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The contribution of short food supply chains in the formation of agricultural income from different production systems in Brazil

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Abstract
Modern agri-food systems are complex and involve understanding nutritional, productive, institutional, and socioeconomic factors. This study aimed to measure the participation of short food supply chains in the formation of income generated from different production systems on the northern border of Rio Grande do Sul, Brazil. We used production systems as a methodological reference to analyze the internal and external relations at the production unit level, and based on the developed activities, we economically estimated the respective sales channels. Thirty-one farmers were interviewed between October and November 2019. The farmers considered in the sample developed more than one productive activity and accessed more than one marketing channel. According to the production carried out, we identified three production systems: vegetables, agro-industrial, and mixed. Each system has different specificities and contribution percentages to the total agriculture income. In the market, farmers mobilize conventional and alternative markets. The first was mainly used to commercialize of products such as commodities. Alternative channels were used to sell alternatively and/or traditionally produced food. Alternative systems and/or short channels allowed the elimination and appropriation of a higher percentage of generated wealth, contributing to the viability of smallholder farmers. A striking feature of the production systems analyzed was the diversification in production and sales. Although the product plays the greatest role in the income generated, other activities are important and contribute to the production unit's productivity and economic stability.
Keywords: Agriculture. Economic evaluation. Systemic analysis. Short food supply chains. Family farming. Productive diversification.

A contribuição das cadeias curtas de abastecimento alimentar na formação da renda agrícola de diferentes sistemas de produção no Brasil

Resumo

Os modernos sistemas agroalimentares são complexos e envolvem a compreensão de fatores nutricionais, produtivos, institucionais e socioeconômicos. Este estudo teve como objetivo medir a participação de cadeias curtas de abastecimento alimentar na formação de renda gerada a partir de diferentes sistemas de produção na fronteira norte do Rio Grande do Sul. Utilizamos sistemas de produção como referência metodológica para analisar as relações internas e externas no nível da unidade de produção, e com base nas atividades desenvolvidas, estimamos economicamente os respectivos canais de comercialização. Trinta e um agricultores foram entrevistados entre outubro e novembro de 2019. Os agricultores considerados na amostra desenvolveram mais de uma atividade produtiva e acessaram mais de um canal de marketing. De acordo com a produção realizada, foram identificados três sistemas de produção: vegetal, agroindustrial e misto. Cada sistema possui especificidades e percentuais de contribuição diferentes para a renda total da agricultura. Nos mercados, os agricultores mobilizam tanto canais convencionais como alternativos. O primeiro foi usado principalmente para comercializar produtos como *commodities*. Canais alternativos foram utilizados para vender alimentos alternativos e/ou produções tradicionais. Sistemas alternativos e/ou canais curtos permitiram a eliminação e apropriação de maior percentual de riqueza gerada, contribuindo para a viabilidade dos agricultores familiares. Uma característica marcante dos sistemas de produção analisados foi a diversificação na produção e comercialização. Embora a produção tenha o maior papel na renda gerada, outras atividades são importantes e contribuem para a produtividade e estabilidade econômica da unidade de produção.

Palavras-chave: Agricultura. Avaliação econômica. Análise sistêmica. Cadeias curtas de abastecimento alimentar. Agricultura familiar. Diversificação produtiva.

La contribución de las cadenas cortas de suministro de alimentos en la formación de ingresos agrícolas de diferentes sistemas de producción en Brasil

Resumen

Los sistemas agroalimentarios modernos son complejos e implican la comprensión de factores nutricionales, productivos, institucionales y socioeconómicos. Este estudio tuvo como objetivo medir la participación de las cadenas cortas de suministro de alimentos en la formación de ingresos generados por diferentes sistemas de producción en la frontera norte de Rio Grande do Sul, Brasil. Utilizamos sistemas de producción como referencia metodológica para analizar las relaciones internas y externas a nivel de unidad de producción, y en base a las actividades desarrolladas, estimamos económicamente los respectivos canales de venta. Treinta y un agricultores fueron entrevistados entre octubre y noviembre de 2019. Los agricultores considerados en la muestra desarrollaron más de una actividad productiva y accedieron a más de un canal de comercialización. De acuerdo con la producción realizada, identificamos tres sistemas de producción: hortalizas, agroindustriales y mixtos. Cada sistema tiene diferentes especificidades y porcentajes de contribución al ingreso agrícola total. En el mercado, los agricultores movilizan los mercados convencionales y alternativos. El primero se utilizaba principalmente para comercializar productos como los productos básicos. Se utilizaron canales alternativos para vender alimentos producidos alternativamente y/o tradicionalmente. Sistemas alternativos y/o canales cortos permitieron la eliminación y apropiación de un mayor porcentaje de la riqueza generada, contribuyendo a la viabilidad de los pequeños agricultores. Una característica llamativa de los sistemas de producción analizados fue la diversificación en la producción y las ventas. Aunque el producto juega el mayor papel en los ingresos generados, otras actividades son importantes y contribuyen a la productividad y estabilidad económica de la unidad de producción.

Palabras clave: Agricultura. Evaluación económica. Análisis sistémico. Cadenas cortas de suministro de alimentos. Agricultura familiar. Diversificación productiva.

1 Introduction

The growing number of technologies, new chemicals, and industries that centralize food processing have allowed an increase in production capacity and less work pain for farmers while distancing them from consumers (HUTTUNEN, 2019; LAMINE et al., 2019). This configuration-imposed challenges to environmental, sociocultural, and agricultural economic sustainability (SCARABELOT; SCHNEIDER, 2012; RUCABADO-PALOMAR; CUÉLLAR-PADILLA, 2018; CHIFFOLEAU et al., 2019)

The development of alternative production and sales networks is seen as a new food policy and aims to fill the gaps left by the regulation of conventional markets, based on growing concern regarding the origin and process of food management (MARSDEN et al., 2000; ZANELLO et al., 2019). These alternative networks initiate and allow the direct sale of food and arise from alternative geography based on local agri-food production, and are frequently reported in areas that have not fully developed industrialization processes (ILBERY; MAYE, 2005; DAROLT et al., 2016; RENTING et al., 2017).

In this perspective, the short food supply chain (SFSCs) is considered "an innovative chain" that stands out for reducing the geographical distance between farmers and consumers and for the number of intermediaries along the chain (RENTING et al., 2003; KOUTSOU; SERGAKI, 2019). In alternative markets, farmers sell their products directly at fairs, production units, and even in consumer homes (PLAKIAS et al., 2019). Farmers can also sell in restaurants, schools (national school of food programs), and hospitals (food acquisition program) (RENTING et al., 2003; DAROLT et al., 2016; PLAKIAS et al., 2019).

Alternative agri-food markets have become differentiated since they tend to be socially constructed and pay attention to food quality (RENTING et al., 2017). Farmers' markets and fairs also fit this line, as they contribute to increasing the sustainability of economies and act to strengthen and value traditional agriculture (ILBERY; MAYE, 2005; SIMS, 2009; DAROLT et al., 2016; RENTING et al., 2017).

Alternative markets perform specific functions depending on the context in which they are located. They may: serve as a reference for the prices of certain agricultural products; allow the added value to be maintained in the property; estimate the importance and quality of locally produced food; promote the knowledge of seasonal foods in each region; and instigate popular rural culture (DAROLT et al., 2016; ARAMENDI et al., 2018). The development of food markets presents a "renaissance" of traditional and direct ways of selling agri-food products (MURDOCH et al., 2000; MALAK-RAWLIKOWSKA et al., 2019).

However, when it comes to operationalization, at the agricultural production unit level, the challenges are significant, given the need to balance economic issues arising from rural and multifunctional activities with objectives that reach the environment, social environment, and food production (MURDOCH et al., 2000; MORRIS et al., 2017). Furthermore, in the external environment, aspects such as culture and insertion in the markets bring challenges, given the systems' complexity (MAZOYER; ROUDART, 2010; DUFUMIER, 2010).

Based on this scenario, this study was permeated by the dynamics of agri-food markets, configured by the organization and operation of production and sales systems developed in the Upper Uruguay region, more specifically on the northern border of Rio Grande do Sul, Brazil. From this perspective, we aimed to measure the participation of short commercialization channels in the income generated in different production systems in the northern region of Rio Grande do Sul, Brazil.

This approach tries to fill the existing gap of studies aimed at short commercialization chains in the economic sphere. In the same bias, it investigates the dynamics of farmers' markets inserted in short marketing chains, converging on issues discussed worldwide, besides being an important food security aspect for rural and urban populations.

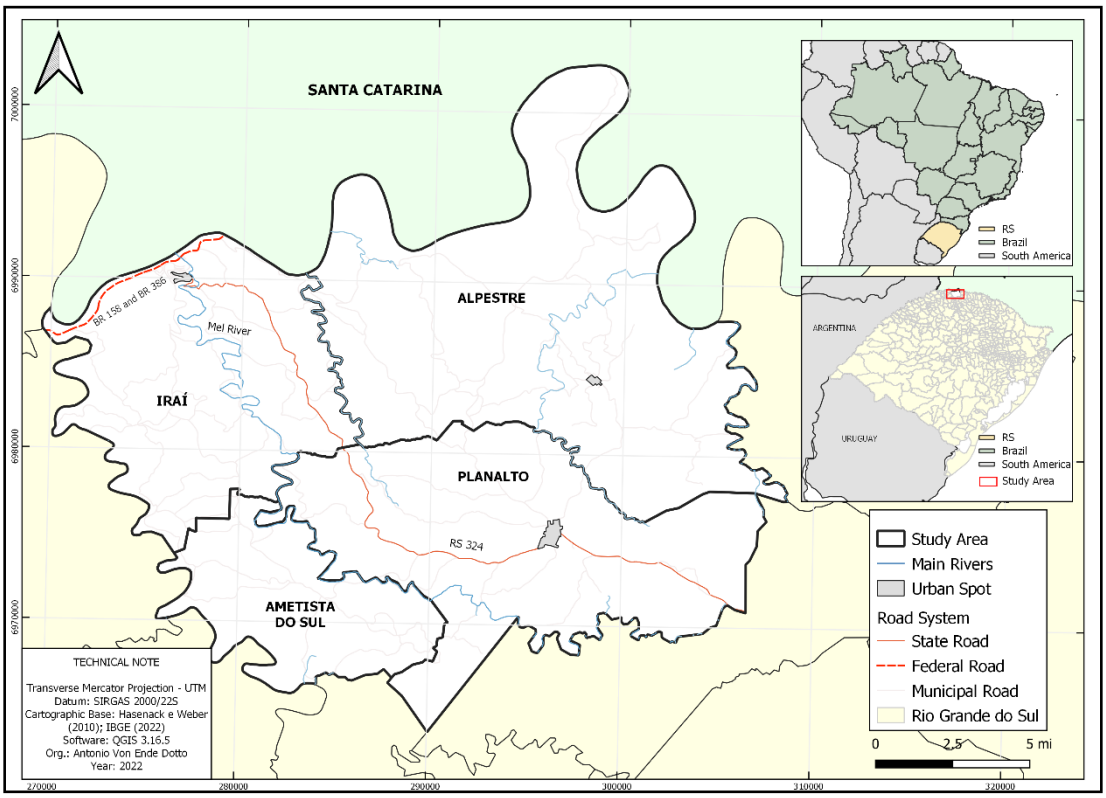
2 Research method and procedures

2.1 Geographical delimitation of the study and sample

In Brazil, the State of Rio Grande do Sul is an important commodity producer, especially soybean (*Glycine max*) (3rd largest producer) and milk (3rd largest producer) (BRAZIL, 2021). These productions occur to a large extent on specialized properties that have a commercial focus on exports. However, there are some limiting and/or driving factors developing productions: climate, relief, concentration levels of rural and urban populations, and local culture, among others. Due to its territorial extension, Brazil has numerous productive configurations that concern combining these factors. Thus, in addition to recognized productions (commodities) for their economic importance and expressive presence in most Brazilian states, Brazil also has a wide diversity of productions developed on a local scale, which maintain small-scale producers in rural areas.

One of these examples is located on the northern border of the state of Rio Grande do Sul, Brazil, in the municipalities of Alpestre (67.74% of the total sample), Ametista do Sul (16.13%), Planalto (12.90%), and Iraí (3.23%) (Figure 1). We chose these municipalities due to the high presence of small-scale farmers, which corroborates that 96.71% of agricultural establishments have less than 50 hectares (BRAZIL, 2017) and employ diversified production systems (TONIN et al., 2018).

Figure 1- Geographical location of the municipalities covered by the research in the State of Rio Grande do Sul, Brazil



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Tobacco, milk, grapes, and oranges (BRAZIL, 2017) are the main production systems developed in the region. These configurations are implications of soil and relief conditions. The territory has strongly undulating relief and soils that cannot be mechanized, which hinders the development of conventional cultivation systems, such as soybean (TONIN et al., 2018). As a result, it is estimated that 30 to 50% of the production units area has severe restrictions on agricultural use, reducing the Useful Agricultural Area to almost 50 to 70% of the total area (TONIN et al., 2018).

Given the above, we selected small-scale farmers who sold at least one product through alternative markets (short marketing chains) for the study (RENTING et al., 2003). This selection started from previous interviews with key informants, such as the Mixed Cooperative of Family Agro-industrial Production of Alpestre-Extremo Norte[1] and the Rural Family School of Alpestre[2] (CAMARA et al., 2021). Both organizations have been working for more than 15 years in the region and have a direct relationship with small-scale producers.

We identified 31 farmers who produced food and marketed them through alternative markets. Despite the low number of producers in the sample in the four municipalities, all producers who maintained some commercial interaction through alternative markets were covered. It is worth mentioning that these municipalities have small urban centers with no more than 10,000 inhabitants (BRAZIL, 2020) and are approximately 23 miles from the state capital (Porto Alegre).

[1] Cooperativa Mista de Produção Agroindustrial Familiar de Alpestre-Extremo Norte.
[2] Escola familiar rural de Alpestre.

We collected data on the producers' properties using a semi-structured research script between September and October 2019. The following section presents this roadmap's systematization.

2.1.1 Systematization of the data collection instrument

The analysis method is based on the Agrarian Systems Approach (INCRA/FAO, 1999; MAZOYER; ROUDART, 2010), and specifically, in this research, the analysis followed the micro-level method (identification and analysis of production systems). The production systems' details are defined as the combination of reproduction and cultivation systems in the production units (INCRA/FAO, 1999). They aim to understand the relationships between ecological parts and facts and technical and social factors that contribute to developing the regions' reality and/or production systems (LIMA et al., 2005; DUFUMIER, 2010; MAZOYER; ROUDART, 2010). This method was disseminated in Brazil as a strategy to perform diagnoses and develop development projects in less dynamic rural spaces (LIMA et al., 2005; LIMA et al., 2017). It is, above all, a holistic method that allows us to understand the impact of the different productive relationships and resources available. Thus, we used this method due to the possibility of jointly analyzing the resources made available by producers within their production units, the agricultural production generated, and the market relations they establish.

When considering the objective of investigating the participation of short commercialization channels in the income generated in different production systems, first, we holistically investigated productions, marketing channels, and consequent income generation for all 31 producers. The following table contains the indicators used in data collection.

Chart 1- Evaluation indicators used to analyze the production units

Indicator	Indicador Description
Liquid Aggregated Value (LAV in U$$)	Refers to the balance obtained from Aggregated Value deducting the depreciation
In natura agriculture income or agroindustrialized (AI in US$)	It's the economic result that evaluates the gain obtained by the APU, either by selling in natura and or agro industrialized products.
Leases and Retirements income (LRI in U$$)	Income share from leases and retirement regarding in natura and or agro industrialized products
Total Income (TI em U$$)	Liquid result available at the production unit after deducting all production costs added to lease income and external transfer.
Agriculture income from other activities (IOA em U$$)	Evaluates the income participation of other agriculture activity not related to in natura and/or agro industrialized products.
Income from short food channels (ISFC in U$$)	Evaluates the income share of short channels regarding in natura and agro industrialized products
IA land productivity (U$$/S)	Income of in natura and agro industrialized products divided by the number of hectares used in production
IA work productivity (U$$/Worker)	Income from in natura and agro industrialized products divided per labor units
ISFC land productivity (U$$/S)	Income from Short Sales Channels divided by the number of hectares used in production
ISFC work (PW) productivity (U$$/Worker)	Income from Short Sales channels divided by labor units
System intensification level	Technologies used in the production as a labor function, the higher this indicator is, the more technician the production is.

Source: Prepared from INCRA / FAO (1999); Lima et al. (2005); Dufumier (2010) and Mazoyer and Roudart (2010).
Legend: **IC**- intermediate consumption; **Workers-** labor force used; **S**- useful area for production; **D**-depreciation; **AV**- Aggregated Value; **LAV**-Liquid Aggregated Value; **AI**-In natura agriculture income or agroindustrialized; **IOA**- Income from other activities; **ISFC**- Income from short food channels; **AIA**-Agricultural income from fresh agricultural products and agro industrialized products; **PW**-Productivity; **APU**- Agricultural production unit; **LRI**- Net Profitability.

2.2 *Systematization and data analysis*

We conducted data analysis considering two levels. From the first level of analysis, the production systems were stratified into three groups. In order to obtain this classification, we used the gross product result of the individualized production units.

When a production unit received a gross product equal to or greater than 70% of plant production, it was classified as a plant production system. We used the same criterion for predominantly agro-industrialized production units (agro-industrial production system). The production units that presented equivalent agro-industrial and vegetable production in the gross product without predominance of one or the other (approximately 50% of each type of production) were classified as a Mixed Productive System.

There were different forms of management, cultural treatment, and predominant cultures in each production system (LIMA et al., 2005). As a result, the mixed and plant systems were subdivided into conventional and alternative.

The conventional plant and mixed production subsystems are those where the production was carried out with higher intermediate consumption, which came from the external environment (seeds, pesticides, equipment) and had the characteristics of homogenization and gains in scale (commodities). "Alternative" subsystems were associated with productions that developed characteristics of a circular economy, an ecological basis, optimizing resources available in production units, and were based on the assumption of a greater diversity of cultures. Regarding the agro-industrial system, the subdivision was carried out from the transformation source: animal or vegetable. The animal agro-industrial system represents the production units that use raw materials of animal origin, and, in turn, the agro-industrial system uses raw materials of plant origin. Based on this, the productive systems and their characteristics are as follows.

Chart 2- Main characteristics of productive systems

Systems		Main Productions
Plant production system	Conventional	Tobacco, orange, grape, watermelon, and cantaloupe
	Alternative	Tobacco, orange, milk, general fruits and vegetables
Agro industrial productive system	Animal	Tobacco, cheese, salami, meat, milk, and jellies
	Vegetable	Orange, sugar cane derivatives, and jellies
Mixed production system	Conventional	Tobacco, orange, general fruits and vegetables, and sugar cane derivatives
	Alternative	Alternative Tobacco, grape, cheese, jellies, honey, and general fruits and vegetables.

Source: Prepared by the authors, 2023.

As for the calculations, specifically of income by the system, we performed a gross decomposition of the product. The respective percentage of each activity was assigned considering the estimated usage and the respective time allocated in each production type.

These production systems were stratified at the second level according to the sales channel used to perform the production flow. We stratified product sales for each production system and/or subsystem using long (conventional) and/or short channels. At this level, more specific indicators were used, as they intended to measure the contribution of each sales channel to the formation of total agricultural income. With this level, we could economically organize the production units according to the type of channel used, their participation in the flow, compared to the chain profile, and consequently, the type of yield at the production unit.

3 Economic participation of short food channels in the composition of the total income of production systems

Three indicators are crucial to assess the economic efficiency of production systems and, in this case, sales channels, such as short channels. $\frac{D}{Worker}\frac{AI}{Worker}\frac{AI}{S}$

Table 1- Efficiency indicators of different production systems and sales channels

Indicator	Plant productive system		Agro industrial productive system		Mixed Productive System	
	Conventional	Alternative	Animal	Vegetal	Conventional	Alternative
S (unit)	18.2	12.1	16.08	9.75	28.5	12.3
Worker (unit)	3.03	3.02	2.72	2.7	3.29	3.08
AV/S (U$$)	916.33	1,674.94	1,751.54	1,053.38	1,039.54	2,049.41
S/Worker (unit)	6.10	4.43	6.84	3.67	8.36	3.95
AI/Worker (U$$)	3,256.87	5,553.11	7,813.35	2,524.50	6,301.24	4,890.50
AI/S (U$$)	480.65	1,282.14	1,355.36	740.10	828.27	1,585.89
AV/S (U$$)	1,349.25	2,038.13	2,864.24	1,779.80	1,340.45	2,690.06
IC/S (U$$)	292.31	242.98	1,008.86	432.80	216.91	478.96
D/Worker (U$$)	645.08	479.46	657.93	1,108.02	716.38	612.65
LAV/S (U$$)	5,746.31	7,004.26	10,274.80	3,681.24	8,105.77	6,612.97
ISFC/S (U$$)	1,663.20	3,268.26	42,430.27	23,734.96	17,318.94	21,785.33
ISFC/Worker(U$$)	1,246.22	4,661.02	5,920.18	2,215.29	3,108.48	3,644.16
IOA/S (U$$)	1,581.03	497.16	3,514.34	103.07	6,115.79	837.68
IOA/Worker (U$$)	2,010.65	892.09	1,893.17	309.21	3,192.76	1,246.34
ISFC/AIA (%)	39.46%	81.08%	86.29%	86.97%	47.91%	74.92%

Source: Prepared by the authors, 2022.

Legend: **S**- useful area for production; **IC**- intermediate consumption; **Workers**- labor force used; **D**- depreciation; **AV**- Aggregated Value; **LAV**-Liquid Aggregated Value; **AI**-In natura agriculture income or agroindustrialized; **IOA**- Income from other activities; **ISFC**- Income from short food channels; **AIA**- Agricultural income from fresh agricultural products and agro industrialized products.

In terms of income per unit of available labor in the productive systems (AI/Worker), the best income systems are the animal agro-industrial, conventional mixed, and alternative vegetable. As for the income per area used for production, the system that stood out the most was the alternative mix, animal agro-industrial, and alternative vegetables (Table 1). Regarding intermediate consumption, the raw materials, and products used for production, the animal agro-industrial system was the one that most converted products for processing. This variable means that intermediate consumption represented 74.43% of the agricultural income generated per hectare, a relatively high cost.

The alternative mixed system was also among the most dependent on raw materials, and the percentage spent on production, depending on the net value generated, is 30.20% and can be considered low cost per hectare. On the other hand, we obtained higher production costs in the conventional plant system (Table 1).

The income stratification as a result of the sales channel used (long or short) for the production flow allows us to infer that the income obtained from the sale in short channels paid better in the usable area (land) than in any productive system (Table 1). On the other hand, the income for available labor in the conventional plant system is higher (U$764.43) than in short channels only. This indicator was also high in the conventional mixed system (U$$ 84.28).

The lowest percentages of SFSCs participation in total income were represented by the sale of fresh products and are reported in the conventional and conventional mixed plant system, a factor associated with the characteristic of the system, which is composed mainly of unprocessed products and production is mostly intended for conventional markets (Table 2). These systems have greater

participation in external transfers (such as leases, rents, and pensions) in income composition, and more than 30% of income comes from product sales through long (conventional) channels.

Table 2- Percentage contribution of the different sales channels by production system in the total income composition

System		Income % *in natura*	Income % Agro industrial	% ISFC	% IOA	% AIA	% Total
Plant production system	Conventional	9.88	15.68	25.56	35.13	39.32	100.00
	Alternative	40.35	21.26	61.60	15.95	22.44	100.00
Agro industrial productive system	Animal	8.83	59.90	68.73	16.66	14.61	100.00
	Vegetal	5.88	43.64	49.52	6.69	43.79	100.00
Mixed production system	Conventional	14.00	17.09	31.09	33.00	36.35	100.00
	Alternative	19.06	33.16	52.22	16.07	31.71	100.00

Source: prepared by the authors, 2022.
Legend: **IOA**- Income from other activities; **ISFC**- Income from short food channels; **AIA**- Agricultural income from fresh agricultural products and agro industrialized products.

The animal agro-industrial system has the highest percentage of income obtained from the sale of products through short channels (Table 2) and tends to be related to production with higher added value, such as salami and cheese, sold in the local market. However, in the conventional and conventional mixed system of vegetables, participation is equivalent, both for short and long channels, as for income from pensions, leases, and/or rents.

Conventional and alternative plant systems have income from agro-industrial products, in which cachaça, vinegar, grape juice, and wine stand out. These products are not necessarily produced to serve the market specifically but result from the transformation of seasonal productions that are drained by long channels, such as grapes, and typical productions of the region, such as sugarcane. However, even based on the assumption of seasonality productions, the fact of transforming the raw material (grape, sugarcane) into other varied products that can be sold later without loss of value, among other aspects, provides added value to productions, generates greater diversity of products, and increases the income percentage.

Based on Table 2, it can be observed in general terms that the agro-industrialization of animal and plant products from family farming is suitable for marketing through short value-added chains (WES; TRENTIN, 2007; RAUPP; GAZOLLA, 2017; GAZOLLA, 2017). In the production units of the survey, the configurations are not homogeneous, and therefore, there is a presence of systems that combine plant-based and agro-industrial productions in the same production unit. Roughly speaking, the developed systems are linked to existing soil and climate conditions and the level of intensification, which, when imposing restrictions, require farmers to have a greater availability of labor. In this case, the predominant crops are tobacco, oranges, and grapes, in which the technical itineraries (planting, treatments, and harvesting) are carried out manually. The production systems that are more focused on alternative productions are found in smaller production units and achieve the highest net incomes per agricultural land area occupied.

For these farmers, alternative productions marketed through short value chains are a way to optimize the land area. Although the incomes obtained from alternative productions are higher, the production of crops carried out with conventional cultural practices is not completely disregarded, to a greater or lesser extent. This combination is a strategy for farmers to obtain different types of income, including annual incomes resulting from the commercialization of products such as grapes, tobacco, and oranges (LIMA et al., 2017; TONIN et al., 2018), which are marketed through long chains. These productions are developed primarily due to the relief and climate conditions that allow the cultivation of fruits. They are also low-intensive productions in terms of technology, mostly carried out with family labor and animal traction and/or agricultural carts. These crops serve as a "guarantee of income" as they are sold in established markets and are directly marketed from the production unit through intermediaries, cooperatives, and/or private companies.

The commercialization in alternative markets provides weekly and/or biweekly income generation. This commercialization takes place in all productive systems, with some systems being more intensive (alternative and agroindustrial) in this activity than others (conventional systems). In these dynamics, the main marketing outlets for alternative production are short chains, with emphasis on marketing, primarily at farmers' markets (48.39%), on-farm sales (48.39%), and home deliveries (35.48%). From this perspective, short food supply chains in alternative and agroindustrial systems represent over 49% of the total income generated in production units annually. The total income available in all production units is still composed of rents, leases, pensions, and services performed outside the production unit.

4 Discussion

The production units considered in the research tend to diversify. Even if a product is a leading role, other activities (to a lesser extent) contribute to income composition. Contributing to this configuration, the edaphoclimatic characteristics of the region (TONIN et al., 2018), land characteristics of the production units considered in the research (less than 30 average hectares of APU's), and the use of intensive family labor (between three and four people working in the APU's) were present. The developments around the production and marketing systems, in which the short channels stood out, were influenced by alternative geography that, in some way, makes it difficult to measure economies of scales (conventional systems) - commodities (MURDOCH et al., 2000), mainly in plant activities, as they require greater availability of land and high investments in mechanization.

Although this research was intended to analyze the participation of short sales channels in the income configuration of the production units, when the income obtained by different production systems was stratified, it was clear that conventional activities and, consequently, long channels were also accessed, only the participation percentage differs. In the long channels, the work income was higher when compared to other sales channels (Table 1). Sims (2009) mentioned that in conventional systems, the concern was focused on the fall in agricultural income since, on average, only 8.00% of the final retail price was appropriated by farmers. However, it also denoted another side of the current conventional production

systems. In other words, the need for investments in raw materials, machinery, and equipment (LIMA et al., 2005; WILKINSON, 2008). Therefore, in the study, it has implied a lower net aggregate value per cultivated hectare than other systems (Table 1).

The highest percentages of IFSC (more than 50%) were reported in the animal, alternative, and mixed agro-industrial systems. The IOA participation and other activities also focus on conventional markets but with a small economic impact on income configuration. This situation of channel combination is also observed in conventional production systems, as is the case of the conventional plant and mixed system, in which products arranged by short food channels occupy a secondary position or even sales of productive surplus. This configuration tends to be due to a strategy of sales channels diversification (RENTING et al., 2003; MORENO; OGLESBY, 2018) that allows a better allocation of products and minimizes the possible market risk, thus ensuring relative productive and economic stability in the production unit (CHIFFOLEAU et al., 2019).

The processing activities (plant and animal) were largely directed to alternative markets. It may also be linked to the fact that in these activities, for insertion in longer channels, there was a need for certification seals, mainly to sell outside the municipality (MURDOCH et al., 2000; RENTING et al., 2003), which is not a common aspect among farmers in the studied region. On the other hand, local marketing implied a reduction of the intermediaries between the farmer and the final consumer, enabling the appropriation of most of the added value generated by the farmer, which increased the profit margins and allowed a better income for the production factors (ILBERY; MAYE, 2005; MASTRONARDI et al., 2019; MALAK-RAWLIKOWSKA et al., 2019).

The economy of short food chains (DAROLT et al., 2016) tends to be associated with the absence of intermediaries, showing that this form of insertion in the markets gave the farmer greater financial autonomy. This aspect was verified in the conventional plant system and occurred when seasonal production directed to conventional markets can cause losses. Faced with this situation, the agro farmers strategically industrialized and distributed through short channels, even in a smaller volume.

The predominance of participation in short channels in production units depends on different local marketing channels and the diversity of products, as described by Rucabado-Palomar and Cuéllar-Padilla (2018). When the products are perishable, the short food supply chains must be multiple (GRUCHMANN et al., 2019). This multiplicity of short channels was evident in the production units surveyed. The combination of different food sale places, such as government programs, sales orders, fairs, and/or restaurants (PLAKIAS et al., 2019) is dynamic and provides the profitability of products sold by these channels. As a result, this allowed a fairer income and greater participation of the SFSC in the total income, even avoiding waste. Thus, in addition to access to new markets and the economic benefits of short food channels, alternative production systems can provide other opportunities such as cost management, optimized transportation, and logistics, enabling the development of a more sustainable production (CRAVEIRO et al., 2019). Alternative systems and short channels largely allow farmers to practice higher prices than other markets, increasing the viability of smallholder farmers (HARDERY; LEFF, 2010).

Farmers who employ conventional systems hardly seek the multiplicity of channels because the intermediate plays a central role in the production flow.

The reported evidence is that short food channels allow the development of more resilient forms of biodiversity and alternatives to production and marketing. In such a way, these production systems (mixed alternatives, alternative vegetables, and agro-industrial) have reached levels that balance multifunctional rural economies and provide conditions to produce high-quality food with the environment and social environment (MORRIS et al., 2017). However, these factors are generally neglected in long channels (GRUCHMANN et al., 2019; LAMINE et al., 2019) due to the search for productive efficiency, through the scale of economies (WILKINSON, 2008; BENEDEK et al., 2018).

From a broad perspective, the research results corroborated the studies by Marsden et al. (2000) and Renting et al. (2003) and demonstrated the role of production and sales, based on quality principles, locality/regionality, contributing to enhancing new forms of agricultural development. Income diversification factors also included the increase in the diversity of productive activities, and the innovation of products/services in the search for intensification activities in the APUs (MORRIS et al., 2017) factors presented in all production systems analyzed (Table 1). The latter may involve the development, transfer and use of new technologies, the exploitation of different markets, and innovations in the search for opportunities to add value, as occurred in the agro-industrial system and mixed systems.

5 Conclusions

The configurations found in the results show a great heterogeneity of income generation and production systems, even for a sample of 31 farmers. In the same context, there is the presence of systems that combine plant-based and agro-industrial production in the same production unit. In general, the developed systems are linked to existing soil and climate conditions, which require farmers to have a greater labor force since the predominant crops are tobacco, orange, and grape, in which technical itineraries (planting, treatments, and harvesting) are carried out manually. The production systems with smaller useful areas focus on alternative production and obtain the highest net incomes per useful agricultural area occupied. For these farmers, alternative production flowed through short marketing chains, which is a way to optimize smaller agricultural areas.

The short channels stood out because they concentrated a significant part of the total agriculture income in alternative production systems. Because of this, it is understood that even with the presence of products sold by other channels, local markets make possible and are made possible by production sold through short food supply chains. They can also contribute to increased income, diversification of production, and development of different skills for farmers, whether to produce food with different attributes or sell in alternative markets.

On the other hand, we observed that in regions more distant from large urban centers, the expansion of this type of production and commercialization (SFSCs), mainly in natura products, finds limits due to the absorption capacity of production in local markets. This locational aspect contributes to the co-existence of products drained in local production and products that are part of large global chains in the

same rural property, implying specificities not observed in most studies, especially in Europe and North America. Based on these results, the need for further studies in different regions investigating the economic and productive configurations of producers who sell through short marketing chains is evident.

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