JOURNAL OF THE Selva Andina Biosphere
Official Journal of the Selva Andina Research Society.

Research Article

ISSN 2308-3867 (print edition)
JSAB
ISSN 2308-3859 (online edition)

Produção orizícola no município de São Gabriel, RS (Brasil)

Rice production in the municipality of São Gabriel, RS (Brazil)

Traversa-Tejero Ignacio Pablo[1*], Bortolotto-Cantarelli, Rogério[2]

Data of the Article

[1]Federal University of Pampa. (Brazil).
Address: Rua 21 de Abril, nº 80.
City Dom Pedrito, RS. Brazil. CEP: 96450-000.

[2]Riograndense Rice Institute. (Brazil). Address:
Duque de Caxias Street S / N °. São Gabriel City.
RS. Brasil. CEP: 97300-000.
rogerio-cantarelli@irga.rs.gov.br

***Contact address:**
Federal University of Pampa. (Brazil).
Address: Rua 21 de Abril, nº 80.
City Dom Pedrito, RS. Brazil. CEP: 96450-000.

Ignacio Pablo Traversa-Tejero
E-mail: igtraversa@gmail.com
ignaciotejero@unipampa.edu.br

Palavra-chave:

Arroz,
sistema de produção,
tecnificação.

J. Selva Andina Biosph.
2020; 8(2):80-91.

ID of article: 093/JSAB/2020

Record from the article.

Received May, 2020.
Returned September, 2020
Accepted September, 2020.
Available online November 2020.

Editado por:
Selva Andina
Research Society

Keywords:

Rice,
production system,
technification.

Resumo

O arroz é um cereal presente em todos os continentes onde diariamente é à base da alimentação de quase metade do planeta ao tempo de fornecer a maior parte da renda principal de milhões de fazendas. A produção de arroz irrigado no sul do Brasil possui características peculiares se comparada a outras atividades agrícolas. Esta pesquisa teve como objetivo analisar os fatores de produção das áreas ocupadas pela cultura do arroz no município de São Gabriel, localizado no estado do Rio Grande do Sul. Foram usados os dados primários de um banco de dados estatísticos. De forma complementar, foram aplicados questionários de campo contendo dez variáveis da safra do cultivo 2017/18. Logo, a informação foi tabulada e analisada por meio de estatística descritiva. Verificou-se que a cultura do arroz é tecnificada e com alto uso de insumos. Os fatores que mais influenciam na produção de qualidade e altas produtividades são: a fertilização diferenciada de base potássica, o uso de sementes certificadas e tratadas que diminuem o arroz vermelho, a substituição do plantio convencional por outro mais eficiente e conservacionista. Os níveis de produtividade atingem o valor médio de 8083 kg/ha, que superam tanto a média estadual como a nacional. A informação dos pacotes tecnológicos analisados nesta pesquisa é referente aos dados produtivos mais elevados do Brasil, por isso, servem como guia aos agentes ligados diretamente ao setor e aos formuladores da política agrícola do Brasil. Próximas pesquisas deveriam se focar no estudo da eficiência econômica e a redução de custos.

Abstract

Rice is a cereal present in all continents where it is used daily to feed almost half the planet at the time of providing most of the main income of millions of farms. The production of irrigated rice in southern Brazil has peculiar characteristics when compared to other agricultural activities. This research aimed to analyze the production factors of the areas occupied by the rice culture in the municipality of São Gabriel, located in the state of Rio Grande do Sul. The primary data from a statistical database were used. In a complementary way, field questionnaires containing ten variables of the 2017/18 crop were applied. Therefore, the information was tabulated and analyzed using descriptive statistics. It was verified that the rice culture is technified and with high use of inputs. The factors that most influence quality production and high productivity are: differentiated fertilization based on potassium, the use of certified and treated seeds that reduce red rice, the replacement of conventional planting with a more efficient and conservationist one. Productivity levels reach an average value of 8083 kg / ha, which exceeds both the state and national average. The information on the technological packages analyzed in this research refers to the highest productive data in Brazil, therefore, they serve as a guide for agents directly linked to the sector and for formulators of agricultural politics in Brazil. Further research should focus on the study of economic efficiency and cost reduction.

Introduction

Rice (*Oryza sativa*) is present on all continents and is basic in the food of 2.4 billion people[1]. In addition, it is the source of the main income of millions of rural properties. World production is 746 million tons in an area of 165 million ha, and productivity 4527 kg ha[2]. World rice production has not kept pace with the growth in consumption. In the last six years, production increased 1.09% per year, while the population grew 1.32% and consumption 1.27%, with great concern in this regard1. In 2017, the world trade in rice grew by 10.7% and produced 45.9 million tons by imports from Asia. The countries of that continent continue to seek to build cereal stocks to limit inflationary trends[3]. Productivity is considerably high, producing more and more in a smaller footprint[2]. Brazil is in ninth place, with a production of approximately 12´452 662 t (20% of world production). Both world production (90%) of rice and consumption are concentrated in Asian countries, where nine of the top 10 grain producing countries are also found: China, India, Indonesia, Bangladesh, Vietnam, Myanmar, Thailand, Philippines, Brazil and Japan[2].

In the 7th century, rice was taken to Europe by the Arabs, from there it arrived in Brazil, brought by the Portuguese. In mid-1587, there were records of rice crops in the state of Bahia[4]. The culture has intensified, and it grows every year[5]. Rice is present in all states of Brazil, in the last decades the culture has been concentrated in the southern states of the country mainly due to the water and soil characteristics[6,7] where there is a greater production and cultivated areas of irrigated rice[8]. Irrigated rice is grown mainly in the states of Rio Grande do Sul and Santa Catarina (86%) 9 and, therefore, the production system is responsible for most of the country's cereal supply[10].

There are reports that the first cereal to be exported by Brazil was rice, destined for Portugal
and from there distributed to other countries on the European continent[11], at present Brazil represents 1%, occupying the seventh place in the ranking of the world's largest exporters[2,12].

The southern region contributes 79% of national production[13] and Rio Grande do Sul is the largest rice producer in Brazil with approximately 70%[13]. The state of Rio Grande do Sul is also the main responsible for the industrialization of the cereal[8].

The State of Rio Grande do Sul (RS) is the largest producer of irrigated rice in Brazil, (80% of national production), and the southern region of RS, contributes 20% of national production[13].

In recent years, the Brazilian rice trade balance has shown a positive balance in most years, due to the higher volume of exports compared to imports[14]. In the last three decades, Brazilian agriculture has experienced a strong transformation process, known as conservative modernization. However, this concentrated modernization brought about a change from the traditional extensive pattern to a more intensive one[14]. Rice production is considered risky, due to market and cost fluctuations, but mainly due to the degree of influence of the climate[15].

At the beginning of the last millennium, an agronomic project was started to increase the productivity, competitiveness and sustainability of the rice crop in the State of Rio Grande do Sul. The project prioritized: sowing time, nutrition, soil fertility, irrigation and herb control weed. As a complement, attention was paid to the choice of cultivars, the use

of quality seeds, the management of pests and diseases and the monitoring of invasive plants. The interaction of this set of practices made it possible to achieve high productivity[16]. Rice is the source of basic energy for human consumption, due to the high concentration of starch, proteins, vitamins and minerals, and low content of lipids. In Brazil consumption per capita is 108 g per day and in developing countries it is one of the main foods in the diet, providing on average 715 kcal per capita per day, 27% of carbohydrates, 20% of proteins and 3% of lipids of feeding[17]. Brazil is a country of prominence in the international rice concert, but it has great regional productive differences given its territorial greatness. In this sense, the analysis of the territory is able to understand the configuration of different regions with local activities, in the idea that economic growth is due to internal conditions and dynamics, which starts a new phase of theorizing territorial development[18]. Thus, it is recognized that the State of Rio Grande do Sul is the largest Brazilian producer. Within this state, the Municipality of São Gabriel develops advanced technologies. It is justified if the objective pursued in this research to analyze the factors of rice production and the management techniques in the areas of municipal geographic interlock. This is the scenario where the highest levels of rice production in Brazil take place. The information had served as a reference to agents directly linked to the sector and to the country's agricultural policy makers.

Material and method

Study area. The municipality of São Gabriel belongs to the state of Rio Grande do Sul. It is located in the extreme south of Brazil, bordering Argentina in the west and Uruguay in the south. It is 320 km from Porto Alegre (state capital) and has 62.061 inhabitants. The city of São Gabriel, belongs to the Campanha Gaúcha Region, bathed by the course of the Vacacaí River, dating back to the year 1750, with the appearance of the first Jesuitic estates[13] (figure 1).

Figure 1 Geographic location of São Gabriel (published by IBGE cities, 2018[13])

In the low-lying state region, the climate is humid subtropical. The seasons are well defined with hot and humid summers, autumn is marked by the arrival of a moderate cold that becomes severe a few weeks before winter. The winter registers low temperatures, frosts, and strong wind of polar origin (minuano). Spring has a balanced and pleasant climate[19].

In Rio Grande do Sul, 60% of the floodplain area is used in rice production, in soils typical Planossolos eutrophic habitats, characterized by high fertility, moderate permeability and low concentration of organic matter[7].

Data collect. The data collected for the realization of the study were related to ten variables of the harvest of the years 2017/2018. There was a predicted docu-mentary research, according to Marconi and Lakatos[19]. Data collection was carried out in the field, in visits to 20 rice fields that were randomly selected from the municipality of São Gabriel. In addition, 99 producers were selected from a total of 119 producers on the list of the Riograndense Institute of Rice (IRGA). The questionnaire, comprising ten closed questions, was applied to cultivated areas between 10 and 1000 ha.

The variables studied were: sown area (ha), crop rotation, planting system, area planted with certified seed, sowing density, sowing time, varieties used, type of basic fertilization, cover fertilization, number of applications of cover (N), area with treated seed and productivity.

Results

Table 1 Surface of the studied rice properties

Area classes	Frequency	Percentage (%)
>100	44	37.07
200	40	33.61
300	16	13.45
600	12	10.08
<600	7	5.88
Total	**119**	**100.00**

Most producers were men (91.6%), the total area for rice planting is 23163 ha, with a range of very variable surface size (minimum 10 ha to maximum 1210 ha); the frequency of producers decreases with the increase in the size of productive buildings (table 1).

The area for culture can be subdivided into leased and owned. 65% of the surveyed producers replied that they have leased land, and some with no own hectare to produce (table 2).

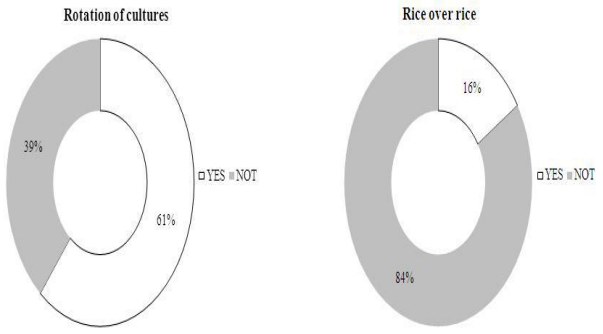
Data processing. The São Gabriel IRGA data matrix (harvest) 2017/2018 was included in a Microsoft Excel spreadsheet, and subsequently all necessary descriptive and inductive statistics calculations were performed through the creation of instruments such as charts, graphs and numerical indicators of central tendency and deviation[20,21].

Table 2 Lease dependence for rice production

Leased area	Freqency (f)	Percentage (%)
Yes	77	65
Not	42	35
Total	**119**	**100**
Leace Dependens	**Frequency (f)**	**Percentage (%)**
Own land	55	46
Landless	64	54
Total	**119**	**100**

Regarding crop rotation, 60.5% of producers do this type of activity, and the remaining 39.5% say they do not practice. Only 16% of producers claim that there is continued rice production for at least five years (figure 2).

Figure 2 Practice of crop rotation and consecutive rice



Crop rotation is carried out with soybeans, except for one researched that uses cattle. Of the 60.5% that rotate, 58% of the properties use their entire available area. As for the type of planting, three

very distinct forms were identified, conventional planting, no-till and minimum cultivation (figure 3). In São Gabriel, planting (without sowing) is carried out, largely by producers with areas between 100 and 300 ha (table 3).

Figure 3 Planting systems used by the researchers

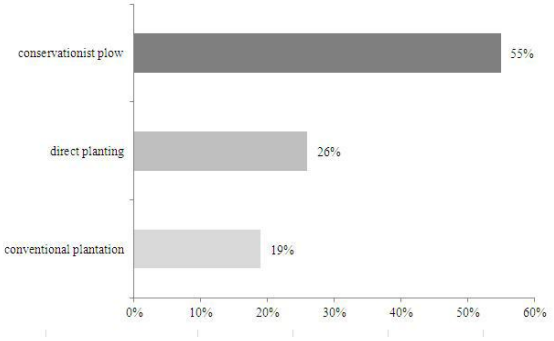


Table 3 Planting Area

Classes (ha)	Frequency	Acumulated
> 100	9	29.0
100 a 200	9	29.0
200 a 300	5	16.1
300 a 400	4	12.9
400 a 500	2	6.5
< 500	2	6.5
Total	**31**	**100.0**

Rice planting takes chemical fertilization carried out through the application of several compounds. Of the producers surveyed in São Gabriel, the most common are fertilizers with N (Nitrogen), P2O5 (Phosphorus Pentoxide) K2O (Potassium Oxide) (table 4).

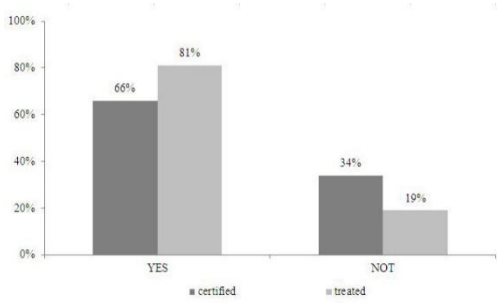
Table 4 Use of fertilizer in crops researched

Statistics	Nitrogenated	Phosphorus	Potassium
Average	12.0	57.2	63.2
Standard desviation	7.1	28.4	30.8
Variation Coefficient (%)	59.2	49.7	48.7

Quando averiguou se a utilização de sementes certificadas e tratadas, constatou se que a maioria dos produtores para ter êxito procura a qualidade das sementes (figura 4).

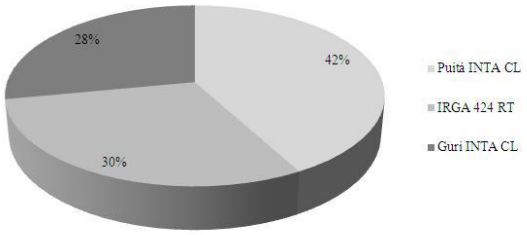
In the rice seed market, there are numerous cultivars with certification that can be treated for later use, and in the case of the sample studied, the varieties most used by those surveyed are described in table 5.

Figure 4 Area sown with treated and certified seeds



Some producers use more than one variety of cultivar in their crops, however, the variety most used by the surveyed producers was the one called Putiá INTA CL, with a total of 80 producers. The IRGA424 RI variety had 56 responses and the Guri INTA CL 53 (figure 5).

Figure 5 Use of rice cultivars by surveyed producers



The productivity of São Gariel crops reaches an average value of 8083 kg / ha, and a median value of 8046 kg / ha, (figure 6).

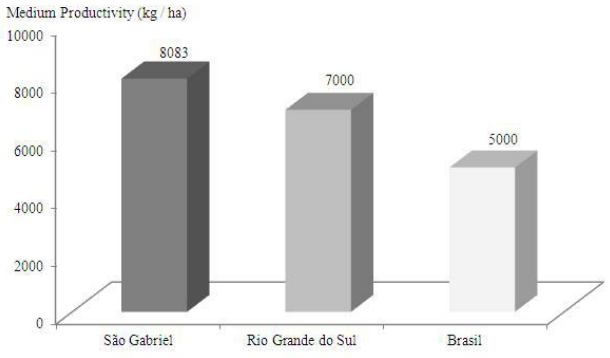
Discussion

Although the sample is made up on average of properties of up to 250 ha mostly (value extracted as a weighted average of the area classes and frequencies in Table 1), it is clear that there is considerable land concentration. The largest properties represent only 6% of the total surveyed, only seven properties together represent about 30% of the total area. This concentrating trend was revealed by Buainain et al.[22] who reports the existence of smaller and smaller establishments, although more numerous.

Table 5 Varieties of cultivars planted by area

IRGA 424 RI (ha)	Absolute frequency	Relative frequency %
< 40	12	21.43
40-80	17	51.79
80-120	9	67.86
120-160	5	76.79
160-200	4	83.93
200-240	3	89.29
> 240	6	100.00
Puitá INTA CL (ha)	**Absolute frequency**	**Relative frequency %**
< 40	24	30.00
40-80	18	52.50
80-120	17	73.75
120-160	7	82.50
160-200	4	87.50
200-240	2	90.00
> 240	8	100.00
Guri INTA CL (ha)	**Absolute frequency**	**Relative frequency %**
< 40	12	22.64
40-80	15	50.94
80-120	13	75.47
120-160	2	79.25
160-200	6	90.57
200-240	1	92.45
> 240	4	100.00

Figure 6 Average productivity of rice production units in the municipality of São Gabriel, State of Rio Grande do Sul and Brazil all over



The high concentration of land makes access to rice production difficult. This situation is aggravated by the fact that more than half of the producers do not have their own land (54%). The scenario of this productive region in Brazil is quite different from the Province of Rivers in Ecuador, where only 21% of the rice fields are leased[23].

Leasing increases the risk of production and increases the cost, production is less efficient and less profitable. According to Chelotti and Bezzi[24] in Rio Grande do Sul, it is one of the highest, reaching around USD 150 / ha, while in countries like Argentina, the land price averages USD 64/ha.

The minimum cultivation method is widely used in rice fields in RS, according to Agostinetto et al.[25], it

consists of preparing the soil with the implantation of pastures or isolating the area for native vegetation to develop. Before planting begins, dissection is used to control red rice (invasive plant). Red rice can affect the crop in two ways, in decreasing the yield of paddy rice [26] and in the quality and commercial value of the product[27].

The conventional method of planting with the use of harrowing and tilling the soil has been losing ground to techniques that cause less impact. Planting without sowing is more sustainable, both in economic and environmental factors, as there is no turning of the land as in the conventional system, but a reduction in labor, machinery and fuel costs. In addition to conserving the nutritional levels of the soil, such as the content of organic matter and nitro genius[28].

In crop rotation plots, intercalated rice and soy planting is used from year to year (58%), the other 42% alternate their production in the same year, a trend that may end up strengthening due to the diversification of crops, and the lower risk. According to Carmona et al.[29] monoculture is becoming increasingly unsustainable because it causes negative socio-environmental impacts on communities that depend on rice production, although rice and soy crops are an alternative for ecosystem recovery[30]. The recommended fertilization for the production of irrigated rice is nitrogen (N), potassium (K) and phosphoric (P) [31,32]. From table 4, it is possible to extract that of these three chemical elements, the one with the highest average use is post-potassium with an aggregation of 63,2 kg / ha of potassium oxide (K2O), one of the explanations for the diffusion of potassium-based fertilization, lies in its composition offering a high yield for the rice crop. To increase production by area, the recommendation can reach 110 kg / ha[16]. The level of nitrogen (N) is considered the most relevant environmental variable in rice yield, being the main responsible for morphogenesis, growth, photosynthesis and senescence. Besides, it forms part of proteins and many non-protein components[33]. After potassium, N is the element that most accumulates in the rice plant[34].

The high-yield system is completed with the use of certified seeds that reduce the appearance of the so-called red rice[28]. However, when analyzing the productivity of each cultivar used in the rice fields of the surveyed producers in São Gabriel, the Puitiá variety is not the most productive despite being the most used. Yields are: IRGA 8914 ton / ha, Guri 8746 ton / ha and Puitá 7280 ton / ha. The use of the Puitá variety can be explained by the better quality of grain, associated with better prices to producers of this variety[16].

The high productive cost of rice crops in Brazil is explained by the tax burden and the low degree of economic openness that limit the possibilities for producers to purchase external inputs[35]. In addition, it ends up reflecting on the increase in the costs of Brazilian rice[36]. According to Lopa da Silva[36], importation is favored since in Uruguay and Argentina there are favorable factors such as: product quality, less aggressive tax burden, more competitive interest rates for financing freight and lower marketing costs than those in Brazil. Through the analysis of the competitiveness index, national production has a disadvantage vis-à-vis other MERCOSUR countries, and support is needed to define partnership strategies to conquer new markets[37]. These values surpass state productivity, which is around 7.000 kg/ ha; value that has been maintained since the 2005/2006 harvest. In addition, they surpass even

more the productivity of Brazil (about 5.000kg / ha) [16]. This intensification in rice cultivation seems to respond to a growing trend in other countries as well. It consists of the use of improved seeds, management of weeds, pests and disease. These factors have allowed the increase in yield and the maintenance of the productive level in the Mexican rice industry[38]. However, according to Gargano[39] (Argentina), the form of production of scientific knowledge is crossed throughout Latin America by the configuration of the productive matrices themselves, where the accumulation of capital at a global level, reserves the extraction of natural goods for peripheral countries, and search results. For this reason, Argentine agribusiness should be revised to transform asymmetries. Although the previous one, according to 40, the competitiveness indexes calculated for rice production were very low or negative for Colombia; demonstrating that, given the current conditions of rice production, this country is not competitive in the international market. In contrast, the competitiveness indices calculated for the United States reflect a high level based on a business model focused on exports.

Finally, in a global way, the contributions generated in this research contribute to the following considerations: i) the scenario of rice producers can be divided into three groups, the first represented by the large producers, highly technological, with their own land, high capital, and high return. A second group of small to large properties, with the characteristics of tenants, dependent on financing, with high risk and little productive efficiency. And a third group, represented in small family farms and settlements that mostly produce on a small scale, in productive systems such as organic agriculture and agroecology. ii) the use of certified seeds is essential for high productivity, as it causes the least contamination and efficiency in the control of red rice. In this sense, fertilization is another differential of the researched crops, since most of them exchange the use of nitrogen fertilizer for potassium fertilizer. The latter, becomes more efficient and with a better cost-benefit ratio, both in production and in product quality. iii) rice farming is highly technified and with high use of inputs, conventional planting has been losing ground in the face of minimal and precision cultivation. The high modernization, increasingly specialized, results in levels of high productivity of an average value of 8083 kg / ha. These figures exceed both the state and national average. iv) Due to the definition of the technological packages reported in this research and because they refer to the highest productive data in Brazil; the data obtained serve as a reference to agents directly linked to the sector and to the country's agricultural policy makers. To increase yields and technical efficiency, the results indicate that the effort in the rice sector should perhaps focus on research that studies improving economic efficiency and reducing costs.

Funding source

This research was funded by the Riograndense do Arroz Institute (IRGA).

Interest conflicts

The authors express the absence of conflicts of interest.

Acknowledgment

The authors wish to thank all producers interviewed, for their receptivity and willingness to access information.

Ethical aspects

This research does not present ethical conflicts with people or institutions, the list of producers interviewed being reserved and anonymous.

Cited Literature

1. da Silva Nunes JL. Arroz Importancia economica do arroz [Internet].Agrolink. 2016. [citado 24 de octubro de 2018]. 310 p. Recuperado de: https://www.agrolink.com.br/culturas/arroz/informacoes/importancia_361560.html
2. Produtos por país [Internet]. Organização das Nações Unidas para a Agricultura e Alimentação. 2018 [citado em 10 de octubro de 2018]. Recuperado de: http://www.fao.org/faostat/es/#rankings/commodities_by_country
3. Informativo mensal do mercado mundial do arroz [Internet]. Agrolink. 2017 [citado 8 de novembro de 2018]. 101 p. Recuperado de: https://www.agrolink.com.br/noticias/informativo-mensal-do-mercado-mundial-do-arroz_404615.html
4. Origem e história do arroz [Internet]. Associação de arrozeiros de Alegrete. 2020 [citado en 13 de novembro de 2020]. Recuperado de: http://www.arrozeirosdealegrete.com.br/origem-e-historia-do-arroz/
5. Productividad del arroz *(Oryza sativa* L.*)* y frijol común (*Phaseolus vulgaris* L.*)* en Brasil, de 1985 a 2018 [Internet]. Empresa Brasileira de Pesquisa Agropecuária. 2018 [citado em 13 de noviembro de 2020]. Recuperado de: https://www.cnpaf. embrapa.br/socioeconomia/docs/arroz/ produtividadedearrozefeijao.htm
6. Zanin V. Panorama geral da orizicultura brasileira. Indic Econ FEE 2013;41(2):51-66.
7. EMBRAPA - Empresa Brasileira de Pesquisa Agropecuária. 2018. Consumo, mercado e comercialização do Arroz no Brasil. 2018. Disponível em: http://sistemasdeproducao.cnptia.embrapa.br/FontesHTML/Arroz/ArrozIrrigadoBrasil/cap18.htm
8. Ferreira CM. Importancia economica e social do arroz no Brasil. In: Ferreira CM, Freire de Sousa IS, Méndez del Villar P, editores. Desenvolvimento tecnológico e dinâmica da produção de arroz de terras altas no Brasil [Internet]. Santo Antônio de Goiás: Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Arroz e Feijão. Ministério da Agricultura, Pecuária e Abastecimento; 2005. p. 9-26. Recuperado de: file:///C:/Users/usuario/Downloads/DesenvolvimentoTec.pdf
9. Pereira JA. Cultura do arroz no Brasil: Subsídios para a sus história [Internet]. [Teresina]: Embrapa Meio-Norte; 2002 [citado 8 de novembro de 2018]. 226 p. Recuperado de: https://livraria. funep.org.br/product/cultura-do-arroz-no-brasil/
10. Departamento agricultura dos Estados Unidos. 2018. Disponivel em: <http://www.bmfbovespa.com.br/CGRCC/download/A-Relacao-em tre-Percepcao-e-Gestao-de-Risco-por-Produtores-de-Arroz-Irrigado-no-Rio-Grande-do-Sul.pdf>
11. Levantamento sistemático da produção agrícola – LSPA [Internet]. Instituto Brasileiro de Geografia e Estatística. 2018. [citado 24 de octubro de 2018]. Recuperado de: https://www.ibge.gov.br/estatisticas-

novoportal/economicas/agricultura-e-pecuaria/9201-levantamento-sistematico-da-producao-agricola.html?=&t=series-historicas

12. Becher EU. A dinâmica da balança comercial brasileira: um estudo da configuração do agronegócio com enfoque na rizicultura do sul de Santa Catarina [tese de bacharelado]. [Criciuma]: Universidade do Extremo Sul Catarinense; 2016 [citado 3 de novembro de 2018]. Recuperado de: http://repositorio.unesc.net/handle/1/5250
13. Carvalho Filho JJ. A produção de alimentos e o problema da segurança alimentar. Estud Av 1995 ;9(24):173-93. DOI: https://doi.org/10.1590/S0103-40141995000200008
14. Silva Moreira V, Vieira Medeiros MR. As transformações no espaço agrário "Sul-Rio Grandense pós 60. Confins 1995;20:74-94. DOI: https://doi.org/10.4000/confins.8805
15. Avisos meteorológicos [Internet]. Instituto Nacional de Meteorologia. 2018 [citado 1 de octubro de 2018]. Recuperado de: https://portal.inmet.gov.br/
16. de Oliveira Neto AA. A cultura do arroz [Internet]. Brasilia: Companhia Nacional de Abastecimento; 2015 [citado em 22 de octubro de 2018]. 182 p. Recuperdo de: file:///C:/Users/usuario/Downloads/2015_-_A_Cultura_do_Arroz%20 (3).pdf
17. Kennedy G, Burlingame B, Nguyen N. Nutrient impact assessment of rice in major rice-consuming countries. International Rice Commi ssion Newsletter [Internet]. 2002 [citado 5 de octubre de 2018];51:33-41. Recuperado a partir de: http://www.fao.org/tempref/docrep/fao/004/y6159t/y6159t04.pdf
18. Moncayo Jiménez E. Evolución de los paradigmas y modelos interpretativos del desarrollo territorial [Internet]. Santiago de Chile: Instituto Latinoamericano y del Caribe de Planificación Económica y Social. Comisión Económica para América Latina y el Caribe; 2001 [citado 22 de octubre de 2018]. 51 p. Recuperado a partir de: https://repositorio.cepal.org/bitstream/handle/11362/7262/1/S0 18637_es.pdf
19. Marconi EM, Lakatos MA. Fundamento da Metodologia Cientifica [Internet]. São Paulo: Editora Atlas S.A.; 2003 [citado 1 de novembro de 2018]. 310 p. Recuperado de: https://docente.ifrn.edu.br/ olivianeta/disciplinas/copy_of_historia-i/historia-ii/china-e-india
20. Reis E. Estatística descritiva. Lisboa: Edições Sílabo; 1996.
21. Gil AC. Como elaborar projetos de pesquisa [Internet]. São Paulo: Editora Atlas S.A.; 2008 [citado 1 de novembro de 2018]. 176 p. Recuperado de: http://www.uece.br/nucleodelinguasitaperi/dmdocuments/gil_como_elaborar_projeto_de_pesquisa.pdf
22. Buainain AM, Alves E, Silveira JM, Navarro Z. O mundo rural no Brasil do século 21: a formação de um novo padrão agrário e agrícola [Internet]. Empresa Brasileira de Pesquisa Agropecuária. Ministério da Agricultura, Pecuária e Abastecimento. Brasilia, Brasil. [citado 6 de novembro de 2018]. Recuperado de: https://www.embrapa.br/busca-de-publicacoes/-/publicacao/994073/o-mundo-rural-no-brasil-do-seculo-21-a-formacao-de-um-novo-padrao-agrario-e-agricola
23. Zambrano CE, Andrade Arias MS, Carreño Rodríguez WV. Factores que inciden en la productividad del cultivo de arroz en la provincia Los Ríos. Universidad y Sociedad 2019;11(5): 270-7.

24. Chelotti MC, Bezzi ML. Perspectivas da cadeia produtiva do arroz irrigado no Sudoeste do Rio Grande do Sul. [tese de bacharelado]. Santa Maria: Universidade Federal de Santa Maria; 2001.
25. Agostinetto D, Fleck NG, Rizzardi MA, Merotto Junior A, Vidal RA. Arroz vermelho: ecofisiologia e estratégias de controle. Ciênc Rural 2001;31(2):341-9. DOI: https://doi.org/10.1590/S0103-84782001000200026
26. Kwon SL, Smith RJ, Talbert RE. Comparative growth and development of red rice (*Oryza sativa* L.) and rice (*O. sativa* L.). Weed Science 1992; 40(1):57-62. DOI: https://doi.org/10.1017/S0043174500056952
27. Dunand R. Red Rice: Its impact on grain quality and its cultural control. A review of research in Louisiana. 1960-1982. Louisiana: Louisiana Agricultural Experiment Station; 1988. Bulletin Nº 792.
28. Carmona FC, Carlos FS. O plantio direto como alicerce. In: Carmona F, Denardim LGO, Martins AP, Anghinoni I, Carvalho PC, editores. Sistemas integrados de produção agropecuára em terras baixas [Internet]. Porto Alegre: Universidade Federal do Rio Grande do Sul; 2018. p. 31-8. Recuperado de: file:///C:/Users/usuario/Downloads/LivroSIPAterrasbaixas.pdf
29. Carmona F, Denardim LGO, Martins AP, Anghinoni I, Carvalho PC. Sistemas integrados de produção agropecuária em terras baixas [Internet]. Porto Alegre: Universidade Federal do Rio Grande do Sul [citado 8 de novembro de 2018]. 158 p. Recuperado de: file:///C:/Users/usuario/Downloads/LivroSIPAterrasbaixas.pdf
30. Carvalho PCF. Reconectando a natureza com a produção agrícola: A via da intensificação sustentável. In: Carmona F, Denardim LGO, Martins AP, Anghinoni I, Carvalho PC, editores. Sistemas integrados de produção agropecuára em terras baixas[Internet]. Porto Alegre: Universidade Federal do Rio Grande do Sul; 2018. p. 17-24. Recuperado de: file:///C:/Users/usuario/Downloads/LivroSIPAterrasbaixas.pdf
31. Carmona FC, Anghinomi I, Meurer EJ, Holzschuh MJ, Fraga TI. Estabelecimento do arroz irrigado e absorção de cátions em função do manejo da adubação potássica e do nível de salinidade no solo. Rev Bras Ciênc Solo 2009; 33(2):371-83. DOI: https://doi.org/10.1590/S0100-06832009000200015
32. Tedesco MJ, Gianello C, Anghinoni I, Bissani CA, Camargo FAO, Wiethölter S. Manual de adubação e calagem para os estados do Rio Grande do Sul e Santa Catarina [Internet]. Porto Alegre: Sociedade Brasileira de Ciências do Solo; 2004 [citado em 22 de outubro de 2018]. 404 p. Recuperado de: http://www.sbcs-nrs.org.br/docs/manual_de_adubacao_2004_versao_internet.pdf
33. Calabio JC, Garcia FV, Datta SK, Craswell ET, Fillery IRP. Alternative strategies for increasing nitrogen fertilizer efficiency in wetland rice soil. Philipp J Crop Sci 1980;5(4):144-9.
34. Fageria NK, Slaton N, Baligar V. Nutrient management for improving lowland rice productivity and sustainability. Adv Agron 2003; 80:63-152. DOI: https://doi.org/10.1016/S0065-2113(03)80003-2
35. Madruga SR, Brondani G, Vey IH, de Lima Trindade L, Cardona Venturini J, Morales R. Diferenciais de custos em culturas de arroz. Revista

Eletronica de Contabilidade 2005;2(2): DOI: https:// doi.org/10.5902/198109466510

36. Lopa da Silva F. Análise competitiva do segmento da produção de arroz irrigado da cadeia agroindustrial do arroz no Rio Grande do Sul [tese de mestrado]. [Juiz de Fora]: Universidade Federal de Juiz de Fora; 2004 [citado 8 de novembro de 2018]. 101 p. Recuperado de: http://www.webrural.com.br/wp-content/uploads/2018/11/CAI_do_Arroz_RS_LOPA.pdf
37. Wander AE. A competitividade do agronegócio brasileiro de arroz. Custos@gronegócio online [Internet]. 2006 [citado 3 de novembro de 2018];2(1):2-15. Recuperado de: http://www.custoseagronegocioonline.com.br/numero1v2/Competitividade%20do%20arroz.pdf
38. Ireta Paredes AR, Altamirano Cárdenas JR, Ayala Garay AV, Covarrubias Gutiérrez I, Muñoz Rodríguez M. Factores que explican la perma nencia de la producción de arroz en México. Rev Mex Cienc Agríc 2016;(15):2981-93. DOI: https://doi. org/10.29312/remexca.v0i15.420
39. Gárgano C. Ciencia, tecnología y mercado: inves tigaciones en arroz en el INTA Argentino. J Technol Manag Innov 2018; 13(1): 75-83. DOI: https://doi.org/10.4067/S0718-27242018000100075
40. Chica J, Tirado YC, Barreto JM. Indicadores de competitividad del cultivo del arroz en Colombia y Estados Unidos. Rev Cienc Agr 2016; 33(2): 16-31. DOI: https://doi.org/10.22267/rcia.163302.49