Typology of conventional and agroecological vegetable production systems in the Campos Gerais region of Paraná, Brazil

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ABSTRACT

In the region of Campos Gerais do Paraná, family farming has a large share in the production of food for direct consumption, such as vegetables. As in the rest of the state and the country, it has been observed that in recent years there has been a distinction between vegetable production systems, especially with the growing stimulus to the consumption of agroecological products. In this context, the objective of this study was to characterize the production systems of conventional and agroecological vegetables, analyzing the typology, in the municipalities of Castro, Palmeira and Ponta Grossa, through multivariate statistical analysis. For this, 29 rural properties were previously selected in the three municipalities mentioned, in which a semi-structured questionnaire was applied. The properties were selected together with technicians from EMATER-PR (regional and local office) and municipal governments, with the basic criteria: having olericulture as their main activity and fitting the profile of family farming. Social, technical-agronomic, economic and financial information was collected. The collected data were tabulated and transformed into numerical values. Subsequently, they were statistically treated using principal component analysis. Of the 29 rural properties interviewed, 19 used the conventional vegetable production system and were mostly located in Ponta Grossa. As for the properties that use the agroecological production system, it can be seen that they were better distributed among the municipalities of Ponta Grossa (4 properties), Palmeira (3 properties) and Castro (3 properties). It was found that the time that the family has lived on the property was not a determining factor for the distinction of the production systems. However, the time they have been in the activity and the area used in the cultivation of vegetables were extremely important variables. It can be observed that the properties in agroecological system are more recent and use a smaller cultivated area. Principal component analysis proved to be a promising tool for this type of study, as it allowed the analysis of technical-agronomic, economic and financial variables, both internal and external to the property, so that it was possible to distinguish differences between conventional and agroecological vegetable production systems. With this, it can be assessed that the complexity between the vegetable production systems in Campos Gerais do Paraná is high. The agroecological system is the one that presents the greatest problems with the control of pests and diseases, even in smaller cultivation areas, which implies lower income for the property, even though producers have a higher frequency of commercialization. For the conventional system, although the cultivation areas are larger, the lack of knowledge of financial management tools, low demand for training and updates are factors that impact the production and sustainability of the property.

Keywords: Organic Agriculture, Rural Economics, Principal Component Analysis.

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INTRODUCTION

Agricultural production of family origin has been the object of study in recent decades, and its representativeness in the world and national scenarios are unquestionable (ALTIERI, 2012; FRANÇA et al., 2009; SCHENEIDER, 2006). Family farmers account for more than 80% of the 500 million family units on farms worldwide (IFAD, 2013).

In family farming, the option of producing vegetables is very common, as there are advantages that attract producers, such as production in small areas, direct sales to consumers (fairs and grocery stores), with the entry of daily, weekly or monthly money, also short crop cycles, among others.

The vegetable market in the State of Paraná moved in 2015 about R$ 4.03 billion, with a cultivated area of 115.5 thousand hectares and production of 3.03 million tons, being the municipality of São José dos Pinhais with the highest production, accounting with a production of 9.8%, followed by Colombo and Marilândia do Sul (DERAL, 2016).

In recent years, changes in consumption habits have led to the segmentation of the vegetable sector in Brazil, changing its production and marketing mode. The production of vegetables by the conventional system has become a tradition, with the use of similar inputs from the production of monocultures. This often leads producers to use agrochemicals that are not recommended for these crops, either due to lack of knowledge of the producer, or ignorance, or even knowing the product, knows that he cannot use it, but does so contrary to technical recommendations.

In the opposite direction of this production process, there are the so-called organic or agroecological-based producers, breaking paradigms. Produce without the use of agrochemicals, only with natural inputs, often produced on your property.

LITERATURE REVIEW

CHARACTERIZATION AND IMPORTANCE OF FAMILY FARMING

Family farming consists of a means of organizing agricultural, forestry, fishing, pastoral and aquaculture productions that are managed and operated by a family and are predominantly dependent on family labor, both women and men (FAO, 2014).

In the national production, family farming is quite representative, participating with 83% of the national production of cassava, 69.6% of the production of beans, 45.5% of corn, 38% of coffee, 33% of rice, 21% of wheat, 58% of milk (composed of 58% of cow's milk and 67% of goat's milk). In animal production, 59% of the pig herd, 51% of the poultry herd and 30% of the cattle herd reach the rates (IBGE, 2006). According to the legislation on family farming (2016), even though the numbers of Brazilian family farming are expressive, this is still a sector that needs support so that it can reach its potential. Unfortunately, a large proportion of farmers live in conditions of poverty.

Even so, they are responsible for a significant portion of food production in the country, especially in regions such as the Northeast. On the other hand, Buainain (2006) states that family farming is extremely diversified, including both families who live and exploit smallholdings in conditions of extreme poverty, as well as producers inserted in modern agribusiness, who have various incomes, higher than what defines the poverty line.

According to Law No. 11,326, of July 24, 2006, a family farmer or rural family entrepreneur is considered to be one who practices activities in rural areas, meeting the following requirements: I- does not hold an area greater than four fiscal modules; II- predominantly uses labor from the family itself; III- has family income predominantly originated from the establishment or enterprise itself; IV- run your establishment or enterprise with your family (MDA, 2009).

Family farmers are responsible for more than 80% of the food supply consumed in much of the world, contributing significantly to poverty reduction and food security (IFAD, 2013). In Latin America, there are about 17 million peasant units, occupying approximately 60.5 million hectares, or 34.5% of the total cultivated land, with properties averaging 1.8 hectares (Altieri, 2012).

One of the striking situations of family farming is precisely in the fact that it is representative in the economic and social spheres, assuming an important role in issues related to sustainable production. However, it can be considered as unproductive, generating a dichotomy, especially when compared to agribusiness (Tonet, 2015). The contribution of family farming to agricultural production is potentially viable in the supply of food, reduction of unemployment and poverty of the most vulnerable families living in rural areas, but it presents low productivity and insufficient income generation for possible investments and guarantees the permanence of families on their agricultural properties (ECLAC, 2014).

The 2006 Agricultural Census (last Census) identified 4,139,369 establishments that are characterized as family farming (85.2%) of the total, occupying an area of 107.8 million hectares. That is, 30.5% of the total area occupied by Brazilian agricultural establishments and accounts for the generation of R$ 18.1 billion of the gross value of production (37.9%). Its importance is also reinforced in relation to jobs in rural areas, thus being responsible for the employment of 13.7 million workers. In the southern region of the country alone, 849,977 establishments (90.5%) were identified, and in the state of Paraná there are 302,907 (IBGE, 2006).

According to Faulin and Azevedo (2003), the production of vegetables commercially or for subsistence plays an important role for family farming, as it is a crop without the need for large tracts of land, which does not require great technical knowledge or high investments. Lima and Wilkinson (2002) corroborate by stating that family farming creates opportunities for local work, reduces rural exodus, diversifies production systems, enables economic activity in greater harmony with the environment and contributes to the development of small and medium-sized municipalities.

However, numerous technical and economic challenges must be overcome by producers when they practice this activity with a commercial character (open market, restaurants and small commercial establishments) or are part of specific and institutional programs for the acquisition of their products. As an example, the PAA/CONAB (Food Acquisition Program – National Supply Company), the PNAE (National School Feeding Program-FNDE, National Fund for the Development of Education) and the Green Fair (Ponta Grossa City Hall) in a more commercial activity. For Oliveira et al. (2016), in most cases the precarious infrastructure available and the low access to new technologies have been major repressors of supply, generating difficulties and deficiencies in links of the production chain. Olericulture presents a high risk due to phytosanitary problems, sensitivity to climatic conditions, vulnerability to seasonality of supply, but when it comes to the potential of net income per hectare to the producer, it surpasses other temporary crops (LOURENZANI; SILVA, 2004).

Family farming can have some other names, such as peasantry, small family production, subsistence production, small production enterprises, among others, representing the different interpretations of family farmers within certain different socioeconomic and political contexts (LOURENZANI, 2005). For Ploeg (2014), family farming cannot be defined only by the size of the establishment, but by the way people cultivate and live. That is why it is also considered a way of life.

In recent decades, Brazil has made significant progress in terms of a better understanding of the real meaning of the social group called family farmers, recognizing its economic diversity and social heterogeneity of small landowners, who use their own family's labor force, producing for their subsistence or for commercialization (DELGADO; BERGAMASCO, 2017).

For Bonnal and Kato (2011), the creation of the MDA (Ministry of Agrarian Development) was an important initiative for the implementation of specific public policies for family farming, in addition to the approval of the National Policy on Family Farming and Rural Family Enterprises, which established principles and instruments aimed at the class. Thus, for Miranda and Martins (2015), the creation of agricultural policies driven by the Federal Government in the 1990s and the beginning of the twenty-first century marked the beginning of an era characterized by important initiatives aimed at strengthening small farmers. The creation of PRONAF (National Program for the Strengthening of Family Farming) was a significant leap, which affirmed and recognized the family farmer as an important and essential member of society, who was considered small, and practiced agriculture for subsistence (DELGADO; BERGAMASCO, 2017).

Family farming is articulated in different forms and intensities between the elements: family, land and workforce and thus adapting to different contexts: social, economic and political. According to Guilhoto et al., (2006) the family farming sector is part of the history of Brazil and consequently of humanity itself. Its interference has been reduced over the centuries due to the technological development of the agricultural sector itself and the other productive sectors of the economy.

Despite its importance, family farming encounters obstacles that limit its development, mainly due to the scarcity of land, lack of technical assistance and insufficient financial resources, so these factors limit the reach of the technological standard necessary to make this segment competitive (SOUZA FILHO; BATALHA, 2005).

Reports show the difficulties encountered in the production process of family farming and especially within the production of conventional and organic vegetables. Since, for example, the seasonality of production causes the supply of production to be discontinuous, making it difficult to commercialize production (ASSIS; ROMEIRO, 2007; SEDIYAMA et al., 2015).

VEGETABLE PRODUCTION SYSTEMS IN FAMILY FARMING

In Brazil, the area cultivated with vegetables is approximately 837 thousand hectares and the production volume is about 63 million tons, covering more than a hundred horticultural species cultivated in all regions (CNA, 2016). In 2015, the area cultivated with vegetables in Paraná was 115.5 thousand hectares, with a production of 3.03 million tons. With a market turnover of approximately R$ 4.03 billion (DERAL, 2016).

The advantages of vegetable production in family farming are due to the following factors: reduced crop cycle, production in small areas, permission for a great diversity of species, use of family labor, relatively low production costs and the possibility, among other things, of direct marketing with the consumer. For example, in neighborhood markets, street markets and grocery stores. Another advantage that we can highlight is subsistence production, thus ensuring the survival of families in rural areas, since the size of properties with this activity varies from 1 to 3 hectares. According to the last agricultural census, family farming had about 1,169,234 establishments producing vegetables (IBGE, 2006).

The per capita consumption of fruits and vegetables (FV) in Brazil is still very small, about 130 grams (FAO, 2014), although this consumption is gaining a lot of prominence in the media, since the population is looking for the conscious consumption of healthy products that are sources of vitamins, proteins and minerals. This search gains even more importance when talking about organic or agroecological-based production.

Studies by the World Health Organization (WHO) recommend that the daily consumption of 400 grams per capita day of fruits, vegetables and greens (FLV) in Brazil this number is far below the recommended 132 grams per capita day (MS, 2006). This low consumption shows us that the vegetable market can grow up to 3 times to achieve this goal. As a result, the WHO has shown that due to the low consumption of vegetables and fruits are associated: Obesity (43% in adults and 21%

of young people are overweight), heart diseases (31% of ischemic heart diseases); strokes (11% of strokes) and cancer incidence (10% of gastrointestinal cancer cases).

Vegetables in open field production systems require investments of US$ 1 thousand to US$ 5 thousand per hectare, and generate more profit for each hectare cultivated when compared to other crops such as grains. Under normal market conditions, it is estimated that vegetables generate income between US$ 2 thousand and US$ 20 thousand per hectare, in the open field (SEBRAE, 2017).

Conventional Production System

Conventional vegetable production is characterized by the use of chemical fertilizers at the time of planting and also as a cover crop during the development phases of the crops. The use of fungicides, insecticides and herbicides have also become common practices in this activity.

With the intention of developing modern agriculture and increasing productivity, a profound change in the agricultural production process began in the 1950s in the United States, called the "Green Revolution" (SILVA et al., 2005). At the heart of this modernization was the use of agrochemicals and other inputs of industrial origin. In Brazil, the "Green Revolution" began in the 1960s and strengthened in the mid-1970s with the creation of the National Crop Protection Program (PNDA). This Program, among other purposes, aimed to stimulate the national production and consumption of pesticides to the extent that the granting of rural credit was conditional on the mandatory use of part of this resource with the purchase of pesticides (ALVES FILHO, 2002; SOARES; FRENCH; COUTINHO, 2005). However, policies to encourage the use of **pesticides** were implemented in a context of structural deficiencies and social vulnerabilities, marked by the lack of knowledge of rural producers and the low level of education of rural workers, which was not accompanied by processes of qualification of the farmers involved in production (MOREIRA et al., 2002; SOARES et al., 2005).

In 1987, Brazil was already the largest pesticide market among developing countries and the fifth largest market in the world, after the USA, Japan, France and the Soviet Union. In 2002, Brazil already occupied the fourth place in the *ranking* of pesticide-consuming countries (MOREIRA et al., 2002). According to a study by the German consulting firm Kleffmann Group, Brazil is currently the largest consumer market for pesticides in the world (PACHECO, 2009). Although pesticides are produced to target specific targets, such as fungi, insects, and mites, this selectivity is never achieved: whether we like it or not, the evolutionary history of living beings makes them similar in biochemical and physiological characteristics. Many of the cellular components or metabolic pathways that are targets of the active ingredients of pesticides are similar to those found in humans.

Agroecological production systems

Several aspects are involved in the conversion from conventional systems to organic production systems, especially the economic and political ones that condition the adoption of organic agriculture among different socioeconomic strata of farmers, and that need to be considered when thinking about the large-scale diffusion of this form of production, requiring more expressive support, which considers its specificities, on the part of the State's agricultural policy (ASSIS; ROMEIRO, 2007).

These authors also highlight the existence of costs and difficulties at entry, related to the initial loss of productivity due to the time for soil reconditioning, and the uncertainties generated by the still precarious structure of commercialization, which has discouraged a more effective response from most farmers, even considering the level of prices that consumers are willing to pay.

Historically, the first movements linked to Ecologically-Based agriculture in Brazil were related to the production of vegetables. The so-called fresh FV (fruits, vegetables and greens) segment, mainly vegetables (legumes and greens), was the lever of the pioneering initiatives that emerged in Rio de Janeiro, Brasília, Rio Grande do Sul, São Paulo and Paraná (ASSIS; ROMEIRO, 2007).

With regard to the commercialization of agroecological vegetables, it originated in two main systems: street markets and home delivery of baskets, which, despite their initial success, present difficulties for the expansion of organic olericulture to a large number of farmers (AMARAL, 1996).

In view of this situation, supermarkets increasingly appear as a path to an effective expansion of this market. In Brazil, following a global trend, large supermarket chains show growing interest in these products, which are for many organic farmers an important alternative for marketing their products (MEIRELLES, 1997).

CHARACTERIZATION OF THE CAMPOS GERAIS OF THE CENTRAL EASTERN MESOREGION OF PARANÁ

The Central-Eastern Paraná mesoregion is located in the Second Paraná Plateau, also called Ponta Grossa Plateau, in the Campos Gerais region, and covers an area of 2,178,254.3 hectares, which corresponds to about 11% of the state territory, with 19 municipalities (AMCG, 2017).

In the region, the climate suffers some variations closely linked to its location, such as temperature, precipitation rates, number of hours of insolation, relative humidity and wind direction. However, analyzing more recent data, based on longer series and obtained with more advanced resources, it is possible to identify two climates in the region, within the Köppen Classification (IAPAR 2000):

(i) Cfa: subtropical climate with average temperature in the coldest month below 18ºC (mesothermic) and average temperature in the hottest month above 22ºC, with hot summers, infrequent frosts and a tendency to concentrate rainfall in the summer months, with no defined dry season.

(ii) Cfb: corresponds to the temperate climate, with an average temperature in the coldest month below 18ºC (mesothermal) with cool summers, and temperature of the hottest month below 22ºC and no defined dry season.

Still in relation to the climate of the Region, it is influenced by other important mechanisms that we can highlight:

- Occurrence of infiltration of cold air masses mainly during the winter;
- Action of humid sea winds influenced by the South Atlantic Anticyclone, causing orographic rains in the Serra do Mar, which can advance and cause rainfall in the plateaus;
- Variations in the position of the Thermal Equator and the South Atlantic Anticyclone, changing the conditions of precipitation, temperatures, relative humidity and winds;
- The "El Nino" and "La Nina" phenomena have also been observed with some frequency, greatly altering the climatic conditions of the Campos Gerais Region.

Temperature variations may occur in the Campos Gerais Region due to the presence of valleys, such as the Tibagi River and its tributaries. Another important factor is latitude, as the region has varied amplitude due to its North-South extension. Considering a shift from the South to the North, the average annual temperatures range from 17-18ºC to 20-21ºC with a predominance of 18-19ºC of annual averages. The average annual rainfall of Campos Gerais is in the range of 1200 mm and 1800 mm, when working with the data of the existing series.

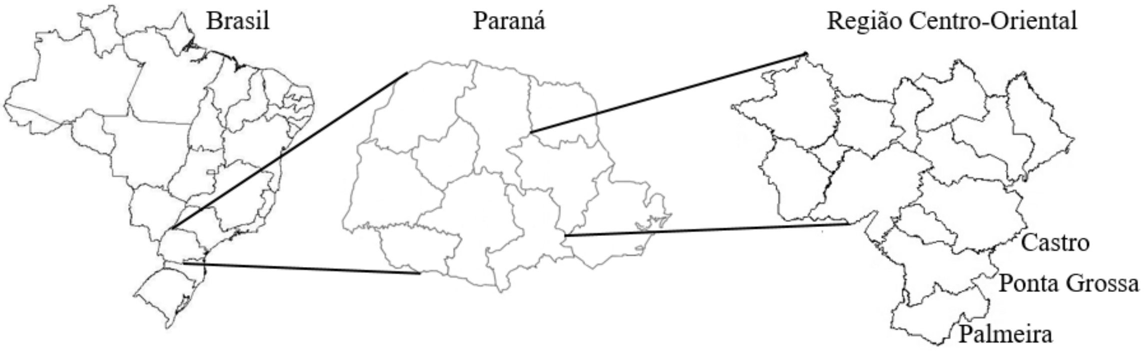
The soils are described as being sandy, shallow and poor, which is shown to be only a partial truth. According to Sá (2007) there are considerable areas formed by silty and/or clayey soils, such as those derived from lithotypes of the Ponta Grossa formation (mainly pelitic rocks) or bodies related to the Serra Geral Magmatism. The main orders of soils in the Campos Gerais Region are: Cambisols - 37%, Latosols - 33%, Ultisols - 10% and Neosols - 17%, with occurrence in sandy rocks of the Furnas formation and the Itararé Group (UEPG, 2003).

MATERIAL AND METHODS

Between June and November 2017, 29 family-based rural properties were visited, in which a semi-structured questionnaire was applied (Appendix 1). These properties are located in the municipalities of Castro, Palmeira and Ponta Grossa, belonging to the Central-Eastern Mesoregion of Paraná (Figure 1). The properties were previously selected, together with technicians from Emater-

PR (regional and local office) and municipal governments, having the following basic criteria: having the activity of olericulture as the main one, fitting the profile of family farming (with up to 4 rural modules, and being in the activity of vegetable production for a minimum period of 5 years). It should be noted that in the municipalities of Castro and Palmeira one rural module is equivalent to 16 hectares, and in Ponta Grossa 12 hectares.

Figure 1. Location of the Central-Eastern Region in the State of Paraná, with emphasis on the municipalities under study.



The Central-Eastern Paraná mesoregion is located in the Second Paraná Plateau (Ponta Grossa plateau), and covers an area of 2,178,254.3 hectares, corresponding to 11% of the state territory. According to Köppen's classification, the climate of the region is humid subtropical (Cfb), with an average temperature in the coldest month below 18 ºC and the occurrence of frequent frosts (mesothermic), cool summers, average temperature in the hottest month below 22 ºC and no defined dry season. The average annual rainfall is approximately 1,600 mm, with August being the driest and January the wettest (IAPAR, 2009).

The semi-structured questionnaire was composed of 90 questions, which was applied to the producers *in loco*, containing questions that enable analyses regarding the indicators chosen to typify them considering social, economic, technical and environmental aspects, also taking into account the threats, risks and uncertainties, in a comparative way between the systems (conventional and organic) in the production of vegetables. This methodology was based on what was described by Manzini (2003), who describes that it is possible to plan to collect information through a script with questions, which in addition to collecting basic information, serves as a means for the researcher to organize himself for the process of interaction with the informant.

From the analysis of the interviews, the collected data were tabulated and transformed into numerical values. Subsequently, the data were statistically treated, using principal component analysis (PCA). The PCA was performed based on the correlation matrix of the variables. Previously, the variables were standardized to mean zero and variance one (1) (MANLY, 2008). The PCA proposes to form linear combinations of the original variables, in such a way that these new variables form a more summarized set of data (LEITE et al., 2009).

Thus, the purpose of such analysis was to distinguish the production systems of rural properties and to verify the correlations between the variables in order to identify the main risks, threats and uncertainties of the systems. With this, we sought to dissimilar individuals according to their own variances, according to their behavior within a population, that is, "groups" of individuals are formed according to the variations of their own characteristics. Statistical analyses were performed with the aid of the R software, version 3.3.4 (R CORE TEAM, 2018).

RESULTS AND DISCUSSION

CHARACTERIZATION OF VEGETABLE PRODUCTION SYSTEMS IN CAMPOS GERAIS CONSIDERING THE ASPECTS OF RURAL SOCIETY

Of the 29 rural properties interviewed, 19 used the conventional vegetable production system and most of them are located in Ponta Grossa (Table 1). As for the properties that use the agroecological production system, it can be seen that they were better distributed among the municipalities of Ponta Grossa (4 properties), Palmeira (3 properties) and Castro (3 properties) (Table 1).

Table 1. Distribution of properties (number of properties) among the municipalities of Campos Gerais do Paraná between conventional and agroecological vegetable production systems

Distribution Production System	Ponta Grossa	Palm	Castro	Total
Conventional	17	2	0	19
Agroecological	4	3	3	10

Considering the social variables, it can be observed that there is an inversion between the conventional and agroecological production systems regarding the distribution of the population by gender. In this case, in the conventional system, there is a predominance of women in the countryside in relation to men; while in the agroecological system, men are the majority of the population (Table 2).

Regarding the distribution of age groups, in both production systems it was found that the majority of the population is distributed between the age groups of 41 to 60 and 26 to 40 years (Table 2). However, among the properties with an agroecological system, the population between 21 and 25 years old is equal to the population between 26 and 40 years old. As a result, the population of children, adolescents and young people up to 25 years of age in the agroecological system (40.6%) was higher than in the conventional system (24.2%). Also, it can be observed that, in general, the properties with the conventional system are composed of an older population (Table 2), which may be directly related to the resistance to change to the transition of the production system, as well as the education of the producers (MAZZOLENI; NOGUEIRA, 2006).

It was also possible to verify that 33.3% of the producers in the conventional system did not have complete elementary education or were illiterate, a condition not observed for the agroecological system, which in turn had a larger population with complete higher education (Table 2).

Table 2. Social variables, as a percentage of the total population analyzed, of the conventional and agroecological vegetable production systems of Campos Gerais do Paraná

Social variables	**Production System**	
	Conventional	**Agroecological**
Family members		
Men	47,8	53,1
Women	52,2	46,9
Age groups		
Up to 10 years	3,0	9,4
Between 11 and 15 years old	4,5	6,3
Between 16 and 20 years old	10,6	6,3
Between 21 and 25 years old	6,1	18,8
Between 26 and 40 years old	27,3	18,8
Between 41 and 60 years old	36,4	34,4
Over 60 years old	12,1	6,3
Schooling		
Illiterate	1,5	0
Incomplete fundamental	31,8	28,1
Complete Fundamental	19,7	18,8
Incomplete high school	13,6	21,9
High School	19,7	18,8
Technical education	3,0	3,1
Incomplete Superior	4,5	0
Complete Superior	6,1	9,4
Activities prior to vegetable production		
Employed or self-employed in the city	15,8	10,0
Employee of other rural properties	26,3	0
General Farming (Owner)	57,9	90,0
Place of residence		
On the farm	89,5	100
Rural area but off the property	5,3	0
Urban area	5,3	0
Workplace		
On the farm	89,5	100
Rural area but off the property	5,3	0
Urban area	5,3	0
Needs or hires labor		
Yes	21,1	10,0
No	78,9	90,0
Satisfaction with the hired workforce		
Yes	0	0
No	100	100
I would like to hire labor		
Yes	75,0	0
No	25,0	100
Vision on family succession		
He didn't think about it	63,2	90,0
It won't happen	0	0
He is thinking of establishing partnerships to continue in the activity	0	0
It will happen naturally	36,8	10,0

Mazzoleni and Nogueira (2006) highlighted two striking factors to overcome the difficult stage of conversion from conventional to agroecological systems: the level of education and experience with other professional activities. In this case, the authors emphasize that these are not indispensable conditions, as farmers with low education and experience only with agriculture can also achieve the conversion and even certification of an organic property, placing themselves positively in the market. However, producers with formal training and market knowledge play a role in bringing new visions and breaking old paradigms, promoting a multiplication effect of agroecological practices.

However, in the present study, it is worth noting that the activity previously performed was not a preponderant factor, because in both systems, but massively in the agroecological system, most producers already came from agricultural activity (Table 2).

For both production systems, the place of residence and work coincided, and most families live and work exclusively on their rural properties (Table 2). However, in the conventional system, one producer (equivalent to 5.3% of the population) lives in the rural area, but outside the property, and another lives in the urban area, both in the city of Ponta Grossa. However, the producer residing in the urban area works exclusively with the production of vegetables, while the producer residing in another property also works in the urban area. In this case, in the agroecological system, it is possible to observe greater satisfaction and comfort of producers, as it is not necessary to search for other sources of income outside the rural property.

There is predominantly no need to hire labor in both production systems. However, in the conventional system, the need to hire labor is higher than in the agroecological system. And, among the labor contractors, in both systems there was total dissatisfaction with the contracted services (Table 2).

Although they do not need labor other than the family, curiously, the vast majority of properties in the conventional system would like to hire the laboratory services of third parties. While in the agroecological system no producer is interested in hiring labor, which may be linked to the fact that the population of this production system is older (Table 3.2) and has a larger area used for cultivation (*see* section 3.5.2). This result was unexpected, as Ecologically-Based agriculture requires a larger contingent of labor per unit area than conventional agriculture (CAMPANHOLA; VALARINI, 2001).

An important aspect to be highlighted is that both in conventional vegetable production systems and in family-based agroecological systems, producers are not concerned with the issue of family succession, because massively producers have not even thought about it (Table 2). This is a serious problem, especially for the agroecological system, because as it was verified, it has a larger young population. However, among those concerned about the future, 36.8% of the conventional system and 10.0% of the agroecological system, all believe that succession will occur naturally, passing from parents to children (Table 3.2).

Panno and Machado (2016) highlight the young exodus, with intensity in the female gender, causing an increase in the aging and masculinization of the rural population (a condition already observed for the agroecological system). Consequently, hindering the succession process and the prospects for the continuity of agricultural activities. Also, the farmers' perception of their situation, purposes and the future of their property end up directing their decisions and driving the decisions of their descendants.

Thus, it is evident that producers must be concerned with the future of the property and the activity performed, and that they must necessarily involve their children in the production process and in decision-making. Panno and Machado (2016) also focus on the fact that the most influencing and motivating factor for young people to remain on the property, attributed as a fundamental aspect in the decision-making process, is the possibility of financial return that the property can provide. Thus, these young people possibly already have a more incisive role in the family's activities and realize the financial return that the property can offer will hardly be achieved with an activity outside of there.

CHARACTERIZATION OF VEGETABLE PRODUCTION SYSTEMS IN CAMPOS GERAIS CONSIDERING TECHNICAL-AGRONOMIC AND ECONOMIC ASPECTS

Table 3 presents the results of the main technical and economic variables[3] raised with the interviews. Succinctly, it was found that the time that the family has lived on the property are not essential factors for the distinction of production systems. However, the time in the activity and the area used in the cultivation of vegetables were extremely important variables. With these, it can be observed that the properties in agroecological system are more recent activities and that they use a smaller cultivated area (Table 3).

Table 3. Technical and economic variables of conventional and agroecological vegetable production systems in Campos Gerais do Paraná.

Technical and economic variables	**Production System**	
	Conventional	**Agroecological**
Time on property (years)	23,7 (8,8)	21,7 (7,7)
Property size (ha)	10,4 (13,0)	11,9 (7,3)
Time in activity		
Up to 10 years	15,8	30,0
Between 10 and 20 years old	21,1	30,0
Between 20 and 30 years old	36,8	40,0
Over 30 years old	26,3	0
Area used for growing vegetables (ha)	3,2 (2,4)	1,7 (0,6)
Vegetable production is the main activity (%)		

[3] Economic aspects were considered to be those internal to properties, which do not depend on external agents, such as banks, financing agencies, among others.

Yes	63,2	60,0
No	36,8	40,0
Production system (number of properties)	19	10
Interest in agroecological production (%)		
Yes	31,6	100
No	68,4	0
Tillage method (%)		
Partially machined	36,8	70,0
Fully machined	63,2	30,0
Cultivation in beds (%)		
Yes	73,7	30,0
No	26,3	70,0
Carry out some soil conservation practice (%)		
Yes	63,2	80,0
No	36,8	20,0
Fertilization (%)		
It does not perform	10,5	0
Chemistry	10,5	0
Organic (animal waste)	68,4	100
Chemical and organic	10,5	0

Values in parentheses represent the standard deviation.

Table 3. Technical and economic variables of conventional and agroecological vegetable production systems in Campos Gerais do Paraná. Cont.

Technical and economic variables	**Production System**	
	Conventional	**Agroecological**
Use of agricultural corretives (%)		
Yes	100	90,0
No	0	10,0
Weed Control Method (%)		
It does not control (coexists with the invaders)	0	0
Capina manual	47,4	60,0
Use herbicides	21,1	0
He seeks to live together and when he controls it he does it manually	31,6	40,0
Pest Control Method (%)		
Does not control	0	0
Chemical	89,5	0
Biological	0	10,0
Alternative	10,5	90,0
Disease Control Method (%)		
Does not control	5,3	0
Chemical	78,9	0
Biological	0	0
Alternative	15,8	100
Crop rotation		
Yes	100	100
No	0	0
Scales up production		
Yes	89,5	100
No	10,5	0
Uses irrigation (%)		
Yes	84,2	90,0
No	15,8	10,0
There are issues with lack of water on the property		
Yes	82,4	80,0
No	17,6	20,0
Conduct training (%)		
Yes	47,4	100
No	52,6	0
Complain about lack of technical assistance (%)		

Yes	52,6	90,0
No	47,4	10,0
Technical assistance officer (%)		
There is no assistance	44,4	50,0
Private assistance	38,9	10,0
Unions or cooperatives	0	0
City Hall or Emater	16,7	40,0
Destination of production (%)		
Government programs (PNAE, PAA, Feira Verde)	10,5	30,0
Free markets	5,3	10,0
Government programs and street markets	84,2	60,0
Frequency of marketing		
Daily	15,8	10,0
Every 2 days	42,1	20,0
Every 3 days	21,1	10,0
Other	21,1	60,0

Table 3. Technical and economic variables of conventional and agroecological vegetable production systems in Campos Gerais do Paraná. Cont.

Technical and economic variables	**Production System**	
	Conventional	**Agroecological**
Demand (%)		
Hardwoods	42,1	10,0
Roots	5,3	10,0
Fruits	5,3	0
There is no preference between products	47,4	80,0
Share of vegetable sales in income		
Between 0 and 20 %	0	0
Between 21 and 40 %	10,5	10,0
Between 41 and 60 %	15,8	20,0
Between 61 and 80 %	10,5	20,0
Between 81 and 100 %	63,2	50,0
Monthly gross income (R$)	4.279 (3.274)	2.045 (1.460)
Difficulties in calculating property costs and revenues		
Yes	21,1	60,0
No	78,9	40,0
Have financing for facilities or equipment (%)		
Yes	57,1	75,0
No	42,9	25,0
Commitment of income from financing (%)		
Between 0 and 5 %	21,1	20,0
Between 6 and 15 %	0	20,0
Between 16 and 25 %	5,3	0
Between 26 and 50 %	10,5	0
Above 50%	5,3	30,0
Don't know	57,9	30,0
Finds it difficult to get credit or financing (%)		
No	50	60,0
Lack of Guidance	0	0
Bureaucracy	33,3	40,0
Interest	0	0
Other	16,7	0
Use credit lines (%)		
No	57,9	33,3
Banks	15,8	0
Credit Unions	5,3	0
Pronaf	21,1	66,7

Values in parentheses represent the standard deviation.

For principal component analysis (PCA), not all the variables presented in Table 3 were used, due to problems of multivariate collinearity (MANLY, 2008). Thus, the variables that circumvented this problem and best explained the variance of the study were selected. This selection was based on the highest correlations of the variables.

After performing the PCA, it was found that six principal components (PC) were needed to explain more than 70% of the total variance (Table 4). However, only the first two PC showed greater relevance, explaining 42.39% of the total variance, since the proportion of explained variance between PC 3 and PC 6 was very similar and much lower than PC 2 (Table 4).

Table 4. Standard deviation, proportion of variance and variance explained by the principal components of the technical-agronomic and economic variables

Main Component (CP)	Standard deviation	Variance Ratio	Cumulative Variance Ratio	Cumulative Variance (%)
CP 1	2,29	0,25	0,25	25,07
CP 2	1,91	0,17	0,42	42,39
CP 3	1,34	0,09	0,51	50,91
CP 4	1,30	0,08	0,59	58,93
CP 5	1,16	0,06	0,65	65,30
CP 6	1,12	0,06	0,71	71,24

PC 1 was represented by both technical and economic aspects (Table 5), mainly related to the production system. In this case, the production system and the practices related to pest and disease control showed positive eigenvalues, while fertilization, vegetable cultivation as the main economic value, monthly gross income and the destination of production were negative values (Table 5). Such results demonstrate the existence of a close relationship between the production system and the control of pests and diseases and that this relationship is contrary. That is, a risk, especially for economic aspects. In this way, CP 1 can be named as "Economic Efficiency Index of the Production System".

In turn, CP 2 was also represented by technical and economic aspects. In this case, the use of irrigation and the problems with the lack of water associated with the cultivation of vegetables as the main economic factor presented negative eigenvalues. While the frequency of marketing was the only variable with a positive eigenvalue (Table 5). Therefore, CP 2 can be named as "Index of water dependence in the cultivation of vegetables for commercialization".

It is worth noting that both in CP1 and CP 2, vegetable cultivation as the main economic crop presented negative eigenvalues, as well as a negative correlation with the scaling of production, which in itself demonstrates that this practice presents a great threat to vegetable production systems (Table 3.5). In this context, Padovan et al. (2017) highlight that the diversification of production, with products distinct from horticulture such as corn and beans, in addition to being a fundamental posture for ecological balance, so important to agricultural systems, is also considered a strategy for continuous income generation by family farmers throughout the year, due to the seasonality of production of each cultivated species. Thus, the diversity of crops in the production units reduces the risks of frustration resulting from climatic adversities, in addition to making it possible to offer different options to the consumer market.

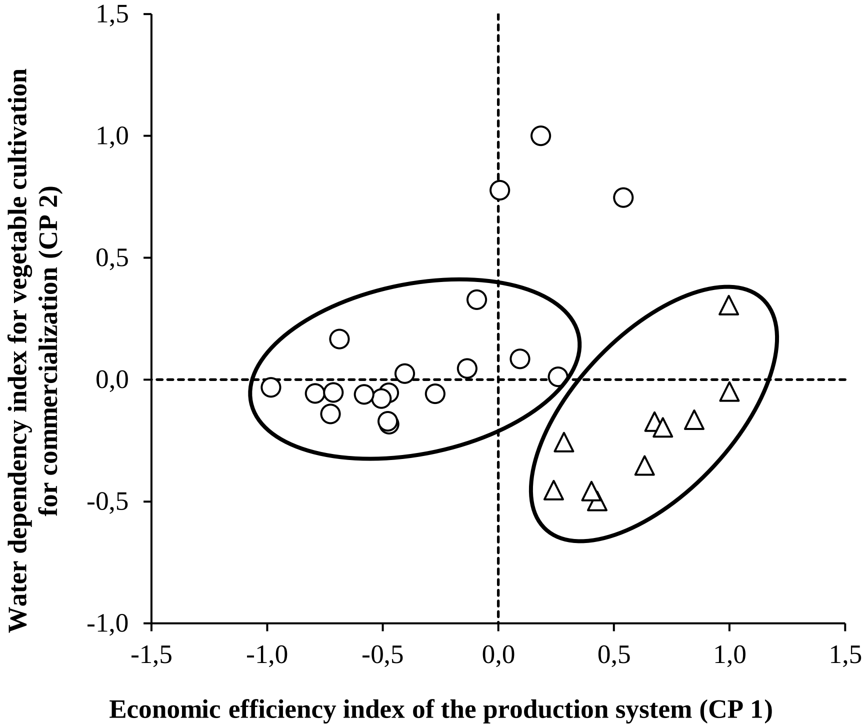
Table 5. Eigenvalues of the variables between the first six principal components (CP) of the technical-agronomic and economic variables

Variables	**CP 1**	**CP 2**	**CP 3**	**CP 4**	**CP 5**	**CP 6**
Planting in beds	-0,19	0,07	**0,35***	**-0,32***	-0,11	**-0,27***
Fertilization	**-0,30***	0,03	**-0,40***	0,03	**-0,22***	-0,02
Use of concealers	-0,06	0,14	-0,05	**0,35***	**-0,23***	**0,48***
Production System	**0,34***	-0,25	-0,01	0,02	-0,01	0,04
Interest in agroecology	0,25	-0,27	-0,09	**-0,26***	0,14	0,30
Use of irrigation	-0,13	**-0,43***	0,01	0,02	-0,12	-0,02
Problems with lack of water	-0,06	**-0,44***	0,06	-0,01	-0,19	-0,07
Scaling up production	0,17	0,02	-0,09	0,03	**0,49***	-0,01
Weed Control	-0,02	-0,20	0,28	-0,04	-0,17	**0,48***
Disease control	**0,31***	-0,23	-0,19	-0,03	-0,13	-0,05
Pest control	**0,37***	-0,16	-0,01	0,00	-0,09	0,04
Training	0,22	-0,16	**0,43***	0,22	0,11	-0,09
Lack of technical assistance	0,24	-0,01	**-0,39***	-0,10	0,08	-0,17
Soil conservation practices	0,16	0,15	0,15	**0,50***	**-0,22***	0,06
Vegetable cultivation as the main economic	**-0,24***	**-0,31***	-0,24	0,02	0,07	0,08
Time in vegetable production	-0,15	0,04	-0,02	**-0,27***	0,19	**0,33***
Area used for the production of vegetables	-0,09	-0,13	-0,08	**0,46***	**0,43***	-0,04
Importance of vegetables for the property's income	-0,18	-0,29	-0,17	0,16	**-0,29***	**-0,23***
Gross monthly income	**-0,26***	-0,08	-0,16	0,15	0,24	0,22
Production destination	**-0,23***	-0,18	0,23	-0,17	0,16	0,17
Frequency of marketing	0,21	**0,23***	-0,23	-0,19	**-0,25***	0,26

*Variables with a weight greater than 70% in relation to the highest eigenvalue, within each principal component.

Relating the PC to the properties interviewed, it is possible to clearly observe the distinction between the properties that work in the agroecological production system and the properties of the conventional cultivation system (Figure 2). It can also be observed that the properties in the conventional system showed greater dispersion, to the point that three properties were completely different from the other properties in the conventional system.

Figure 2. Biplot dispersion (n=29) between the Economic Efficiency Index of the Production System (CP 1) and the Index of Water Dependence in the Cultivation of Vegetables for Commercialization (CP 2) of agricultural properties in the conventional (○) and agroecological (Δ) vegetable production systems in the Campos Gerais region of Paraná.

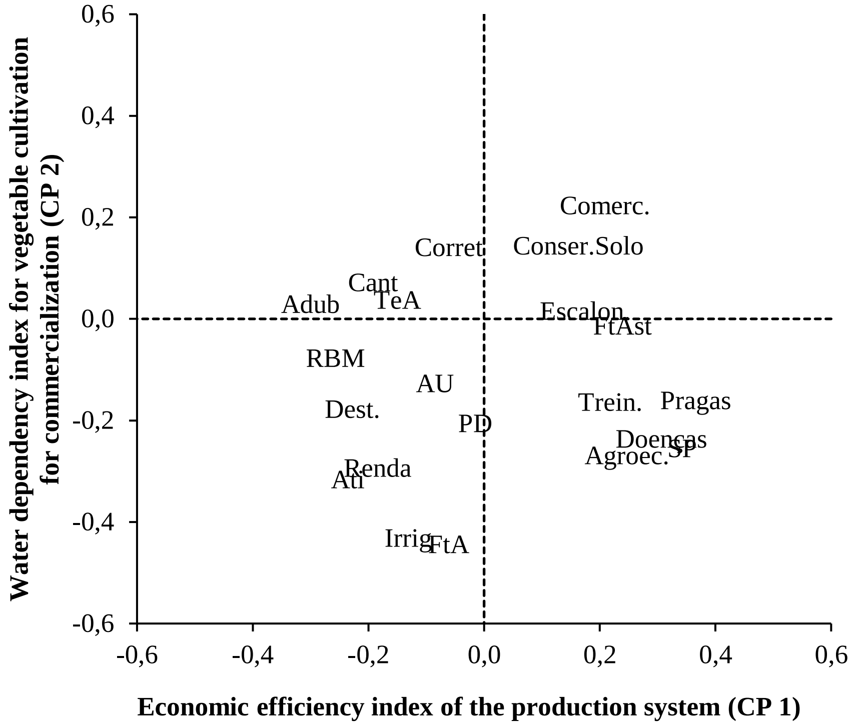


Correlating the variables (Figure 3) with the rural properties (Figure 2), from the point of view of the Economic Efficiency Index of the production system (CP 1), it can be observed that the properties in the agroecological production system are the ones that have the greatest problems with pests and diseases, although they are the most participative in technical training, and that they spend less time in the activity and make fewer investments in fertilization. Such technical conditions end up resulting in lower gross monthly income for the properties (Figure 3).

Such results are due to the fact that in organic cropping systems, pest and disease control should be done only when there is a possibility of considerable damage to production. Prior to such damage, the natural balance of the agroecosystem must be sought, through practices that promote biodiversity, such as intercropping, crop rotation, green manure, windbreaks, and the use of companion plants. As well as seeking to increase the levels of soil organic matter and balanced crop nutrition, in addition to other factors that allow adequate management of the systems (SEDIYAMA et al., 2014).

Therefore, considering the lower investments in fertilization of producers in the agroecological system and the short time they have been in the activity (Figure 3), it is estimated that their production systems are not yet in ecological balance, which ended up restricting their production and profitability.

Figure 3. Multivariate correlations between the variables (n=21) in relation to the Economic Efficiency Index of the Production System (CP 1) and the Water Dependence Index in the Cultivation of Vegetables for Commercialization (CP 2) of agricultural properties in the conventional and agroecological vegetable production systems in the region of Campos Gerais do Paraná. Cant = Planting in beds; Adub = Fertilization; Corret = Use of concealers; SP = Production system; Agroec = Interest in agroecology; Irrig. = Use of irrigation; FtA = Problems with lack of water; Escalation = Production scaling; PD = Weed control; Diseases = Disease control; Pests = Pest control; Train = Training; FtAst = Lack of technical assistance; Conser.Solo = Soil conservation practices; PAt = Vegetable cultivation as the main economic one; TeA = Time in vegetable production; AU = Area used for the production of vegetables; Income = Importance of vegetables for the property's income; RBM = Gross monthly income; Dest = Production destination; Comerc = Frequency of commercialization.



On the other hand, properties in the conventional system are the properties with the longest time of activity, which means that these producers seek less training and are not affected by the lack of technical assistance. These properties are also the ones with the highest monthly gross income, directly related to the larger area used for the cultivation of vegetables, greater investments in fertilization and fewer problems for the control of pests and diseases (Figures 1 and 2). Thus, with these results, the hypothesis that the agroecological systems evaluated are not yet in balance is reinforced.

Similarly, Luz et al. (2007) observed that under protected cultivation conditions, tomato production in the organic cultivation system is inferior to conventional cultivation, but with less seasonality in production. However, the authors did not mention whether the causes of the lower production were aspects related to soil fertility or pest and disease management, although they did evaluate these variables.

Based on the Water Dependence Index in the cultivation of vegetables for commercialization (CP 2), it can be observed that the frequency of commercialization was not influenced by the production system (Figure 3.3). However, it is important to highlight that the frequency of commercialization showed a strong negative correlation with the area used for the cultivation of vegetables and the destination of production. Demonstrating that the size of the area or to whom the production is intended for the frequency of commercialization does not matter. However, what most affected this variable were the aspects related to the lack of water for production and, consequently, the use of irrigation. In this case, again the farms in the conventional production system were the ones that presented the highest use of irrigation and the greatest problems with lack of water, restricting their frequency of commercialization (Figure 3).

Lima et al. (2009; 2012) found that lettuce and eggplant cultivation, respectively, are affected by water deficit under different soil cover conditions, such as no-tillage, in a conventional production system. Thus, the authors emphasize that irrigation is a necessary practice for the production of the vegetables in question.

In this context, Assis and Romeiro (2007) point out that a factor that limits the conversion from conventional production systems to organic systems is the existence of costs and barriers to entry, related to the initial loss of production due to the time for soil reconditioning, and the uncertainties generated by the still precarious marketing structure, which has discouraged a more effective response from most farmers, even considering the level of prices that consumers are willing to pay.

Another important multivariate correlation to be highlighted was that the lack of technical assistance directly interferes with the scaling of production. Likewise, properties with such problems are the ones that make the least investments in fertilization. As a result, production on these properties becomes limited, which restricts their gross monthly income (Figure 3).

In addition, rural properties that carry out soil conservation practices have a higher frequency of commercialization, consequently have fewer problems with lack of water and make less use of irrigation (Figure 3). These results are important because they reinforce the importance of soil conservation for the sustainability of agricultural production (LIMA et al., 2016; NAREZI, 2018; NUNES et al., 2018).

This importance of soil concern, especially in organic systems, has been highlighted for a long time in the literature. According to Assis and Romeiro (2002), for the success of agroecological systems, the first concern should be, in the implementation, related to the soil, with regard to the recovery and maintenance of its biological balance, as this will influence the efficiency of the system. As a result, in the environmental aspect, organic systems generate little significant impacts. While, in the conventional one, these impacts are more evident, especially regarding the quality of the products produced (ALENCAR et al., 2013).

CHARACTERIZATION OF VEGETABLE PRODUCTION SYSTEMS IN CAMPOS GERAIS CONSIDERING TECHNICAL-AGRONOMIC AND FINANCIAL ASPECTS

Considering the main technical-agronomic aspects (Figure 3) and the financial aspects[4], the first three PC explained 51.18% of the total variance (Table 3.6). However, it can be observed that the proportion of variance explained by CP 2 to 4 was very similar, ranging from 0.15 to 0.10 (Table 6).

Table 6. Standard deviation, proportion of variance and variance explained by the principal components of the technical-agronomic and financial variables.

Main Component (CP)	**Standard deviation**	**Variance Ratio**	**Cumulative Variance Ratio**	**Cumulative Variance (%)**
CP 1	1,93	0,25	0,25	24,84
CP 2	1,48	0,15	0,39	39,38
CP 3	1,33	0,12	0,51	51,18
CP 4	1,24	0,10	0,61	61,49
CP 5	1,05	0,07	0,69	68,78
CP 6	1,01	0,07	0,76	75,52

[1] Financial aspects were those that are external to the property, on which the producer depends on third-party services (bank branches and/or credit unions, for example), such as agricultural credits, financing, among others.

PC 1 was composed of the positive association of the production system with pest and disease control, with the negative association of the destination of production, monthly gross income and difficulties in calculating the costs and revenues of the property (Table 7). Thus, it is possible to verify again the dependence of the destination of production and gross monthly income in relation to the control of pests and diseases among the production systems. Also, the limitation of producers in the financial management of the property was highlighted, as most producers do not know how to calculate their production costs or even their profitability and relation to gross monthly income (Table 3). Thus, it is proposed that the association of these variables composes the "Financial Management Efficiency Index".

Table 7. Eigenvalues of the variables between the first six principal components (CP) of the technical-agronomic and financial variables.

Variables	CP 1	CP 2	CP 3	CP 4	CP 5	CP 6
Production System	**0,45***	0,14	0,00	0,03	-0,24	-0,02
Time in vegetable production	-0,21	-0,14	-0,06	0,03	**-0,43***	**-0,38***
Area used for the production of vegetables	-0,05	0,15	**-0,55***	0,25	0,04	**-0,35***
Production destination	**-0,27***	0,31	0,14	**-0,33***	-0,15	0,17
Marketing frequency	0,26	**-0,36***	-0,03	-0,01	-0,09	**-0,38***
Share of vegetable sales in income	-0,13	**0,38***	0,11	**0,44***	-0,23	0,04
Gross monthly income	**-0,27***	0,19	-0,32	-0,04	0,04	0,11
Difficulties in calculating property costs and revenues	**-0,25***	**-0,27***	0,26	0,24	-0,07	0,17
Financing	0,05	0,26	**-0,39***	**-0,37***	**0,20***	-0,18
Commitment of income through financing	-0,07	-0,09	-0,08	**-0,35***	**-0,72***	-0,03
Difficulties in getting credit or financing	0,11	0,21	**0,41***	**-0,48***	0,15	-0,24
Lack of water	0,02	**0,55***	0,15	0,16	-0,20	-0,09
Scaling up production	0,16	-0,08	**-0,37***	-0,15	-0,16	**0,63***
Disease control	**0,44***	0,16	0,03	0,17	-0,05	0,11
Pest control	**0,47***	0,04	0,02	0,05	-0,12	0,04

*Variables with a weight greater than 70% in relation to the highest eigenvalue, within each principal component.

In this context, PC 2 was composed of the combination of the problems of lack of water for production with the participation of the commercialization of vegetables in the total income of the property in relation to the frequency of commercialization and the difficulties in calculating the costs and revenues of the property (Table 7). Thus, it can be seen that the arrangement of these variables composes the "Production Valuation Index", as it will influence production, marketing, income and production management.

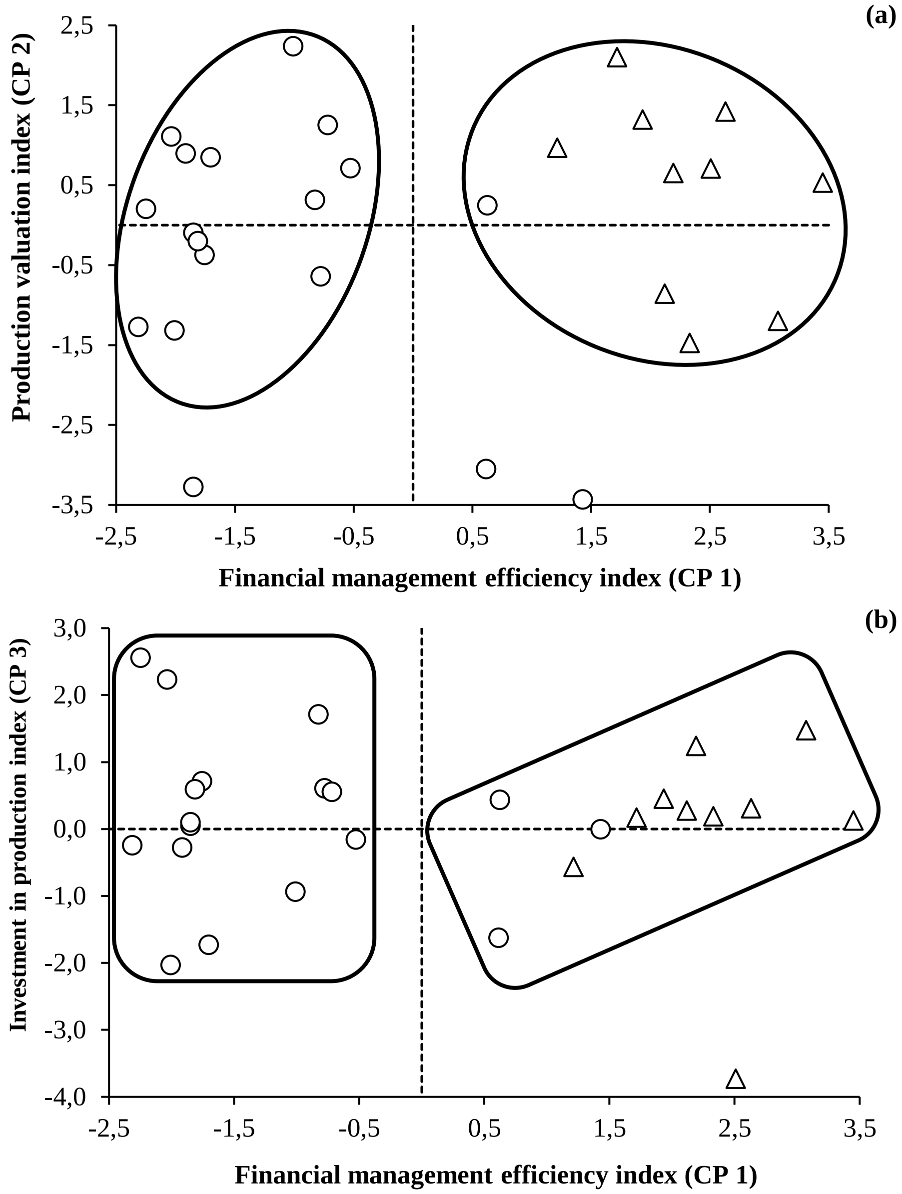
In turn, for PC 3, it was formed by the association of difficulties in obtaining credit or financing with the area used for the production of vegetables, the scaling of production and financing (Table 7). With this, it was observed the difficulty in obtaining credits being inversely proportional to the size of the cultivated area and the regular production, this directly reflects on the investments of the property made through financing. Thus, CP 3 is the "Index of investments in production".

The relationship of the properties interviewed between the Financial Management Efficiency Index and the Production Valuation Index (Figure .4a) clearly highlighted the differences between conventional and agroecological production systems. However, one property of the conventional system showed similar behavior to the agroecological properties, while 3 other properties (the same ones observed in Figure 2) were completely different from the others (Figure 4a).

In turn, the relationship between the Financial Management Efficiency Index and the Production Investment Index (Figure 4b) also distinguishes production systems. However, in this case, three properties of the conventional system resembled the agroecological system and one agroecological property showed high dissimilarity from all the other properties (Figure 4b).

Considering the relationship of the properties (Figure 4) with the variables of these main components (Figure 5), it can be observed that the agroecological properties are the ones with the best financial management, as they demonstrate less difficulties in calculating their production costs and revenues. However, the valuation of their products is deficient, which can be attributed mainly to the destination of their production, since their commercialization frequency is higher than the properties of the conventional system (Figure 5a).

Figure 4. Biplot dispersion (n=29) between (a) the Financial Management Efficiency Index (CP 1) and the Production Valuation Index (CP 2) and (b) CP 1 and the Index of investments in the production of agricultural properties in the conventional (○) and agroecological (Δ) vegetable production systems in the Campos Gerais region of Paraná.



As highlighted, most producers allocate their production to government programs (Table 3). Although this is an important marketing channel for family farming products, especially in the southern region of Brazil (SARAIVA et al., 2013), there are other possible marketing channels to add value to organic products, such as street markets, supermarkets, restaurants, natural food stores, among others (CAMPANHOLA; VALARINI, 2001).

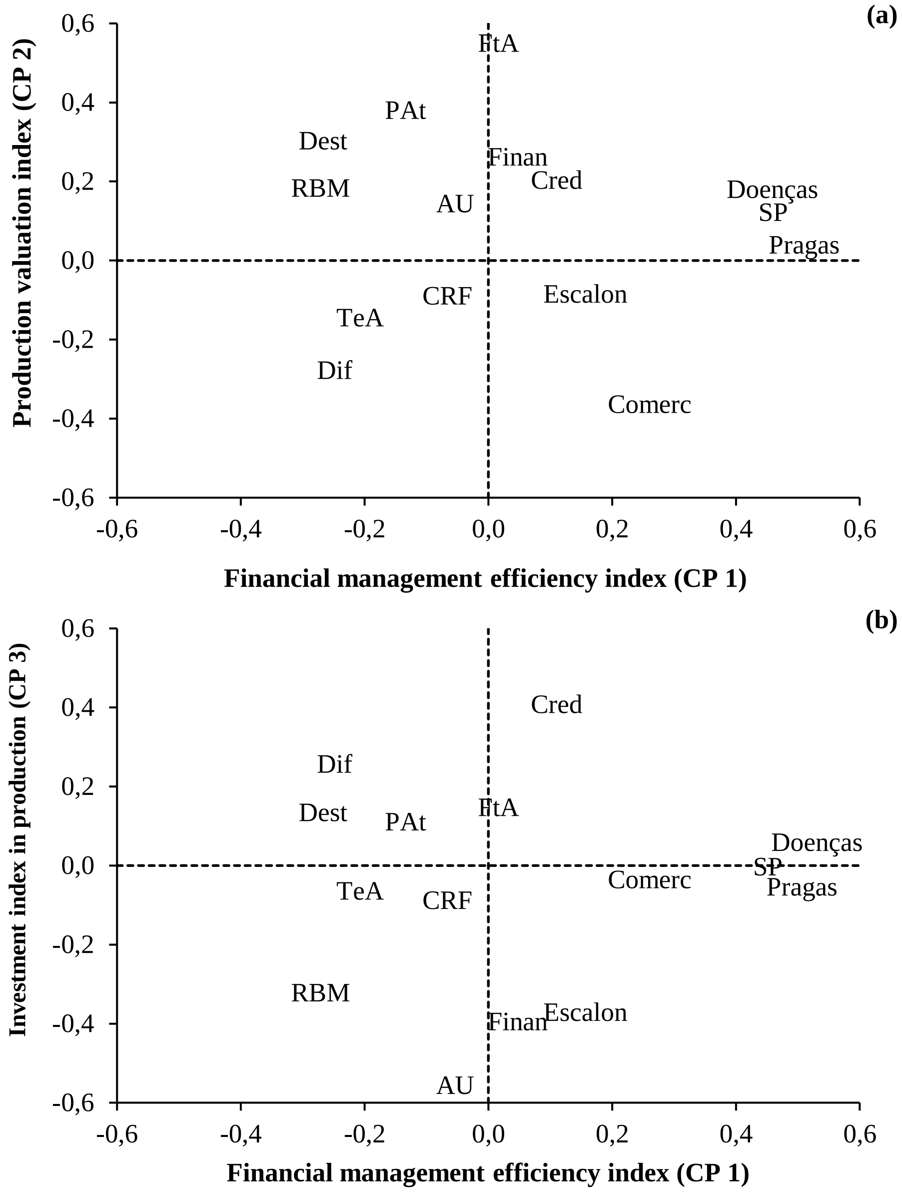
It is worth noting that in no way is the migration of the producers' marketing channel being encouraged, as government programs are a form of assured purchase for them (SZIWELSKI et al., 2015). But, yes, the existence of other market possibilities capable of improving the product valuation index is being demonstrated (MALUF, 2004).

Even so, the valuation of the production of the agroecological system is complex. To exemplify, Silva et al. (2005) discuss the existence of some barriers to the dissemination of the consumption of agroecological products in retail (supermarket chains). First, the economic factor is the great complicating factor, as consumers claimed that the high price of organic products makes consumption difficult. But, on the other hand, it is necessary to work better on the display of these products in the store, as previously pointed out by the location of the products in a single section. As well as the regularity of organic products in retail establishments.

When analyzing the financial management efficiency index with the production investment index (Figure 5b), it was observed that agroecological production systems find it more difficult to obtain credit or financing, although they have better notions of managing their property. In this case, the best management may be a direct reflection of the smaller cultivation area, absence of costs in the purchase of phytosanitary products, and absence of labor contraction (ASSIS; ROMEIRO, 2007; LUZ et al., 2007; SOUZA et al., 2008).

In turn, the difficulty in obtaining credit, Assis and Romeiro (2007) have already highlighted for more than a decade the prejudice in relation to the availability of agricultural credit to organic agriculture by state agencies. However, the authors point out that among the producers interviewed by them, among whom they used agricultural credit, the minority that did not observe resistance or faced difficulties were those who used specific lines of credit for organic production.

Figure 5. Multivariate correlations between the variables (n=15) in relation to (a) the Financial Management Efficiency Index (CP 1) and the Production Valuation Index (CP 2) and (b) CP 1 and the Production Investment Index (CP 3) of agricultural properties in the conventional and agroecological vegetable production systems in the Campos Gerais region of Paraná. Cred = Difficulty in getting credit or financing; SP = Production system; FtA = Problems with lack of water; Escalation = Production scaling; Diseases = Disease control; Pests = Pest control; PAt = Vegetable cultivation as the main economic one; TeA = Time in vegetable production; AU = Area used for the production of vegetables; Income = Importance of vegetables for the property's income; RBM = Gross monthly income; Dest = Production destination; Comerc = Frequency of marketing; Finan = investment financing; CRF = commitment of income due to financing.



Still analyzing the relationship between the Indices of deficiency of financial management and investments in production, it was found that the difficulty in obtaining credit and financing presented a strong negative correlation with the scaling of production (Figure 5b). Such a correlation makes a lot of sense and points to a serious problem of family farming as a whole, regardless of the production system: lack of planning in cultivation that results in the scaling of production reflects directly on investments in the property.

MAIN RISKS, THREATS AND UNCERTAINTIES IDENTIFIED AMONG PRODUCTION SYSTEMS: SUMMARY OF MULTIVARIATE ANALYSES AND INTERVIEWS

Considering the importance of family farming, regardless of the production system, it is necessary to identify the main risks, threats and uncertainties. In this context, these aspects were analyzed intuitively based on the joint interpretation of the principal component analyses and other variables raised in the interviews (Tables 2 and 3). Thus, the variables were grouped as a risk, threat or uncertainty for both production systems (Table 8).

The main common risks among production systems can be observed, the distinction being that phytosanitary management, especially pest and disease control, is a greater risk to agroecological producers (Table 8). Similarly, for both systems, family succession was the main uncertainty identified. As for the threats, it can be clearly seen that the threat posed by the conventional system is not reflected in the agroecological system (Table 8).

Table 8. Main risks, threats and uncertainties of conventional and agroecological production systems in Campos Gerais do Paraná

Production System	Risks	Threats	Uncertainties
Conventional	Lack of scaling up production. Lack of water for production.	Frequency of commercialization. Lack of property management knowledge. Lack of updating in the production process. Lack of technical assistance	Family succession. Abandonment of the activity
Agroecological	Phytosanitary management. Lack of scaling up production. Lack of water for production.	Valuation of production. Difficulty in getting credit or financing.	Family succession. Abandonment of the activity

CONCLUSIONS

The complexity between vegetable production systems in Campos Gerais do Paraná is great. The agroecological system presents greater problems such as the control of pests and diseases, even in smaller cultivation areas, which has repercussions on lower income on the property, even though these producers have a higher frequency of commercialization. This fact is also due to the destination of production and the valuation of products not occurring satisfactorily.

For the conventional system, although the cultivation areas are larger, the lack of knowledge of financial management tools and low demand for training and updates are factors that have repercussions on the production and sustainability of the property.

Principal component analysis proved to be a promising tool for this type of study. It allowed the analysis of technical-agronomic, economic and financial variables, both internal and external to the property. It is possible to distinguish between conventional and agroecological vegetable production systems in Campos Gerais do Paraná.

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