composed of any type of areas with a predominant artificial part, including any urban or related feature. In 2014 this class represented a 0.6% of the total land cover. The urban land has triplicatd since 2000, determining the relevance to focus the study and planning of UPA toward a goal of sustainable development.

Edaphological diagnosis is critical, specially for planning orchards in UPA provided that in a few years serious consequences for the security of the quality of food produced in these areas may occur in family orchards.
The Chair of Edaphology, Faculty of Agronomy, University of Buenos Aires (UBA) is involved in a project of the NGO "A Roof for My Country", which is based on the development of a plan of family and community orchards complemented with other crop and animal productions. In this framework, growers are sensitized by the need to consider the quality of the soil, and the need for soil analysis of their small farms to detect limiting factors and the risk of pollutants entering the trophic chain. The objective of this work is to present the social profile of the growers, and to diagnose soil conditions for a sustainable orchard management in peri-urban soils of Escobar (Buenos Aires province), in the framework of the Phase 3 Orchards Project of the mentioned NGO.

2. Materials and Methods

2.1. Orchards Plan

The NGO "A Roof for My Country", is an organization acting in Latin America and the Caribbean, which seeks to overcome the poverty that thousands of people that live in villages and settlements, through the joint action of its neighbors and young volunteers, building a more fairsociety where everybody can have the opportunity to develop their skills, and to exercise their rights.

The work is performed by neighborhood coordinators and volunteer groups to make follow-up visits and recommendations.They also contact the organization to provide the necessary inputs for the neighbors. The scope is to improve the nutrition and life conditiontsof the involved people, promoting sustainable food self-production, spreading healthy forms of human nutrition and providing tools to improve the environment in which they live. The idea is to create a culture of cooperative work in small-scale, generating an improvement in the local urban environment (PAT, 2014).

The Chair of Edaphology has assisted since 2011 in the planning of orchards, considering that in Argentina there are no heavy metals baselines in soils, and that there were warnings about this kind of contamination, which may affect the food chain and the health of the population (Giuffré et al, 2012, a, b).

2.2 Social Structure

The social context evaluation was conducted through a survey by volunteers in the village of Los Pinos, Escobar, Buenos Aires Province, belonging to Phase 3 Project. Basic questions about qualitative indicators, such as production inputs in the orchards, knowledge of horticultural practices and grower profile were answered by local growers (n= 32).

2.3. Soil Analysis

For each orchard (n= 32) a composite simple (3 subsamples) was extracted with a soil bore, considering the surface layer (0-15 cm). The samples were taken in november 2013, air dried for 24 to 48 hours, and sieved by 2 mm. Routine analysis were performed: textural analysis (Bouyoucos, 1962); pH in 1:2,5 soil: water relationship (McLean, 1982); electrical conductivity EC (Rhoades, 1996); Bray extractable phosphorus (Page, 1982); and total organic carbon (Nelson & Sommers, 1996).

In order to evaluate the total content of heavy metals in soil, McGrath et al (1994) technique was used. The aqua regia extracted metals that were quantified by induced plasma spectrometry on a Baird - 2070 ICP emission equipment. To monitor the effectiveness of the method NIST 2704 was used as reference. Other general soil conditions such common pollutants were also visually evaluated.

The obtained data obtained were analyzed using descriptive statistics and multivariate analysis (Infostat, 2002).

3. Results and Discussion

3.1. Social Profile of the Growers

Table 1: Social Profile of the Producers

No.	Previous knowledge	Profile
1	+	She is a maid (part time) and the husband is a mason. She mantains the orchard.
2	+	She is a housewife and her husband is a mason. He is the one who has the knowledge, though she mantains the orchard..
3	++	She is a is cook and her husband is a mason. She is more interested , and sows and maintains the orchard
4	++	Idem No.3, women are sisters, they are interested in producing their own food because it is something they have done all their lives.
5	-	She is a maid and her husband currently has no job, so the husband and children handle the orchard.
6	-	She cooks and sells the food in the neighborhood and he is a plumber, both are very enthusiastic.
7	-	She is a housewife and her husband is a laborer. Despite not having much knowledge the orchard has grown a lot because of their dedication.
8	-	She is maid and her husband is a mason. He is the one who has more knowledge about the orchard and keeps it on Sundays.
9	-	She is a housewife and her husband is a mason. They have no previous knowledge , but they have been able to overcome some difficulties in production
10	+	She is a maid (part time) and her husband is an electrician. He is the most knowledgeable and enthusiastic but his wife is the one who spends more time at home so she keeps the production.
11	+	She cooks and sells food in the neighborhood and her husband is a plumber and electrician. Both handled very well the orchard. By spending more time at home she is in charge, but gets help over the weekend.
12	++	She is a housewife and her husband a mason. She had previously orchards and has the experience to carry out them today
13	+	She is a maid and her husband is currently unemployed. He is who is more enthusiastic and has some knowledge so that takes care of maintenance of the orchard
14	+	Idem 13, the same producers
15	-	She is a housewife and her husband is an electrician. Nobody has the expertise but they work with dedication and enthusiasm. She is mostly in charge, with help on weekends.
16	+ +	She works at a local and her husband is a laborer. They both know a lot about gardening and usually take turns to perform the tasks.
17	-	She works at a local and her husband is an electrician. They had no knowledge about orchards, but this has not been an impediment to produce and harvest.
18	+	She is a housewife and her husband is a plumber. He knows a little more about production, but she is responsible for the orchard and carries it forward.
19	+ +	She is maid and her husband is an electrician. Although both are not long at home, the orchard is productive because they have expertise.
20	+ +	She is a housewife and her husband a mason. The husband is the one who has more knowledge of orchards, because he grew up on a farm.
21	-	She cooks and sells food in the neighborhood. She is in charge of the garden because her husband works all day as a mason.
22	-	Idem 21, the same producers
23	-	She is a maid and her husband is a laborer. Neither of them has expertise in the orchard, but because of their commitment and interest they have a good production
24	+	She is a maid and her husband is a plumber and electrician. She has some knowledge so is responsible for maintaining the orchard
25	+	She is maid and her husband is an electrician. He has more idea about gardens but she is very motivated so in recent times learned a lot and is now maintaining the orchard
26	+	Idem 25, the same producers
27	+	She is a housewife and her husband a mason. She had previously orchards and has more knowledge.
28	-	She is maid and her husband is a laborer. She keeps the garden so she gained much technical knowledge.
29	-	She works at a local and her husband is a bricklayer. Neither of the two has expertise but anyway they carry the garden very well due to the interest and dedication put on production.
30	+	She is a housewife and her husband is a laborer. Both had orchards previously, but she is the one who carries out the production.
31	-	She is a housewife and her husband is a mason, and hepls her with the orchard on weekends.
32	-	Idem 31, the same producers

All orchards were already in production, and management at all of them is organic, without the use of any pesticide.In Table 1, social profile of the growers is presented. Growers belong to low socioeconomic levels, men work mostly in the building industry, and women are mainly housewives, cooks or maids, and have an important role in the management of orchards. It is clear that in these production systems, feminization of the work is the most relevant feature, since woman spend most of their time at their houses, and they are also responsible for family food preparation.

This situation may be focused within the Feministor Gender Anthropology. The anthropology of gender has a fundamental epistemological and methodological dimension .It raises new problems and rethinking of conceptual forces that affect the whole discipline (Tarducci, 2012). In recent decades, the work of women in agriculture has become more visible. In part, this is because research has attempted to establish more reliably the activities performed by women and also due to the fact that with increasing frequency is falling on their shoulders the responsibility for family support This trend has been called "feminization of agriculture". Women take over important part of agricultural tasks previously done only by men, such as site preparation, and are devoting a lot more work to cash crops (Lastarria-Cornhiel, 2008).

3.2. Soil Conditions

The texture of the samples ranged between loam and sandy loam conditions, implying good infiltration without surface impedances. The pH values are considered suitable for most growing plants (Table 1); the presence of calcium carbonate from building materials in some soils with pH greater than 8.2 was noticed, but no danger of problems of sodicity was found. The electrical conductivity values (EC) were low at all samples (< 2 ds m^{-1}), corresponding to non-saline soils. The average content of oxidizable carbon (C) was moderate, ranging between 6.6 and 15.5 g C kg^{-1} (Table 1). Extractable phosphorus (P) showed a great variability and some high points could indicate contamination (Table 2). The data are consistent with analysis in six soil samples performed the previous year, at the same neighborhood (Giuffré et al, 2014).

Table 2: Summary of Routine Analysis

Variable	Average	Standard deviation	Minimum	Maximum
pH	7,75	0.35	6.99	8.48
EC (dS m^{-1})	0.38	0.18	0.15	0.92
P ug g^{-1}	35.24	19.44	12.13	88.99
Org. C g kg^{-1}	10.8	0.2.6	6.6	15.5

3.3. Visual Evaluation of Environmental Conditions

Several limiting factors were observed: proximity to the septic tank prepared by the residents themselves in precarious conditions, which implies possible contamination of the water used for irrigation. Some orchards are surrounded by residues from the buildings supplies, or have debris and trash on the soil surface. Some orchards are located near the street ditches which overflow when heavy rains occur; others are close to local streams or areas with municipal solid waste. These are not easy problems to solve, since they are structural, but they must be taken into consideration for future settlings, and growers must be aware of the risk they represent, in order to optimize the management of their orchards.

3.4. Heavy Metals Content

The contents of heavy metals in the different orchards are presented in Figure 1.

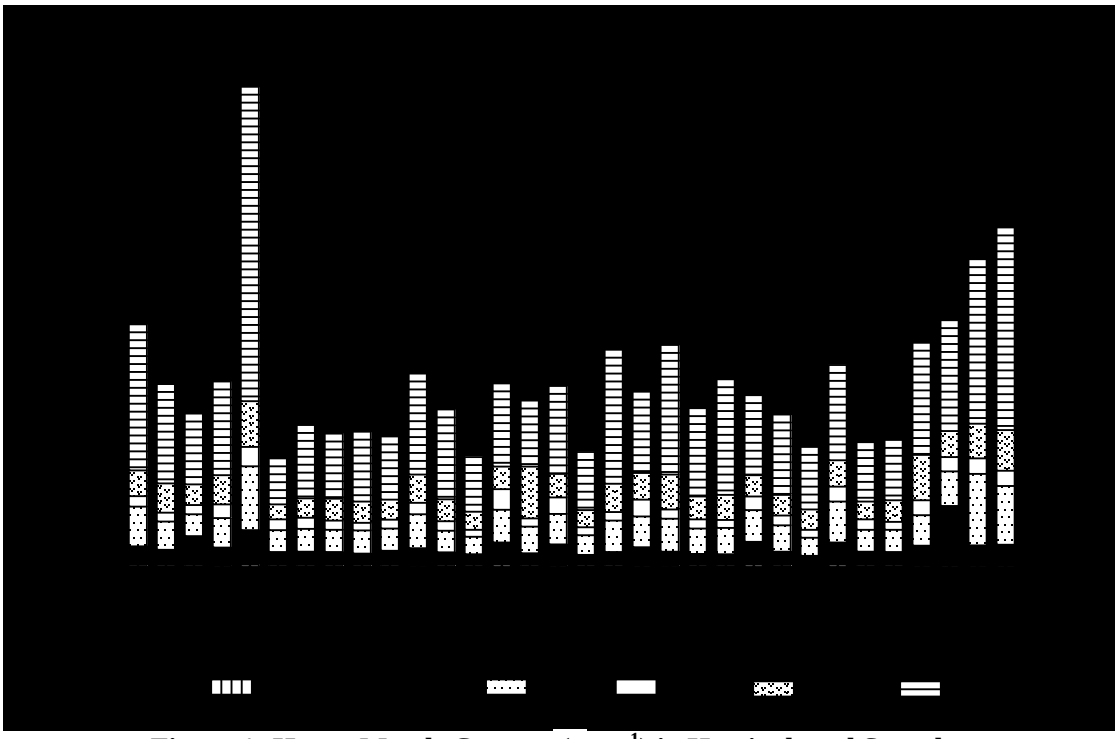

Figure 1: Heavy Metals Content (µg g^{-1}) in Horticultural Samples

Descriptive statisticsof the metal contents and their limits according to the argentine laws (Law 24051, year 1992) are presented in Table 2.

Table 2: Descriptive Statistics of heavy Metal Content in the Surface Layer of Soils and their Levels Compared to Argentine soil Quality Guidelines for Agricultural Soils, (Law 24051, Regulatory Decree 831/1993)

Metal	Range (µg g^{-1} soil)	Level guide (µg g^{-1} soil)	Mean	Standard deviation	Average value	Maximum value
Cd	0.4-1.2	3	0.2	0.7	acceptable	acceptable
Pb	7.4-25.3	375	12.9	4.3	acceptable	acceptable
Ni	3.5-10.1	150	5.6	1.8	acceptable	acceptable
Cr	5.1-28.8	750	8.9	4.5	acceptable	acceptable
Cu	8.5-31.2	150	15	6.2	acceptable	acceptable
Zn	22.5-153.6	600	48.3	25.5	acceptable	acceptable

The cultures in urban areas are exposed to more pollutants than in rural areas, as reported by Kowarik et al (2012) from concentration of heavy metals in vegetable crops in Berlin, under the influence of hig cars traffic. Urban and peri-urban agriculture could lead to health hazards for population if they are not handled properly. Argentine laws provide general guideline levels to soil contaminants, and other countries have considered lower acceptable levels based on risk evaluations.

Although all metals contents were acceptable for argentine legislation; in the case of cadmium there are some values slightly above optimal value (0.8 µg g-1 soil) of other national laws (Dutch list, 2000), which could indicate some influence of anthropogenic effect (Saumell et al, 1995) on its content. However, these values are lower than the baseline presented by Micó et al (2010) for other european countries. Cadmium is an extremely toxic metal, related with industrial activities, also present in some fertilizers. Trace quantities of cadmium may produce overexposures, due to low standard limits, so attention must be particulary focused in this metal (OSHA, 2009). Chromium, copper, nickel and lead values were below critical levels, even when considering the citedinternational standars. In the case of zinc, a sample with a value of 153µg g^{-1} soil stands well below the limit of the argentine law, but above the standards established by the Dutch list (2000) and the baseline of Micó et al. (2010). Zinc in soil may be relevant as food is an important source for human exposition to zinc, that could lead to digestive problems and anemia.

In order to visualize the distribution of the samples relative to the metal content, a multivariate analysis was conducted. In Fig 2 cluster analysis is presented, with a clear división into two groups of samples: Group 1 with higher metal content than Group 2.

This is used as exploratory data method in order to obtain more knowledge about the structure of the observations, as it groups together units of study with maximal similarity.

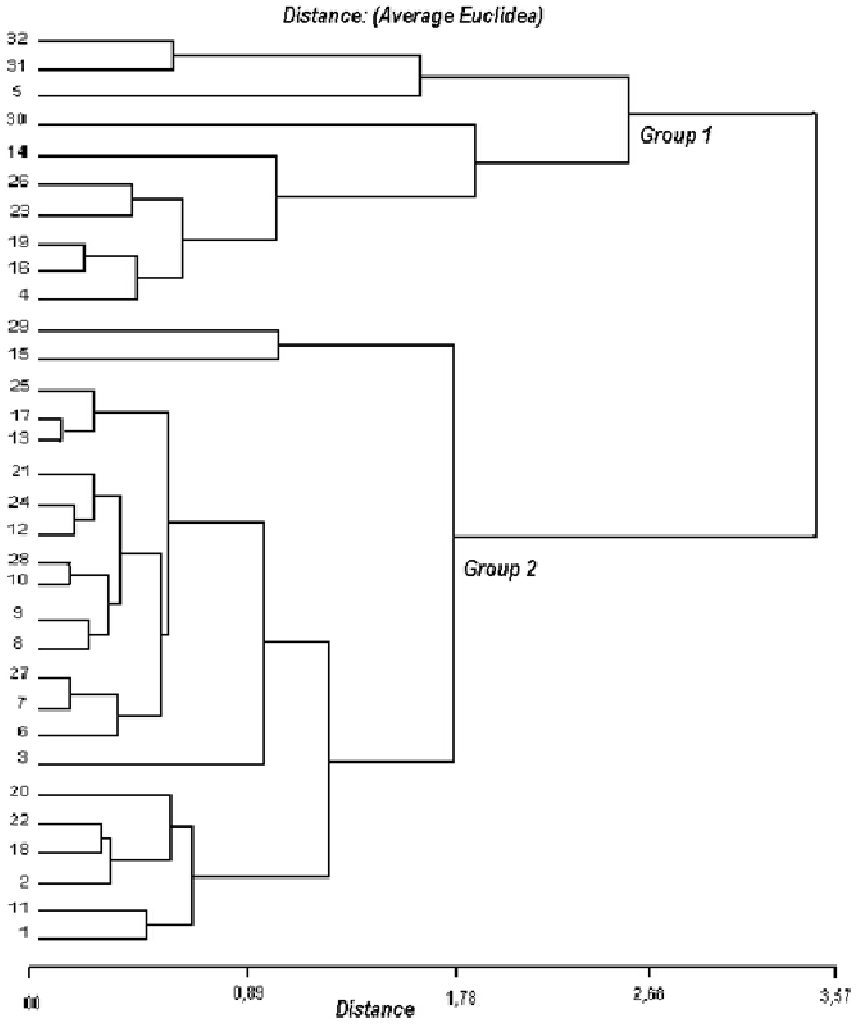

Figure 2: Multivariate Cluster Analysis by Complete Linkage

To have a better understanding of the cluster separation, a principal component analysis provides a graph where both treatments and soil variables, can be displayed to study the correlation among the measured soil variables, and the association between treatments and soil measurements. The principal component multivariate analysis is shown in Figure 3.

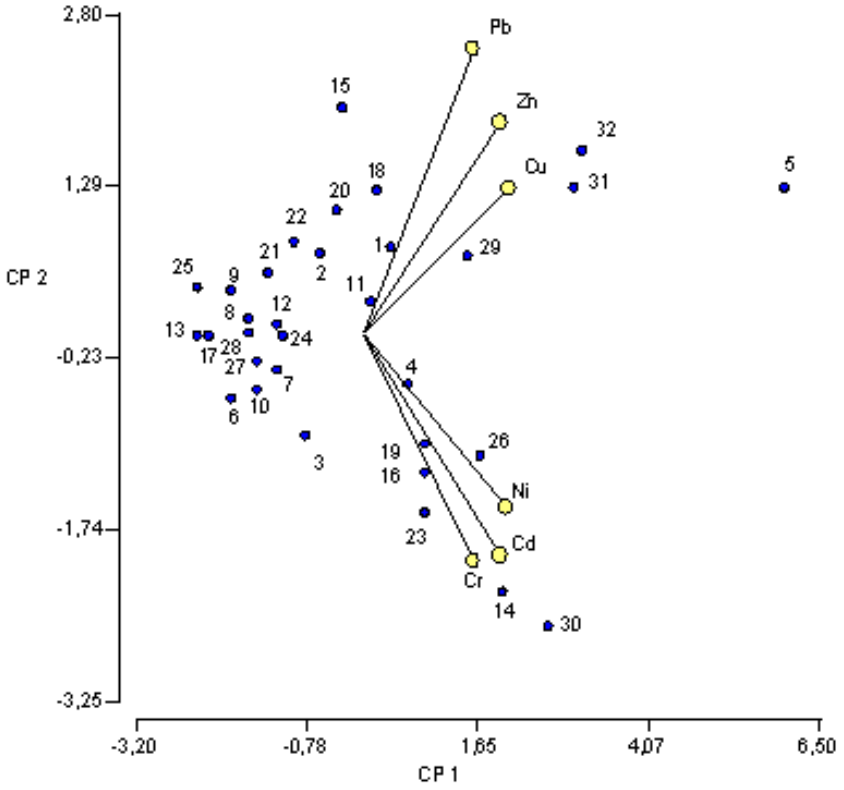

Figure 3: Principal Component Analysis Considering heavy Metals at all Sites (n=32)

This analysis highlights the highest total metal content, and groups the sites sharing the fact of presenting, for example, high levels of zinc and copper, which is reflected in the case of samples 31, 32 and 5. The orchards 30 and 14 have the highest contents of chromium, cadmium and nickel. The premise is to take into account over time the more problematic sites, since in the current sampling values for metals were aceptable for argentine and international legislation.

Urban agriculture carries health and environmental risks as the potential use of contaminated land and wastewater, and the inappropriate use of pesticides and of raw organic manure that can leak into water sources. These issues require proper attention added to the study of the soil quality required for a sustainable production.

4. Conclusions

Surveyed growers presented low socioeconomic status, and the feminization of the horticultural work is remarkable.

Soil analysis showed appropiate fertility conditions, but producers should take into account other limiting factors related to their precarious accomodation.

Heavy metal concentrations in soils were acceptable according to Argentine and international soil quality guidelines for agricultural soils.

Multivariate analysis could group sites of high levels of zinc and copper, and distinguished other sites with the highest contents of chromium, cadmium and nickel, so these more problematic sites should continue to be monitored.

The role of NGO "A Roof", with coordinators and volunteers colaborating with the producers, makes real the improvement of families nutrition and promote sustainable production.

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