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Technological management index and social capital of producers in the municipalities of Cedro, Iguatu and Cariús in Ceará

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Summary
The objective is to elaborate and analyze indexes of technological management and social capital of producers in the municipalities of Cedro, Iguatu and Cariús in the State of Ceará. The data of primary nature were collected in 2017 by non-probabilistic sampling by convenience. In the sample, 49 producers fell within a scale of 0.37 to 0.54, indices considered average, for the levels of technological management and social capital, respectively. In the scale from 0.62 to 0.78, indexes considered high, 28 and 35 producers were found for the technological management index and the social capital index, respectively. Only two producers presented a high technological management index (scale between 0.79 and 1.00) and no producer was identified with a high social capital index. The variables that most contributed to technological management were service provision; cash flow control; production control, and cost control. The variables that most impacted the level of accumulation of social capital were the participation and suggestion in meetings; payment of fees/fees/membership dues; performance of function for association and participation in elections.
Keywords: Índice de gestão tecnológica e capital social. Análise fatorial. Ceará.

Índice de gestão tecnológica e capital social dos produtores nos municípios de Cedro, Iguatu e Cariús no Ceará

Resumo
O objectivo é preparar e analisar índices de gestão de tecnologia e capital para produtores nos municípios de Cedro, Iguatu e Cariús no Estado do Ceará. Os dados de natureza primária foram recolhidos em 2017 por amostragem não probabilística por conveniência. Na amostra, 49 produtores introduziram um intervalo de 0,37 a 0,54, índices considerados médios, aos níveis de gestão de capital tecnológico e social, respectivamente. Na escala de 0,62 a 0,78, os índices considerados elevados, encontraram-se 28 e 35 produtores para o índice de gestão tecnológica e de capital social, respectivamente. Apenas dois produtores apresentaram índice de gestão tecnológica (escala de 0,79 a 1,00) e nenhum produtor foi identificado com índice elevado de capital social. As variáveis que mais contribuíram para a gestão tecnológica foram a prestação de serviços; controlo do fluxo de caixa; controlo da produção e controlo dos custos. As variáveis que mais influenciaram o nível de acumulação de capital social foram a

participação e sugestões em reuniões; taxa de pagamento/quota/mês; desempenho da função para Associação e participação nas eleições.
Palavas-chave: Gestão tecnológica e índice de Capital Social. Análise de factores. Ceará.

1 Introduction

In the 2006 agricultural census, family farming contributed to the basic food basket of Brazilians, accounting for 87% of the national production of cassava, beans 70%, corn 46%, coffee 38%, rice 34%, and wheat 21%. In livestock, the following results were obtained: milk 58%, pigs 59%, poultry 50% and cattle 30% (IBGE, 2017).

In view of its economic and social importance, public policies were formulated that enabled the creation of programs such as the Program for the Strengthening of Family Agriculture (PRONAF), in accordance with the reality of rural families, proposing conditions for the productive development of farmers, raising the technological level, and promoting social welfare.

Experiences show that producers who have an adequate technological management have a better use of available resources, promoting improvements in production and the results targeted by producers such as higher yields and lower production costs. Another development factor inherent to producers is the formation of social capital.

The accumulation of social capital applies to the creation of processes capable of revealing the potential resources that individuals of a given locality can discover in their communities. However, it is necessary to capture its characteristics and the most important elements to achieve socioeconomic development. In this sense, the questions that guide this proposal are: what factors contribute to the increase in the producers' technological level and social capital? Does participation or not in public policy programs result in a differentiated level of technological management or social capital formation?

The basic hypothesis is that the conditions of technological management and formation of social capital of farmers allow subsidies to the process of decision-making to obtain the best performance of productive activities in the regions, as factors built through

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associativism, cooperativism and coordinated actions of agents, enabling the creation of strategies for enterprises that prosper economically in a sustainable way.

The objective of this study was to elaborate and analyze the indexes of technological management and social capital formation of producers in the municipalities of Cedro, Iguatu, and Cariús in the State of Ceará.

The contribution of this study is related to the fact that the analysis of the level of technological management and the formation of social capital may contribute to a better targeting of efficient public policy instruments within the reach of the producers.

Besides this introductory part, the article was divided into four more sections. In the second section, a contextualization of the technological management and social capital indicators for the development of regional localities was carried out. The third section exposes the methodological procedures adopted in the construction of the indexes by means of factor analysis, as well as the source and nature of the data. In the fourth section, the summarization of the data and the discussions of the results were presented. Finally, the fifth and last section outlines the final considerations.

2 Theoretical framework

2.1 Contextualization of the technological management index and social capital

According to Gomes (2015), technology plays an important role in determining the economic and financial performance of any rural establishment, becoming a mechanism responsible for changes in the behavior of economic agents and the reallocation of resources.

The innovation system is related to the understanding of changes, countering the idea that technological changes would occur in a homogeneous manner and the location would not develop in a particular way (CAMPOS; SILVA; CAMPOS, 2016).

The use of modern technologies causes positive effects on production, productivity, and in all sectors of the economy. However, this cannot spread evenly among farmers nor with the same intensity so that it could be consolidated.

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Besides the technological donation that stimulates competitiveness, there are several factors that contribute for the production to enable satisfactory financial returns, among which: variety planted, climatic characteristics, cultural treatments, price of the product and of the production factors, production planning, market prices, market functioning, among others that are part of an adequate management enabling a good income for the enterprise.

Social capital can be elaborated from the indicators that express the interpersonal relationships among producers and their participation in associations of associative and cooperative nature and, consequently, channeling resources aimed at promoting their development and that of their families.

According to Morais and Muller (2012), social capital is a collective phenomenon based on the relationships of individuals. It results from relationships of reciprocity, trust, solidarity, and collaboration that can be used to favor the growth of both the individuals involved and society in general, favoring development.

The rural environment has the worst social indicators; however, it offers favorable conditions for development, and it is possible to create mechanisms to overcome its bottlenecks. One of the difficulties inherent to the accumulation of social capital in rural areas is the absence of a favorable educational environment adapted to local conditions.

According to Moreira et al. (2008), social capital can be considered an essential factor for the economic growth of cooperative associations, especially in the Northeast region, where physical capital is very socially concentrated and human capital is in a process of democratization, that is, people from disadvantaged social classes are having greater opportunity to study, and natural capital needs other forms of capital to be able to have a more efficient and ecologically sustainable productive exploitation.

The larger the social capital, the larger the circle of relationships in which those who participate in its construction live. It is something that must be well managed to enjoy its benefits, because it involves trust, cooperation, and innovation. Its transforming role requires that the agents that are part of it develop relations of cooperation, mutual trust, and association so that they can fight for causes that benefit everyone.

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3 Methodology

3.1 Study área

In the State of Ceará, the municipalities of Cariús, Cedro and Iguatu have very peculiar characteristics regarding production, commercialization and form of organization that are the sources of the basis of this study.

The municipality of Cariús is located in the Center-South of the State of Ceará, has a territorial area of 1,061 thousand km², a hot tropical semi-arid climate, rainfall of 865.6 mm, in which the rainiest months are from January to April and the average temperature is 26ºC to 28ºC. The population makes up a total of 18,567 inhabitants (IPECE, 2016).

The municipality of Cedro has a geographical position in the south of Ceará State and has a territorial area of 725.8 km², a warm tropical semi-arid mild climate, rainfall of 927.1 mm, the rainiest months are from February to April. The average temperature is 26°C to 28°C and the population totals 24,527 inhabitants (IPCE, 2016).

The municipality of Iguatu is located in the Center-South of the state of Ceará, has a land area of 1.2 thousand km², a warm tropical semi-arid mild climate, rainfall of 927.1 mm, the rainiest months are from January to April. The average temperature is 26°C to 28°C and the population makes up a total of 96,495 inhabitants (IPCE, 2016).

3. 2 Nature and source of data

Primary data obtained through questionnaires were used with producers in the municipalities of Cedro, Cariús and Iguatu, aiming to obtain a socioeconomic and technological characterization of these producers. The data survey was conducted between the months of February and March 2017.

For the application of factor analysis, variables of social capital and technological management were selected based on the works of Souza (2015) and Gomes (2015) that aimed to measure the levels of social capital and technology. To characterize the degree of technological management of the producers, the following variables were considered:

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service provision contract, labor training, commercialization partnership, cash flow control, production control, and cost control.

Regarding the degree of social capital formation of the producers, the following variables were considered: interaction among community members; costs associated with the association/cooperative/union; participation in meetings, whether it presents suggestions in meetings; whether decisions are approved in meetings; does it pay any fees/membership dues; whether investments made are submitted and approved in meetings; whether the leaders are accountable to the members; if the farmer held/does any position/activity for the functioning of the association; trust in other members of the association/cooperative/trade union; trust in the leaders of the association/cooperative/trade union; the association helps in the commercialization of the products for the market; and if the producers would help other people in case of need.

The data of secondary nature were extracted from the database made available by IBGE (Brazilian Institute of Geography and Statistics), UN (United Nations Organization), Institute of Economic Research of Ceará (IPECE), National Supply Company (CONAB) and the Food and Agriculture Organization of the United Nations (FAO).

3. 3 Population and sample

The study was conducted taking into account the process of non-probabilistic sampling by convenience with producers in the municipalities of Cariús, Cedro and Iguatu in the State of Ceará.

In non-probability sampling methods, the samples are obtained non-randomly, that is, the probability of each element of the population being part of the sample is not equal and, therefore, the selected samples are not equally likely (FÁVERO et al., 2009). The convenience method is applied when participation is voluntary and the sample elements are chosen for convenience and simplicity. Moreover, in this research 100 questionnaires were applied to producers in the respective municipalities that have homogeneous characteristics.

3. 4 Data Analysis

The factor analysis technique was used to calculate the Technology Management Indices (ITG) and the Social Capital Index (ICS) in order to obtain weights represented by the factorial scores that may be able to generate measures for the technologies adopted and the formation of social capital for each technological level and Social Capital Index (ICS) of each farmer. This technique was used as a tool for the preparation of several papers on the modernization of agriculture and productive agglomeration of irrigated fruit farming in the Cariri region, among which: Souza and Campos (2010); Sousa, Justo and Campos (2013); Gomes (2015) and Campos, Silva and Campos (2016).

The factor analysis method has been commonly used for the construction of indexes, given its statistical robustness. To measure these indices, the conventional method given by the weighted average of the contribution of each suggested indicator to the technology is performed. To verify the suitability of the data for factor analysis the Kaiser-Mayer-Olkin (KMO) index, Bartlett's test of sphericity (BTS) and the Anti-Image Matrix were used.

The procedure used in the research considers the extraction of the initial factors through principal component analysis (PCA) showing a linear combination of the observed variables, in order to maximize the total variance explained.

For the choice of the number of factors, the latent root criterion (Kaiser criterion) was used, in which the number of factors to be retained is chosen. Also, in order to minimize the difficulty of interpreting the factors, the varimax orthogonal rotation method was used, which will minimize the number of variables with high loadings in different factors, allowing the association of a variable to a single factor, maintaining orthogonality among them.

According to Fávero et al. (2009), the factor analysis method consists in trying to determine the quantitative relationships between variables, measuring their patterns of movement, in order to associate with them a similar pattern, the effect of a causal factor underlying and specific to these variables.

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The mathematical model of factor analysis can be represented by:

$$Z_{11} = a_{11}F_1 + a_{12}F_2 + \ldots + a_{1m}F_m + d_1u_1$$
$$Z_{21} = a_{21}F_1 + a_{22}F_2 + \ldots + a_{2m}F_m + d_2u_2$$
$$Z_n = a_{n1}F_1 + a_{n2}F_2 + \ldots + a_{nm}F_m + d_nu_n \quad (1)$$

In simplified form, we have:

$$z_j = \sum_{z_j} a_{ji}F_i + d_ju_j \; (j = 1, 2, \ldots, n); \; (i = 1, 2, \ldots, m) \quad (2)$$

Tal que:

Z_j = j-ésima variável padronizada;

a_{ji} = é o coeficiente de saturação referente ao i-ésimo fator comum da j-ésima variável;

F_i = é o i-ésimo fator comum;

d_j = é o coeficiente de saturação referente ao j-ésimo fator específico da j-ésima variável;

u_j = é o j-ésimo fator específico da j-ésima variável.

According to Simplício (1985), in factor analysis, each factor is constituted by a linear combination of the original variables entered in the model. The association between factors and variables occurs through factor loadings, which can be positive or negative, but never greater than one. The saturation coefficients have a similar function to the coefficients in the regression analysis.

Five groups of variables were chosen to characterize the calculated indexes based on the work of Cunha et al. (2008), Gomes (2015) and Campos, Silva and Campos (2016), who developed similar studies on classification and grouping of indexes through a better structuring of the variables.

3.4.1 Calculating the technology management index

The factor analysis allowed us to create a technological index of the farmers in these municipalities based on the factor scores/factors that contributed most to the producers' level of technology. The Technological Index of the producers was obtained as follows:

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$$ITFC_i = \sum_{j=1}^{p}\left[\frac{\lambda_j}{\sum \lambda_j}\right]F_{ij}^{*} \qquad (3)$$

Em que:

ITFCi = Índice Tecnológico do i-ésimo produtor;

j = é a j-ésima raiz característica (J= 5 raízes);

p = é o número de fatores extraídos na análise (F= 5 fatores);

F_{ij}^{*} = é o j-ésimo escore fatorial do i-ésimo produtor.

$\sum \lambda j$ = é o somatório das raízes características referentes aos *p* fatores extraídos

The relative participation of factor j in explaining the total variance captured by the p extracted factors is given by:

$$\frac{\lambda j}{\sum \lambda j} \cdot \qquad F_{ij}^{*} \qquad (4)$$

To make all the values of the factorial scores greater than or equal to zero, they are all placed in the first quadrant (LEMOS, 2001), before constructing the ITFCi, using the algebraic expression:

$$F_{ji}^{*} = \frac{F_{ji} - F_j^{min}}{F_j^{max} - F_j^{min}} \qquad (5)$$

Where: F_j^min is the lowest observed score for the j-th factor, and F_J^max is the highest observed score for the j-th factor.

3.4.1 3.4.1 Construction of the Social Capital Index (SCI)

The SCI of the communities was calculated from the estimated scores associated with the factors obtained in the factorial structure defined. We also used the latent root or the eigenvalue, which corresponds to the sum (in column) of squared factor loadings for the respective factor (HAIR JUNIOR et al., 2005). The standardization of the factorial scores is necessary in order to fit them in the zero to one interval, using the expression:

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(6)

So that:

F^*g_j = escore fatorial do g-ésimo fator padronizado da j-ésima produtor; (g={1,..,n} e j = {1,...,n})

Fg_j = escore fatorial do g-ésimo fator para da j-ésima produtor;

FgF = menor escore fatorial do g-ésimo fator entre as produtor;

$FgFA$ = maior escore fatorial do g-ésimo.

To construct the SCI for the j-th producer, the equation was defined:

$$ICSj = \sum_{g=1}^{p}\left[\frac{\lambda g}{\sum \lambda g}\right]F_{gj} * \quad (7)$$

Where γg corresponds to the eigenvalue of the g-th factor. It is observed that the expression indicates the relative participation of factor g in the explanation of the total variance captured by the n factors.

For the classification of the Social Capital Index (SCI) value, the following criteria were stipulated: the closer to 1, the higher the level of social capital accumulation in the communities·

4 Results and discussion

4.1 Analysis of the technological performance of producers

To use the PA, it was $F^*_{gJ} = \frac{F_{gj} - F_{gF}}{F_{gFA} - F_{gF}}$ initially checked for the presence of outliers and if the data present skewed distribution. In addition, the Kaiser-Mayer-Olkin (KMO) test was calculated, considering the normal distribution of data, and it was observed that the KMO presented a value of 0.811, therefore indicating that the data are consistent, i.e., it is considered a good and accepted index for the factor analysis technique.

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The Bartlett's test of sphericity presented a value of 708.837, which is considered a high value to ensure that the correlation matrix is not an identity matrix, at the 1% significance level, rejecting the null hypothesis (H0) that leads to the rejection of the hypothesis that the correlation matrix is an identity matrix.

It is concluded, therefore, that the sample data are suitable for the use of factor analysis. With the use of factor analysis, by the principal components method, five characteristic factors were obtained, with indexes greater than one, considering the latent root criterion, as shown in Table 1.

Characterizing a total of original variables in a smaller number of variables in order to explain the technology adopted by producers, we chose to work with two factors, considering that Factor 1 has root 4.045 and Factor 2 has root 1.078, i.e., the factors meet the methodology requirement of presenting latent roots greater than 1 and that, together, explain 85.39% of the total variance of the technology adoption data of the respective producers.

Table 1 - Characteristic root values and percentage of total variance explained by factor analysis, 2017

Factor	Root characteristic	Variance explained by factor (%)	Accumulated variance (%)
1	4,045	67,423	67,423
2	1,078	17,970	85,394
3	0,623	10,378	95,772
4	0,159	2,651	98,423
5	0,75	1,255	99,678
6	0,19	0,322	100,00

Fonte: Resultados da Pesquisa (2017).

According to Table 2, the factor loadings or correlation coefficients after the rotation of the technology adoption factors and their respective communalities were observed, where the value is obtained by the sum of the square of the factor loadings of each variable. It is assumed that values above 0.5 (in bold) indicate a strong association between the variable and the factor.

Table 2 - Rotated factorial loadings of the technology variables obtained in the factor analysis, 2017

Variables	F1	F2	Communalities
X1- service contract	**0,922**	0,194	0,887
X2- labor training	-0,320	**0,923**	0,853
X3- partnership in commercialization	0,473	**0,591**	0,573
X4- cash flow control	**0,954**	0,110	0,923
X5- production control	**0,971**	0,107	0,954
X6- cost control	**0,961**	0,099	0,934

Fonte**:** Resultados da Pesquisa (2017).

The first factor (F1) is related to the management techniques of the agricultural enterprise composed of X1 (service provision), X4 (cash flow control), X5 (production control) and X6 (cost control) being, therefore, F1 represented by the intensive use of technology aimed at the productivity of the activity.

In relation to the factor loadings (F2), it was found that this has a correlation with the variables X2 (labor training) and X3 (partnership in commercialization) indicating the intensive use of productive agricultural techniques or practices.

Through factor analysis, after obtaining the factorial scores extracted by the varimax rotation method, we proceeded to construct the Technological Index for the producers surveyed in the period of 2017. Next, the index was standardized so that it varied between zero and one. The closer to one, the better the management levels developed by the farmers.

As shown in Table 3, five classes were obtained for the classification of technological index (TGI). Five producers with very low TDI were identified, corresponding to 5% of the sample. It is observed a greater participation of producers with low IGT, i.e. 63% of producers.

Table 3 - Management index and number of producers, according to the groups of the technology adoption index in Cariús, Iguatu and Cedro, 2017

Grups	IG	Number of producers	Relative frequency
1- Very Low	0,00 - 0,20	5	5
2- Low	0,21- 0,35	63	63
3- Medium	0,37- 0,54	2	2

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4- High	0,62 - 0,78	28	28
5- Very high	0,79 - 1,00	2	2
Valid Information	-	100	100,00

Fonte: Resultados da Pesquisa (2017).

The variables that had the most impact on determining the producers' level of technological management were service provision, cash flow control, production control, and cost control. Therefore, it is identified that most of the producers present a low level of administrative and financial management.

4.2 Analysis of the producers' social capital

Again, to analyze the consistency of the collected data, the Kaiser-Mayer-Olkin (KMO) test was calculated, considering a normal distribution of data, and a KMO of 0.875 was observed, and the Bartlett's test of sphericity showed a value of 870.269; this is considered a high value to ensure that the correlation matrix is not an identity matrix. Therefore, there is correlation among the variables, concluding that the sample data are suitable for the use of factor analysis (FA).

In the PA, by the principal components method, three characteristic factors were obtained with indexes greater than one, considering the criterion of the latent root, as specified in Table 4.

Table 4 - Characteristic root values and percentage of total variance explained by factor analysis, 2017

Factor	Root characteristic	Variance explained by factor (%)	Accumulated variance (%)
1	6,950	53,462	53,462
2	1,722	13,245	66,707
3	1,055	8,133	74,820
4	0,844	6,492	81,312
5	0,686	5,279	86,590
6	0,457	3,513	90,103
7	0,369	2,839	92,942
8	0,211	1,623	94,565
9	0,194	1,491	96,056
10	0,162	1,248	97,303
11	0,140	1,079	98,381

12	0,129	0,989	99,370
13	0,082	0,630	100,00

Fonte: Resultados da Pesquisa (2017).

According to Table 5, it was observed the factorial loadings, after the rotation of the factors of social capital adoption and their respective communalities obtained by the sum of the square of the factorial loadings of each variable. It is inferred that values above 0.5 (in bold) indicate a strong association between the variable and the factor.

Table 5 - Rotated factorial loadings of the social capital variables in factor analysis, 2017

Variables	F1	F2	F3	Community
X1- Participation in meetings	0,793	0,256	0,418	0,869
X2- Suggestions at the meetings	0,547	0,003	0,624	0,688
X3- Decisions approved	0,222	0,404	0,690	0,691
X4- Paid fees/membership dues	0,714	0,277	0,451	0,790
X5- Investments approved	0,139	0,282	0,866	0,849
X6- Accountability	0,255	0,401	0,770	0,818
X7- Position in the association	0,555	-,126	0,278	0,401
X8- Trust in association members	0,146	0,890	0,233	0,868
X9- Participation in elections	0,802	0,304	0,271	0,810
X10- Trust in Association Officers	0,162	0,897	0,223	0,881
X11- Help from the association	0,611	0,140	-,141	0,413
X12-Help from others	0223	0,861	0,248	0,853
X13- Is associated	0,771	0,329	0,291	0,796

Fonte: Resultados da Pesquisa (2017).

The first factor (F1) is related to the accumulation of social capital composed of X1 (Participation in meetings), X4 (Payment of fees/fees/membership fees), X7 (Performs a function for association), X9 (Participation in elections), X11 (Help from association) and X13 (Is associated) being, therefore, F1 represented by the intensive use of social capital generated by associativism.

Regarding the factor loadings (F2), it was found that it has a correlation with variables X8 (Trust in association members), X10 (Trust in association leaders) and X12 (Helping other people), indicating the intensive use of social capital disseminated based on the trustworthiness of participating members.

Analyzing the factor (F3), it was noticed that it is strongly linked to the variables X2 (Suggestions in meetings), X3 (Approved decisions), X5 (Investments approved in meetings) and X6 (Accountability) representing the intensive use of social capital generated by approved decision making and put into practice for the benefit of the collectivity.

Also by means of factor analysis, the factorial scores extracted by the varimax rotation method were obtained, the Social Capital Index was built, and the index was standardized so that it could vary between zero and one. The closer to one, the better the producers' social capital levels are.

According to Table 6, as well as for the technological management index classification, the same parameter was adopted for the Social Capital Index (SCI) classification, obtaining five classes.

This choice of five groups was based on the work of Cunha et al. (2008), who developed similar studies on the classification and grouping of indexes. Greater participation of the sample for producers with medium and high SCI, that is, 49 and 35 producers with these profiles were identified, respectively.

Table 6 - Índice de capital social e número de produtores, de acordo com os grupos de fruticultores da Região do Cariri, Ceará, 2017

Groups	**ICS**	Number of producers	Relative frequency (%)
1- Very Low	0 - 0,20	7	7
2- Low	0,21 - 0,35	9	9
3- Medium	0,37 - 0,54	49	49
4-High	0,62 - 0,78	35	35
5-Very High	0,79 - 1,00	0	0
Valid Information	**-**	**100**	**100,00**

Fonte: Resultados da Pesquisa (2017).

The variables that most impacted in determining the level of accumulation of social capital of the aforementioned index were: participation in meetings, payment of fee/membership dues, performance of a function for association, participation in elections, whether it receives help from the association and whether it is associated. Therefore, the

accumulation of social capital of the producers in the municipalities of Cariús, Iguatu, and Cedro occurs through processes of interaction and cooperation among the participating agents that dynamize and contribute to the socioeconomic development of the activity.

5 Final considerations

The study concludes that the indexes found through the joint sample of producers from the municipalities of Cedro, Iguatu and Cariús, were important to determine the level of technological management used in production and accumulation of social capital for the sustainable development of the communities where they are inserted.

It is observed that in the sample researched, producers were found with a technological management index above 0.79 up to 1.00, considered very high, however, for producers with a level of social capital no farmers with very high levels were found.

Although the results show high values for the social capital index, it was still not enough to improve the quality of life of producers, because it is necessary to overcome other inhibitors that were not computed for the formation of this index, such as: rural credit, improved infrastructure, among others. This analysis remains as a suggestion for further work.

In this perspective, the results provided relevant implications to direct the formation of public policies that serve the producers and enable those who are not yet participants to insert themselves, as is the case of the participants located in the municipalities of Cedro, Iguatu, and Cariús, who already participate in the process.

Therefore, the formation of associations and cooperatives is fundamental so that the producers can articulate themselves in the search for common objectives, promoting development with emphasis on their own resources.

As a suggestion for future work, we believe it is relevant to verify the impact of programs such as the National Family Agriculture Program (PRONAF) and the National School Meals Program (PNAE), using for example the Propensity Score Matching, which is a matching method that statically builds a control group based on observable

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characteristics. Also, to identify or include indicators and their relative weight in the composition of the social capital formation and technological management index.

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