Urban agriculture and food security: a case study in Maringá, PR-Brazil

Agricultura urbana y seguridad alimentaria: un estudio de caso en Maringá, PR-Brasil

Paulo de Oliveira Neto[I], Andréa Scalco[II], Ana Elissa Smith Bressan Lourenzani[III], Sandra Cristina de Oliveira[IV]

ABSTRACT

The urbanization resulting from Brazilian industrialization after World War II influenced the development and infrastructure aspects of urban centers. This generated a growth of the urban population, resulting in socioeconomic structural problems related to public health, education, food insecurity, among others. Urban agriculture consists of agriculture activities within urban spaces and can promote food security to those who practice it and to those who benefit from its access. In this sense, the objective of this study was to analyze the impact of urban agriculture on food security. The research was carried out in community gardens in the city of Maringá, Brazil, using the EBIA method, with procedures of descriptive statistical analysis and multiple linear regression. The results indicate that the activity did not contribute to the food security of people who depend on the resources generated, whether for consumption or income.

Keywords: Urban agriculture; Sustainable agriculture; Food security; Urban agri-food systems; Multiple linear regression

RESUMEN

La urbanización resultante de la industrialización brasileña después de la Segunda Guerra Mundial influenció los aspectos del desarrollo y infraestructuras de los centros urbanos. Esto generó un crecimiento de la población urbana, resultando en problemas socioeconómicos estructurales relacionados con la salud, educación, además de la inseguridad alimentaria, entre otros problemas. La agricultura urbana consiste en la actividad productiva dentro de los espacios urbanos y puede promover la seguridad alimentaria de aquellos que la practican y de aquellos que se benefician de su acceso. En ese sentido, el objetivo de este estudio fue analizar el impacto de la agricultura urbana en la seguridad alimentaria. La investigación se realizó en huertos comunitarios en la ciudad de Maringá, Brasil, utilizando el método EBIA, con procedimientos de análisis estadístico descriptivo y regresión lineal múltiple. Los resultados indican que la actividad no contribuyó a la seguridad alimentaria de las personas que dependen de los recursos generados, ya sea para consumo o renta.

Palabras clave: Agricultura urbana; Agricultura sostenible; Seguridad alimentaria; Sistemas agroalimentarios urbanos; Regresión lineal múltiple

[I] Universidade Estadual Paulista, São Paulo, SP, Brasil - paulo_oliveira_01@yahoo.com.br
[II] Universidade Estadual Paulista, São Paulo, SP, Brasil - andrea.scalco@unesp.br
[III] Universidade Estadual Paulista, São Paulo, SP, Brasil - ana.lourenzani@unesp.br
[IV] Universidade Estadual Paulista, São Paulo, SP, Brasil - sandra.oliveira@unesp.br

1 INTRODUCTION

Brazil had an exponential increase in urban centers in the second half of the twentieth century, the urban residents comprised 26.3% of the population in 1940, and by 2000, they came to represent 81.2%. This phenomenon began in 1930 because of industrialization, which increased due to the Second World War, constituting a way of strengthening the internal market, developing productive forces, diversification, increasing wage and modernization of society (MARICATO, 2000).

As a result of industrialization and productive stagnation, urbanization happened unequally, as the number of unemployed increased, since the tertiary sector also failed to absorb the unemployed population, which belongs to the surplus of industry, resulting in job extinction. On the basis of this assumption, the government acted with urban policies that were preferentially allocated in places that could only afford the reproduction of capital, reinforcing the economic role of the metropolis. However, the majority of the population existed in sub-standard living conditions, wich included food insecurity (COUTINHO, 1996).

Despite the differences and non-concomitant variables, the phenomenon of growth of the urban population, which resides in the cities in relation to rural, was verified. About 53% lived in cities by 2010, and the estimate is that by 2050, about 75% of people live in urban areas (INEP, 2007).

Public policies seek to address a series of social issues, like poverty, food insecurity, and infrastructure conditions but they are not enough to mobilize an articulation, and transform the households that are economically vulnerable; there are still a very large number of poor families in the countryside, and many households include elderly relatives with no prospect of economic empowerment. In this sense, there is no incentive for young person to stay in the countryside (CAZELLA et al., 2016).

Because of the aforementioned causes, in urban populations, to meet the necessities of life for these urban populations, the concept of Food Security (FS) is conceived in Brazil as Food and Nutritional Security (FNS), is approached.

According to Cunha and Lemos (1997), although this concept has been developed, and although it originally characterized food as a strategic asset for a country, its current conception has undergone changes from the initial premise. It is now geared towards national defense.

The context of food security changes with the event of the Second World War. Soon after Second World War, countries began to implement guidelines for individual rights and guarantees; laws were created aimed at basic human rights, life, well-being and, in this context, the right to food. Policies were developed and implemented to address the issue of food insecurity and hunger, through bodies such as the Food and Agriculture Organization of the United Nations (FAO), the World Health Organization (WHO), and the United Nations Children's Fund (UNICEF). In Brazil, studies around the theme Food and Nutritional Security (FNS) seeks to identify populations vulnerable to hunger and their determinants and consequences for their health and well-being (ANSCHAU; MATSUO; SEGALL-CORREA, 2012).

In order to provide an overview of food insecurity issues in Brazil, a survey was carried out by the National Survey of Household Sample (PNAD), of the Instituto Brasileiro de Geografia e Estatística (IBGE), or Brazilian Institute of Geography and Statistics. This survey used Brazilian Food Insecurity Scale (EBIA), considering the period of three months prior to the application of the questionnaire, in order to verify conditions of food restrictions in quantity and regularity on Brazilian households (IBGE, 2013).

According to PNAD (IBGE, 2013), the number of private Brazilian households that had some type of food insecurity suffered a reduction of about 21% between the period of 2009 and 2013, leaving 66.2 million people in Situation of food insecurity in 2009, for a total of 52 million people in 2013 in 14.7 million Brazilian households that have undergone some type of food restriction.

These data indicate that the number of households in food insecure situations still represents a significant portion of the Brazilian population in the perspective of food shortages, which can lead to malnutrition and hunger.

It is in this context that urban agriculture can contributes to the self suficency of citzens, Urban agriculture provides new production models that can decrease forms of food deprivation (EMBRAPA, 2002; MAGALHÃES, 2014).

The research seeks to identify, from the perspective of Food and Nutrition Security, whether urban agriculture activity reduces or increase the levels of food insecurity for urban and periurban agriculture practitioners, using as an object the urban farmers of the municipality of Maringá, the state of Paraná.

The research sought to characterize the urban farmers, their habits, types of production, age, level of income through variables that could have some type of influence on levels of food insecurity.

For this, the Brazilian Scale of Food Insecurity (EBIA) model, validated and used by the Brazilian Institute of Geography and Statistics (IBGE), was used within a survey to quantitatively evaluate the FI levels, and from them to verify the level influence of each of the listed variables. In this sense, it was sought to verify the real impact on the reduction or increase of food insecurity through the urban agriculture activity and its perceptions about the urban producers of the city of Maringá-PR.

2 URBAN AGRICULTURE

The concepts "Urban Agriculture", "Urban and Periurban Agriculture" and "Intra and Urban Agriculture" are recent and do not yet have universal definition, although the term has been widely used (FAO - United Nations Agriculture and Food), as well as other organizations such as the Resource Center For Urban Agriculture and Forest (RUAF), which deals with this issue worldwide (AQUINO E ASSIS, 2007).

According to Santandreu and Lovo (2007), Urban and Peri urban agriculture (UPA) shows a multidimensional conception of agricultural production, agro extractivist and the collection, transformation, and rendering of services to generate agricultural products for own consumption Of traders, exchanges, donations, and marketing, using local resources and inputs (soil, water, solid waste, labor,

knowledge). The differential of this activity of a conventional agricultural production is its realization that takes place within the interurban space and peri urban, public or private, linked or not to the urban dynamics and articulated with the territorial and environmental management of the cities.

Cribb and Cribb (2009, p.4), also synthesize the concept of Urban and Peri-urban Agriculture:

> "An activity that refers to small productive spaces located in cities, such as backyards, vacant lots, gardens, balconies, bins, containers generally used to produce vegetables, medicinal plants, ornamental plants; As well as areas for the raising of small domestic animals for own consumption or for sale in neighboring markets. In some places it involves not only production but food processing and marketing, it can be said that urban agriculture is an industry that is located in regions within (interurban) or on the fringes (periurban) of a municipality, City, an urban center."

For a conceptual standardization that covers the specific aspects regarding this agricultural production, according to the Food and Agriculture Organization of the United Nations (FAO) define urban and peri urban in two types: intra-urban (within existing spaces in the city) and peri urban (peripheral regions of the urban network), and can be carried out in various spaces, such as power lines, land, parks, schools, near airports (FAO, 2007).

Arruda (2011) points out the urban agriculture (UA) as an instrument for the environment, for fight against hunger and poverty, for income generation and employment, with a role of relevance in the construction of citizenship, with a role of relevance in the construction of the context of citizenship, which goes beyond that of agricultural production.

Within this social perspective, we can infer that food security is part of the AU perspective, providing access to food in quantity, regularity and quality to practicing individuals (BELIK, 2003).

According to the study by Zezza and Tasciotti (2010), in the world scenario, UA activity has income representativeness ranging from 11% in Indonesia to 70% in

Vietnam and Nicaragua. About 30% of the families participate in production. In this context, however, the share of income is low, varying from 1% to 27%, being higher in five cases (Ghana, Madagascar, Malawi, Nepal and Nigeria), with African countries above 10%. In this way, the activity is more representative in these African countries in terms of income generation.

According to United Nations data (2012) in 2050, 67% of the world's population will live in urban areas. Thus, food accessibility and availability are aspects of food security (LANG; BARLING, 2012) that cannot be fully ensured in urban areas, since access to adequate nutritional food is limited.

3 FOOD SECURITY

It is observed that over time the concept of the right to food has undergone changes as a consequence of socioeconomic transformations after the armed conflicts of the twentieth century, especially the First and Second World War. The FAO has contributed, through various events and forums, to the formulation of more specific guidelines not only related to the right to food, but also to the right to food security, which was not based only on a nation's food self-sufficiency, but access to food, which promotes social welfare, not restricting any person from acquiring food in availability and nutritional and sanitary quality according to the maintenance of their life (CUNHA; LEMOS, 1997).

It is a concept of an interdisciplinary order, defined as access to quality food, sustainability in production and fruitful food practices, in a quantity that is necessary and aimed at all social classes, especially the least favored. In Brazil, public policies aimed at food security of the population have been developed since 2003, with the entry of the Zero Hunger Program, with agendas focused on access to food and poverty reduction (KEPPLE; CORRÊA, 2008).In this way, the UPA is inserted, as an activity that can reduce nutritional deficiency rates, while offering access to food for the population with lower purchasing power.

A reflection of this approach and the precepts linked to access to food and nutrition of the population has been constituted, in the Brazilian case, in the form of a document approved at the II National Conference on Food and Nutrition Security, instituted by Law 11366/2006, Organic Food and Nutrition Security. The law can be said to operationalize the national instruments for the implementation of Food and Nutrition Security policies and establish the National System of Food and Nutrition Security, with a view to ensuring the human right to adequate food, Establishes the National Policy on Food and Nutrition Security, establishes the parameters of action and other measures.

4 METHODOLOGY

Among the different methodologies to establish the degree of food security (or insecurity) of urban farmers, it was chosen a model based on scales to determinate stages of food (in)security. This method is the result of studies carried out by NGOs (hunger identification tools for children's community), by Cornell University and by government entities in the United States, since the 1980s, with the objective of bringing new indicators of hunger measurement, since anthropometric studies did have not been well successful because they did not serve for populations with nutritional deficiencies, such as obesity. In Brazil, this method was adapted to measure food security in Brazilian households, used by IBGE in the Household Nacional Sample Research (PNAD) in the year 2013 (KEEPLE; CORRÊA, 2008).

According to Keeple and Corrêa (2008), to build knowledge about the term "food insecurity scales", the method to be explored was preceded by two previous methods that served as a reference in the final elaboration of the scale. The first one is the Cornell/Radimer method, developed by Radimer et al. (1990), at Cornell University, where the hunger is approached in a qualitative perspective, by appropriating the perspective of a person who had experienced the hunger, and from there observing quantitative patterns of experiences.

These experiences are observed through researches, identifying situations of food deprivation, with questions about the hunger situation: habits, psychological and physical sensations, and how the idea of hunger was conceived. Then there arise two concepts about hunger: In the first, it is attributed the physical and biological sensation of food urgency in the body; In the second moment, the hunger has a connotation where it reaches the individual in its psychological scope, in the environment of the domicile and in its social condition. From these concepts, indicators are used to determine levels of food security (RADIMER et al, 1992).

In addition, a survey was conducted by the Community Childhood Hunger Identification Project (CCHIP) - It emerged in two NGOs, the Connecticut Human Services Association, and later the US National NGO, called the Food and Food Research Center, whose objective was to draw attention to the growing number of people that sought emergency food assistance, evaluating in the households if the income was insufficient to purchase food; if the food was acquired, and if what was purchased was sufficient in terms of quality and quantity (Campbell, 1991).

In 1995, the United States Bureau of Census conducted its first data collection on food insecurity in the country as a supplement to the Current Population Survey (CPS). About 45,000 American households were interviewed. It was the first to collect special data needed to measure food insecurity and hunger considering a representative sample of households (USDA, 1995).

Then, the Food and Consumer Service (FCS), a body linked to the United States Department of Agriculture (USDA), directed the creation of a supplement to the FCS by means of a study led by the government, universities or other entities, including the contracted company Abt Associates Inc, and Center for Hunger, Poverty and Nutrition Policy Studies of Tufts University. The Department of Nutritional Sciences of Cornell University conducted the construction of the scale (USDA, 1995).

Thus, a scale was developed to measure the degree of food insecurity and hunger in American households in two previously proposed periods; it could refer to the period of 12 months preceding the interview or 30 days prior to the interview.

In Brazil, this scale of food insecurity was adapted and validated in the middle of the year 2000, when the Brazilian government jointed to academic institutions decided to investigate the issue of food security; specifically, in 2006 there were already studies using the adapted model called Brazilian Food Insecurity Scale (EBIA), validity by Brazilian researchers (IBGE, 2013).

The present research sought to identify whether food insecurity levels increased or decreased in urban and peri-urban agriculture (UPA) for urban farmers of the project "Community Gardens", which currently has 37 community gardens consolidated in the urban and peri-urban space of Maringá municipality, Paraná state, Brazil, using the EBIA, to order to identifying perceptions of food restriction of these farmers in terms of quantity and regularity. For the analysis of the data, the multiple linear regression method was used, which identified the specific variables that predict the food security state of these individuals.

For this, a data collection was done using a survey, which according to Pinsonneault and Kraemer (1993) is a way for obtaining data through forms or questionnaires, with information or characteristics, actions, and opinions of a particular group of people. These individuals represent the population studied and the main objective is the production of quantitative descriptions of this population by means of the survey.

In this way, a survey with 3 stages (modules) of questions was used to identify the levels of food insecurity for urban farmers. The first stage of the form sought to characterize the individual practicing urban agriculture and the UPA. In the second stage, the EBIA model was used, with pre-established questions that determined degrees of food insecurity levels. In the third and final stage, the form based on the EBIA model is again carried out, but with questions adapted to urban farmers in community gardens. This last part of the form sought to compare the results of the second stage so that different characteristics of scale levels could be obtained according to the sale and consumption of these products.

The intention of this adaptation was precisely to adjust the reality of the urban farmers with respect to food security by the fact that there is immediate availability of

food and income by means of the direct sale of these same foods, which become products. In this context, it is evident that this practice can influence the food consumption of these farmers, defining different levels of food security by the influence of the activity. In this way, the influence of the activity was verified by means of this quantitative-qualitative method and it was possible to make comparisons between the answers and identify patterns among the variables.

The project "Community Gardens" developed in Maringá consists of agricultural production with a view to providing quality food social and productive inclusion for the population in a state of economic and nutritional deficiency, reduction of levels of food insecurity, promotion of the agriculture, and reorganization of the urban public spaces (MICHELLON, 2016).

The sample size of practicing individuals consuming urban agriculture in the community gardens of Maringá, Paraná, was defined as 36, based on an estimative error of 10%, a confidence level of 95.5%, and an infinite population (COCHRAN, 1977; MARTINS, 2002). The farmers were randomly selected, protecting their name or any information who identified them.

Then, it was applied the form described previously, divided into three question modules: The first module with questions related to the characterization of the farmer and UPA activity (age, gender, schooling, time of action in UPA, types of urban production, motivation of activity, management way, income, among other variables); The second module with levels to identify whether the individuals were in food (in)security (mild, moderate and severe); and the third module with questions focused on urban and peri-urban agriculture.

The data obtained from the three modules were compiled, coded, tabulated and analyzed using descriptive statistics. Subsequently, in order to corroborate the information about descriptive statistics, a model of multiple linear regression was adjusted to data in order to identify the variables that most influenced in the food insecurity condition for this particular group studied.

The multiple linear regression method is used when it is assumed that a dependent (response) variable Y can be a linear function of two or more explanatory (independent or predictive) variables (HOFFMAN, 2015).

Thus, a linear regression model is given by:

$$Y = E(Y \mid \mathbf{X} = \mathbf{x}) + \varepsilon \tag{1}$$

where $\mathbf{X} = (X_1, X_2, \ldots, X_k)$, $E(Y \mid \mathbf{X} = \mathbf{x}) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k$ and ε is a random variable (random error) with mean zero and variance σ^2. Errors, by hypothesis, are uncorrelated and, for purposes of inference, the additional assumption of their normality is made.

The values of the coefficients $\beta_0, \beta_1, \beta_2, \ldots, \beta_k$ of the regression equation (1) can be estimated by the ordinary least squares method, which obtains coefficients (or estimates) $b_0, b_1, b_2, \ldots, b_k$ that minimize the sum of the squares of the residuals (differences between the observed values Y and those obtained from the model adjusted $\hat{Y}$). Thus, the least squares estimators of the regression coefficient vector $\mathbf{B} = [\beta_0, \beta_1, \ldots, \beta_k]'$ are given by

$$\hat{\mathbf{B}} = (\mathbf{X}'\mathbf{X})^{-1} \mathbf{X}'\mathbf{Y} = [b_0, b_1, b_2, \ldots, b_k]' \tag{2}$$

where $\mathbf{Y}$ is the vector of observations of size n and $\mathbf{X}$ is the matrix of predictors (MONTGOMERY et al., 2001).

The significance of the model is then tested by hypothesis test on the existence of linear regression. Since the significance level α (or error limit) of the test, it is concluded that there is multiple linear regression, that is, the model can explain and predict the variable Y if the *p*-value (significance probability) is less than or equal to α. The process of selecting predictor variables for the adjusted regression model can be performed by hypothesis tests on the existence of the parameters $\beta_0, \beta_1, \beta_2, \ldots, \beta_k$. If α is the significance level, it concludes that β_i is nonzero if the *p*-value of the test is less than or equal to α. Finally, the accuracy of the adjustment is evaluated by the multiple determination coefficient, which measures the percentage of the variation of Y that is explained by the model. This coefficient is given by

$$R^2 = \sum_{i=1}^{n} \left(\hat{Y}_i - \bar{Y} \right)^2 \Bigg/ \sum_{i=1}^{n} \left(Y_i - \bar{Y} \right)^2 \qquad (3)$$

in which $0 \leq R^2 \leq 1$. The adequacy of the model will be better, as the coefficient of determination is closer to 1 or 100% (MARTINS, 2002).

Three additional measures are also considered to verify the regression constraints: Analysis of the absence of serial correlation of the model residues; Analysis of the absence of multicollinearity (cross-correlation among independent variables); and Analysis of the existence of the residues normality (Durbin-Watson test) (TABACHNICK; FIDELL, 1996).

To verify the multicollinearity, the Variance Inflation Factor (VIF) is used. If VIF <1, there is no multicollinearity; If $1 \leq$ VIF ≤ 10, there is acceptable multicollinearity; and, If VIF >10, there is problematic multicollinearity.

For the serial autocorrelation analysis, the Durbin-Watson test (D-W) is used, and it is considered no existence serial correlation for a level of significance α if the D-W statistic is close to 2 (CUNHA; COELHO, 2009).

In this study, the response variable Y was formed by the individual's score regarding the food security situation, relating it to a set of independent variables (questions in the first module). The individual's score regarding the food insecurity situation was obtained by the form responses on the EBIA model in the second module. In this way, as the questions had affirmative or negation answers (Yes and No), for each answer scored affirmatively (Yes), a score of 01 points was made for food insecurity.

Systematization and statistical analysis of data is performed using Excel and Minitab software (Stepwise tool). This automatic tool can be used in exploration of the construction of models and identification of predictors subsets. Automatically, it adds the most significant variable and removes the least significant variable during the whole stage. For all hypothesis tests contained in the regression analysis a significance level of 5% was used.

5 RESULTS

The study showed that 81% of those interviewed are not in food insecure situation, without food restriction or lack of money to access food. On the other hand, the practitioners of UPA who are in food insecure (FI) situation are mostly retired. The average age is 64.71 years taking in account all the food insecure groups.

Even though 2% of the unemployed are not food insecurity situation, their food is guaranteed, since there are people in the household who can guarantee income and access to food, and even if they are practicing consumers of urban agriculture, they do not consider it an activity that influences on income and consequently on access to food.

However, if we relate the reduction of expenses in the purchase of products already produced in these gardens, then this reduction will be a way of acquiring food security, which is also access to food through income and empowerment.

People who are food insecure need the income generated through these commercializations, as well as the economics of acquiring products they already produce.

For those considered in food security (F.I.), about 8.5% buy most of the food through commercialization of the products derived from urban agriculture. However, they do not know how much they use to buy food, but also to buy inputs (equipment purchases, seedlings), or help with certain works (installation of wells, vegetable gardens beds). In this way, there is no way to determine that their marketing has an influence on food insecurity

Approximately 13% of individuals with FI stated that they had problems related to food acquisition and consumption because they did not have agricultural production for their own consumption and for their families. Of these, 8.33% still depend directly on the commercialization of these products, these consumers practitioners do not have technical support regarding the marketing or their incentive; Often their productive capacity is reduced by the lack of manpower, problems with increase the production or the use of the space.

The percentage of individuals in FI, there is a significant difference in occupation: 50% are retired, 16.67% are paid workers and about 33.33% are self-employed urban farmers. Despite of the condition of income or despite the occupation, it does not eliminate the condition of FI in the household.

In the population in IF situation in the analysis adapted to the UPA, the variable "income conversion of the UPA products in the acquisition of other foods not produced in the vegetable gardens" is observed by all the consumers of this population, since about 83% are able to to get the income from the sale of products in the purchase of at least half of the food consumed in the home, and about 16% of the total consumers say they buy most of the food at home by selling what is produced in the gardens. In both situations, even with the sale of the products, the person remains in IF situation. Analyzing the composition of the daily diet of each of the interviewees, it is verified that about 20% of these producers can consume more than half of all food consumed daily using urban agriculture income.

6 ANALYSIS OF MULTIPLE LINEAR REGRESSION ON FOOD INSECURE POPULATION

After exploratory analysis of the results, 7 individuals in food insecurity status and 29 individuals in a food security situation were identified. The proposed regression model sought to observe the information referring to group who was in food insecurity status (dependent variable Y).

Multiple regression is used to construct statistical models that can reasonably interpret relations between two explanatory variables of a given problem (PORTAL ACTION, 2017).

In order to ensure that there is no multicollinearity between the independent variables, a statistical analysis was performed on the FIV statistic, previously mentioned in the methodology, verifying all the variables. The variables AGE, FQM9 COMMUNITIES, FQM9 FAMILY, FQM10 MAIN SOURCE OF INCOME, FQM13, FQM14, had FV between 1.57 and 3.60, presenting a multicollinearity framework within the standard, and could be used for analysis (Annex 1).

The significant variables were those whose p values (probability of significance) were lower than α (α for input = 0.10 or 10%, α for withdrawal = 0.1 or 10% - the level of significance of the test).

It was corroborated the capacity of generation of linear regression model by the nonexistence of initial multicollinearity that allows to use of the variables mentioned above.

In order to explain the variation in individuals who are (or not) in food insecurity situation (categorical predictors 1 and 0), a multiple linear regression models was fitted from the data collected. The model obtained, by tabulation of data from the appendix and previously codified is as follows:

Y=   0.38   + 0.0774 Age   + 0.0FQMP9 relatives_1   - 1.351 FQM relatives_2 + 0.0 FQM 9 Communities_1   1.244 FQM 9 Communities_2.0 FQM10 Main source of income _1 3.860 FQM10 Main source of income _2   + 0.0 FQM13_1 + 1.101 FQM 13_2 + 0.621 FQM   13_3   + 2.679 FQM   13_4   + 0.890 FQM13_5   + 0.0 FQM14_1   - 0.466 FQM14_2 - 0.306 FQM14_3 - 0.92 P FQM14_4 - 0.98 FQM 4_5 + 5.97 PBP14_6 - 1.325 FQM14_7

As for the regression model, where the p_value <5%, it is stated that there are subsidies for the model to explain and predict the variable Y. After applying the statistics, only a few variables have shown significance in relation to the pre-established restrictions, (Response 2 - no), FQM9 (response 2 - no use), FQM9 (response 2 - at least half, 3 - less than half, 4 - very few) Little and 5- I have no income), FQM14 (2- to 10%, 3- from 11 to 20%, 4 - from 21 to 30%, 5 from 31 to 50%, 6 from 51%, 7 -I do not have Income), being parameters that showed relevance for the model, if we observe the values of these variables and the T statistics of the table wich shows multiple linear regression analysis (Annex 2) and the summary of results obtained by the multriple linear regression models.

The Kolmogorov-Smirnov test (P> 15) was performed for standardized residues, confirming the normality of the model. Moreover, the degree of fit of the model was obtained by means of the multiple determination coefficients, which can be seen in Annex 2 with a value established in 67.93% of the variance of the food insecurity

variable on the consumer practitioners surveyed. The degree of adjustment can also be explained by means of independent variables that have shown to be significant. It was also observed that the residues were not auto correlated according to the Durbin-Watson statistic (D-W = 2.11088).

The same variables cited above, AGE (age of urban and periurban farmers, FQM9 (destination of products for the families of the consuming practitioners), FQM10, response 2 (motivation to produce for own consumption and consumption of the family), FQM13, answer 2, 3.4.5 (conversion of income from marketing of UPA products into food purchases); FQM14, responses 2,3,4,5,6,7 (percentage of products consumed in the diet purchased with the income obtained from commercialization of UPA products) were relevant to the explanation of the interaction between urban agriculture on the levels of insecurity and food security of UPA consumers

In this way, the variables AGE and FQM13 showed positive coefficients, which indicates that they move individually, in the same sense as the independent variable Y (food insecurity). This indicates that the older the individual the greater the chance of the same being in situation of food insecurity. This data is corroborated by the results of the descriptive analysis in the first part, which indicated that the majority of the persons investigated and who were food insecurity status were older, belonging to the retired group.

In this way, even if it is still incipient, urban agriculture can offer an income subsidy for these older individuals who are in FI satatus, even though their production capacities are less productive than younger people.

The variable FQM 13 related to the question "With the money obtained from the sale of the products you produce, is it sufficient to buy the amount of food your family consumes?" response 2 (very little), response 3 Half), response 4 (at least half), response 5 (most) showed with positive coefficients, that is, it moves independently of other significant variables, in the same sense as the dependent variable Y (insecurity to feed). The FQM13 indicates that the greater the degree of dependence on the conversion of income obtained in the commercialization of UPA products for the purchase of food from the individual and also from the family, the greater the degree

of occurrence of food insecurity, due to the dependence on the sale of these products. This is not to say that the activity alone does not provide a reduction in the situation of food insecurity, because it is often the only form of income that is effectively converted into food acquisition. However the activity does not provide an income that adequately assures the individual's nutritional needs.

This is clear, since the activity of urban agriculture has until now been considered an advisory activity and not the main one of the individuals, that in the majority does not have a preoccupation with variables that could influence in the commercialization, and consequently, in the increase of income, such as: better cost control, marketing, negotiation capacity, production scheduling, idle space capacity, among other factors that would add more value to the product. In this way, the productions today do not have a capacity of conversion of this income in the effective purchase of food, what causes greater food insecurity.

The perception that urban agriculture can be a way to improve income is not confirmed by the majority of consumers, not even practitioners in the situation of FI, given their technical limitations, lack of incentive, among other factors. The current understanding is that activity is not viewed as an activity that can be profitable from the point of view of an enterprise.

In the same way that some variables were positive in the analysis of linear multiple regression, others were variables that showed a negative coefficient, that is, indicating an opposite movement to that of the variable of Food Insecurity. Other variables were kept constant.

This significance can be further explored in the explanation of the interaction between the dependent variable Y versus the categorical variables: FQM10 (main source of income, answer 2); FQM14 (percentage of products consumed in the diet purchased with the income obtained from marketing of UPA products), responses 2 (up to 10%), response 3 (from 21 to 30%), response 4 (from 31 to 50%), response 5 (above 51%), answer 6 (I do not get income).

The FQM10 shows that among the motivations to produce UPA, the main response would be family consumption. The response of this variable, which

presented a negative coefficient, and moved in the opposite direction to the variable Y, indicates that the motivation for production for own consumption corresponds to those that are not in a situation of food insecurity.

The production of food for the family reduces the expenses with the purchase of food that favors the food security framework, plus the fact that the impact does not lie only in the consumer practitioner but is replicated for all members of his family, who are at home, or close relatives. In addition, there is access to foods with nutritional qualities necessary to the human being. In this way, the level of food security is replicated, and other studies are needed to monitor the impact of UPA on households or populations collectively.

It is important to emphasize that self and family consumption as motivating factors do not directly result in a positive impact on the aspects of food security, resulting in individuals seeking to improve the productivity and quality of the products produced, either through production scheduling, alternation of systems that provide a greater variety of foods with nutritional conditions and consequently better quality of life not only to the consumer practitioner but also to his family.

It was analyzed the variable FQM14 (percentage of products consumed in the individual diet of the consuming practitioner, acquired with the income obtained by marketing UPA products). The results showed: 2 (up to 10%), 3 (from 11 to 20%), 4 (from 21 to 30%), 5 (from 31 to 50%), 6 (above 51%) and 7 (I do not have income from UPA). The negative coefficient of the response indicates that the lower the daily percentage of food consumed with the income from the urban agriculture activity greater will be the food security by the individual. This data, at first, seems to be conflicting with the information about UPA income, since the activity leads to a conversion of income into food. However, through the analysis, it was found that the income from the sale of UPA products was not significant enough to meet the need for regular access to food in quantity and quality, as well as to families and individuals residing in each household of the UPA.

This degree of income dependence in relation to the need of food by the consumer practitioner for an activity that has little profitability, in no way influences

the individual to reestablish a proper food security framework. Since the income does not meet the need of the consumer practitioner, it will remain within the framework of food insecurity, with the perception that there may or may not be financial availability to purchase food, even producing various foods. This is clear if it can be observed that within the FQM variable 14, one of the responses had a positive coefficient, that is, it was closer to the Y event of Food Insecurity. This variable indicates that those consuming practitioners, who depend on 51% or more of their daily consumption of food for survival, are more likely to be food insecurity because this production does not guarantee adequate income need.

As only the foods in the vegetable gardens do not meet the nutritional needs of the individuals, they remain in an activity of little profitability, and at the same time, very laborious.

DISCUSSION

The elderlies have greater representativeness in urban agriculture activity, either by use of this activity as a way of obtaining food and income, or as an leisure activity. This can be observed in other investigations, such as Pessoa, Souza and Schucs (2006), which concluded in an analysis of the urban and peri urban agriculture activity, the insertion in the majority of individuals aged over 41 to 59 years.

Resende and Junior (2006) still indicate the activity in an occupational character by individuals who no longer practice any work activity and require some type of daily activity.

However, the impact on income has contradictory meanings for food security, since the primary data indicated that income obtained from the the commercialization of urban agriculture products generates the purchase of food; the contradiction is that commercialization does not always reach values that in fact remove people from situations of food insecurity by not meeting their basic needs.

This can be corroborated by other studies, such as the work of Rezai, Shamsudin and Mohamed (2016). They show that the daily composition of the diet with the consumption of the food produced can increase the level of food security,

however, the farmers with higher income tend to have a more closely related AU association and food security, as it is more related when practiced by younger people, with greater potential for product scaling, greater productive strength, and greater marketing knowledge.

This corroborates to the results of this investigation, which pointed to the positive association between food insecurity and older producers, with less potential for the development of the activity. These data were first identified from descriptive analysis, and corroborated with linear regression. As we have seen before, there is a parallel between the use of agriculture production to reduce insecurity over food, but it is evident in this research that the activity is flawed for a given elderly public, which does not generate income that meets their needs and their production, even these initiatives from public policies, such as the National Program of Urban Agriculture that provides financing and technical support for producers. Since 2008, federal, state and municipal governments have financed initiatives in cities to promote the activity (Ministry of Social Development and Fight against Hunger, 2019).

The variables evidenced in this study showed that the high degree of dependence of the urban agriculture activity in the case of the producers in the city of Maringá leads to a greater propensity to the condition of alimentary insecurity since the income obtained from the activity does not provide nor increase of income, as well as the consumption of food the consumption of food necessary for the promotion of food security.

Rezai Et al (2016) points out this same difficulty in the case of the study done in Malaysia that verified a change in the food and economic pattern of the producers, but necessary, as in Brazil, of a public policy focused, not only for people of low power or at-risk households, but appropriate technical assistance to various groups of people who enjoy the activity.

CONCLUSIONS

As observed in the research results, the UPA is a small part of the income composition, since it still does not meet the needs of food purchases in quantity and regularities sufficient to meet the needs of consumers. Even for practicing consumers who are in an Food Insecurity situation and who have a greater dependence on income from urban farming practice, they do not have regular access to food, given their technical limitations and limitations on marketing forms.

The data indicated that the objectives of urban agriculture practitioners have been to improve the quality of life through the reuse of space, urban agricultural practice, and the social reintegration of both retirees, as well as the interaction of other people in the community.

Using the multiple linear regression methods, some variables were significant and could be related to the food insecurity condition. Age and dependence on income from UPA products are variables identified as directly related to food insecurity. Thus, the greater the dependency of the products originated by UPA, the greater the level of food insecurity observed among the consuming practitioners.

This conclusion is based on the fact that UPA practice is not converted into income or food necessary to meet the requirements of each consumer practitioner. This is a result of this practice not being seen as an activity that can guarantee the supply of food for these individuals since there is no production scheduling planning, aligned practices for market insertion, distribution, and marketing of products. These individuals do not have effective technical support since most of the producers are retired workers who already work at the limit of their forces, and paid workers whose labor force is employed in other activities.

This may indicate that even if there are many factors that imply the strengthening of urban agriculture, such as a lack of production schedules, a lack of technical knowledge or a low bargaining power, public policies can be developed to reduce these negative factors.

Urban agriculture can be considered an activity that goes beyond reformulation in the environmental context, but social, and thus could be engaged in initiatives of

production planning and sales, aiming at improving the income of the target population.

REFERENCES

ANSCHAU, F. R.; MATSUO, T.; SEGALL-CORREA, A. M. 2012. **Insegurança alimentar entre beneficiários de programas de transferência de renda.** *Revista de Nutrição* 25 (2): 177-189. Available at <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1415-52732012000200001&lng=en&nrm=iso.

AQUINO, A. M. DE; ASSIS, R. L. De. 2007. **Agricultura orgânica em áreas urbanas e periurbanas com base na agroecologia.** *Ambiente & Sociedade*, 10 1:137-150 Available at <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1414-753X2007000100009&lng=en&nrm=iso>.

BRASIL. Law 11.346/2006, *Lei Orgânica de Segurança Alimentar e Nutricional* sept 15, 2006.

CAZELLA, A. A.; CAPELLESSO, A. J.; MEDEIROS, M.; TECCHIO, A.; SENCÉBÉ, Y.; BÚRIGO, F. L. 2016. **Políticas Públicas de Desenvolvimento Rural no Brasil: o dilema entre inclusão produtiva e assistência** *Política & Sociedade* **15.**

COUTINHO, L. 1996. **A fragilidade do Brasil em face da globalização. In: BAUMANN, R. (Org.).** *O Brasil e a economia global*. Rio de Janeiro: SOBEET: Campus, 219-237.

CUNHA, J. V. A.; COELHO, A. C. 2009; **Regressão linear múltipla.** In: CORRAR et. al. (Coord.). *Análise multivariada: para os cursos de administração, ciências contábeis e economia*. São Paulo: Atlas, 131-231.

CUNHA, A. R. A. DE A. and LEMOS, M. B. 1997. *Segurança alimentar sob o prisma das políticas públicas de abastecimento* **- Universidade Federal de Minas Gerais – Faculdade de Ciências Econômicas.** Centro de Desenvolvimento e Planejamento Regional. 113, Available at <http://www.cedeplar.ufmg.br/pesquisas/td/TD%20113.pdf>.

CRIBB, S. L. DE S. AND CRIBB, A. Y. **Agricultura urbana: alternativa para aliviar a fome e para a educação ambiental.** *Analls*... 47° Congresso brasileiro Sober – Sociedade Brasileira de Economia, Administração e Sociologia Rural, Porto Alegre, 2009. Disponível em: <http://www.sober.org.br/palestra/13/359.pdf>

EMBRAPA. **Embrapa Cerrados – Documentos** (INFOTECA-E). *Agricultura Urbana*. 2002. Available at <http://www.infoteca.cnptia.embrapa.br/handle/doc/565842>

FAO - AGRICULTURE. **FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS.** 2007. The state of food and agriculture (SOFA) Rome, *FAO Agriculture Series* 38. Available at*:* frtp://frtp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf

GILLESPIE, S. R.; MASON, J. B. AND MARTORELL, R. 1996. *How nutrition improves*. Geneva, United Nations Administrative Committee on Coordination/ Sub-Committee on Nutrition (ACC/SCN). State-of-the-Art Nutrition Policy Discussion Paper 15. Available at: <http://www.scielo.br/scielo.php?pid=S0103-40142003000200002&script=sci_arttext>

HOFFMAN, R. 2015. *Análise de regressão: uma introdução à econometria* [recurso eletrônico] / Rodolfo Hoffmann. - - Piracicaba: ESALQ/USP. 393.

IBGE - Instituto Brasileiro de Geografia e estatística. *Pesquisa Suplementar de Segurança Alimentar PNAD 2013*. [online]. Available at <http://www.ibge.gov.br/home/presidencia/noticias/imprensa/ppts/00000020112412 112014243818986695.pdf>

INEP – Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira. 2007. *Panorama da educação do campo*. Brasília: Inep.

KEPPLE, A. W. and SEGALL-CORREA, A. M. 2011. **Conceituando e medindo segurança alimentar e nutricional.** *Ciência & Saúde Coletiva*, 16 (1)187-199, Available at <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1413-81232011000100022&lng=en&nrm=iso>

LANG, T. and BARLING, D. 2012. **Food security and food sustainability: reformulating the debate.** *The Geographical Journal*, 178 (4) 313-326.

MANIGLIA, E. 2009. *As interfaces do direito agrário e dos direitos humanos e a segurança alimentar – São Paulo: Cultura Acadêmica.*

MARICATO, E. 2000. **Urbanismo na periferia do mundo globalizado: metrópoles brasileiras.** *São Paulo em Perspectiva*, 14 (4) 21-33. Available at <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0102-88392000000400004&lng=en&nrm=iso>.

MARTINS, G. A. 2002. *Estatística geral e aplicada*. São Paulo: Atlas.

MESSIAS, S. S.; MICHELLON, E.; SANTOS, M. R. DA S. A. DOS; CROGE, C. P.; TAIT VARESCHINI, J.; AND FERNANDES, F. A. 2009. **Implantação do Centro de Referência**

em Agricultura Urbana e Periurbana (CERAUP) em Maringá, Paraná *Revista Brasileira de Agroecologia* 4 (2).

MICHELLON, E. (2016). ***Hortas comunitárias em Maringá: um modelo de agricultura urbana – Centro de referência em agricultura urbana e periurbana.*** Ceraup – Maringá. Clichetec, 110 p.

MONTGOMERY, D. C. and PECK, E. A.1992. ***Introduction to Linear Regression Analysis***, 2nd ed., John Wiley and Sons, Inc., New York.

OLIVEIRA, S. C.; MAZIERO, L. P.; OLIVEIRA, M. L.V. DE; and Pinto, L. DE B. 2016. **Análise da restrição ao crédito a produtores de assentamentos rurais da região oeste paulista *G&DR*,** 12, (2) 70-90.

PAULILO, L.F. and ALVES, F. 2000. ***Restruturação Agroindustrial: políticas e segurança alimentar regional*** – São Carlos: Ed. UFSCAR

PÉREZ-ESCAMILLA, R. and VIANNA, R.P.T. 2012. **Food insecurity and the behavioral and intellectual development of children: a review of the evidence.** *Journal of Applied Research on Children*: Informing Policy for Children at Risk: (3): Iss. 1, Article 9. Available at <http:// digitalcommons.library.tmc.edu/childrenatrisk/vol3/iss1/9>

PINTO, L. B.; OLIVEIRA, S. C.; HIGUCHI, M. E.; MOCHIUTI, J. C.; SANTOS, G. D. ; AND BIANCHI, V. R. 2016. **Um estudo sobre a renda bruta de estabelecimentos rurais familiares de municípios da Região Nova Alta Paulista, Estado de São Paulo, Brasil.** *Espacios* (Caracas), 7, 10.

SANTANDREU, A.; and LOVO, I. C. 2017. ***Panorama da agricultura urbana e periurbana no Brasil e diretrizes políticas para sua promoção.*** Identificação e Caracterização de Iniciativas de AUP em Regiões Metropolitanas Brasileiras. Documento referencial geral. IPES RUAF Belo Horizonte.

TABACHNICK, B. and FIDELL L. S. 1996. ***Using multivariate statistics* (3a ed.).** New York: Harper Collins.

WEBB, P.; COATES, J.; FRONGILLO, E.; ROGERS, B.;, SWINDALE, A.; AND BILLINSKY, P. 2006. **Measuring household food insecurity: why it's so important and yet so difficult do.** *J Nutr.*136(Suppl 1):1404-8.

ANNEX 1

Code and description of the most significant variables searched in the first question module (FQM).

Name of Variable	Description of the variable	Questions from the questionnaire concerning the variable
SCHOOLING	Describes the schooling of the producers	
PROFESSION	Describes your occupation (Retired, hardworking, etc.)	
FQM9 FAMILY	Destination of products - UPA customers	Which destination of the products are consumed? For customers?
FQM 9 COMMUNITIES	Motivation to produce - main source of income	Which destination of the products are consumed? For communities?
FQM 10 MAIN SOURCE OF INCOME	Destination of products - communities	Why do you produce these products?
FQM P10 LEISURE AND HOBBY	Motivation to produce - Leisure and hobby	Why do you produce these products?
FQM 10 - THERAPY	Motivation to produce - Therapy	Why do you produce these products?
FQM 10 - DONATIONS	Motivation to produce - Donations	Why do you produce these products?
FQM 10 - QUALITY OF THE SOIL AR, EAGUA	Motivation to produce - Improvement of soil, water and air	Why do you produce these products?

FQM 13	Use of income to purchase food	With the money you get from selling the products you produce, is it enough to buy the amount of food your family consumes?
FQM 14	% of consumed products of the diet acquired with the income of UPA	What is the percentage of products consumed in your diet that are acquired with the income obtained from the marketing of the products you produce?

Source: developer by author

ANNEX 2

Multiple linear regression analysis - Results summary

```
Term                     Coef  EP de Coef       T-Value    P-Value  VIF
Constant                 0.38       1.40           0.27   0.788
Age                    0.0774     0.0273          2.83    0.010 2.11
FQM9 Familiares
2                      -1.351      0.474         -2.85    0.010 2.08
FQM 9 Comunidades
2                      -1.244      0.611         -2.03    0.055 3.59
FQM10 Principal fonte de renda
2                      -3.860      0.953   -4.05   0.001 1.99
FQM13
2                       1.101      0.705    1.56   0.133 2.48
3                       0.621      0.836    0.74      0.4662.22
4                       2.679      0.749    3.58      0.002 1.79
5                       0.890      0.550    1.62      0.121 2.68
FQM14
2                      -0.466      0.448   -1.04      0.310 1.57
3                      -0.306      0.563   -0.54      0.592 2.07
4                      -0.92       1.25    -0.73      0.471 1.75
5                      -0.98       1.06    -0.92      0.3683.60
6                       5.97       1.18    5.06       0.000  1.57
7                      -1.325      0.747   -1.78      0.090 2.29


S = 0,929546 Rquad = 80,76%  Rquad (adjust) = 67,93%


Analysis of Variance (ANOVA)
Source                GL        SQ (Aj.)  QM (Aj.)  Valor F  Valor-P
Regression            14         76.160     5.4400    6.30   0.000
Error                 21         18.145     0.8641
Total                 35         94.306
Durbin – Watson Statistic = 2,11088
```

Source: Prepared by the author using Minitab software