

MULTIFARM MECHANIZATION OF SMALL FARMS IN THE CENTRO-SERRA REGION OF THE BRAZILIAN STATE RIO GRANDE DO SUL

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Abstract

The search for crops and concerned activities that become mechanized through multifarm mechanization services was the main objective of this research. The production of corn, black beans, soybeans and wheat is primarily getting mechanized by contracting machinery services. The main mechanized activities are no-tillage drilling, crop protection and harvesting. Important providers of equipment for these activities are farmer contractors, farmer groups, machinery services of the local government and cooperatives.

Keywords: Small farms, Multifarm mechanization, Mechanization.

Resumo

O objetivo central do presente trabalho é a busca de culturas e atividades ligadas a elas, as quais são mecanizadas através do uso coletivo de maquinaria agrícola. Para este estudo, pesquisa de campo foi realizada e os dados coletados estatisticamente analisados. As culturas com maior incidência de mecanização coletiva são milho, feijão preto, soja e trigo. As principais atividades mecanizadas coletivamente nestas culturas são o plantio direto, as pulverizações e a colheita. Os principais fornecedores de maquinaria agrícola para estas atividades são agricultores prestadores de serviços e grupos de agricultores, bem como serviços de patrulha agrícola das prefeituras e cooperativas.

Palavras-chave: Pequenos agricultores, Mecanização coletiva, Mecanização.

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1 INTRODUCTION

South Brazilian's agriculture is mainly based on two farm types: the large farms (latifundies), which activities are concentrated on a few crops and/or cattle production and the smaller farms² with a very diversified agricultural production.

Small farms in the Southern State of Rio Grande do Sul (RS) mainly produce tobacco, beans, corn, wheat, rice, potato, sweet potato, cassava and to some extent also soybeans. The integration of animal production into the farming system is common. Latifundies in RS usually focus their production on soybeans, rice, wheat, corn and beef.

1.1 The Scope of the Problem

Since the "Green Revolution", modern inputs like seeds, mineral fertilizers, pesticides and mechanization are used more and more frequently. Many small farms changed the priorities regarding their production patterns from subsistence to market oriented production. Today, there are very few farmers producing for their family's subsistence only. However, large differences regarding the intensity of use of modern inputs have been reported (Silva 1990, 12p.).

The integration of these small farms into market economy has been accelerated by the formation of MERCOSUR³ in 1991 since it provided new opportunities and led to increased competition. Increased competition induces farmers to reduce the cost of production and improve the quality of products.

Many authors argue that mechanization could be one of the strategies to reduce costs (see Holtkamp et al. 1978, Steinmann 1988, Wieneke 1982). Apart from the advantages of mechanization, very often negative effects like "too high investment costs for small farmers..." have been observed (see Balestreire 1993, Binswanger 1984, International DLG-Symposium 1986:1pp, FAO 1985:45pp, FAO 1990, Steinmann 1988).

Farmers around the world tried different arrangements for provision of machinery services in order to minimize these negative effects of mechanization.

1.2 The Contractual Arrangements for Provision of Machinery Services

The FAO (1985) divides the main arrangements for provision of machinery services into individual and group ownership. Individual ownership is further divided into

² Usually units with less than 50 hectares of arable land are considered small farms in the Brazilian state Rio Grande do Sul (Klingensteiner 1982; Klingensteiner 1984).

³ MERCOSUR means "Mercado Comun del Sur" (Common Market of the South) and comprises four countries: Argentina, Brazil, Paraguay and Uruguay.

informal sharing, farmer contractors, commercial contractors, machinery rings and hiring (renting) and leasing. Group ownership is divided into cooperatives, syndicates and partnerships and farmer groups.

Informal sharing is mostly concerned with machinery and work capacity, which is shared between farmers with or without operator and without monetary payment. Farmer contractors comprise farmers with over-capacities in work and machinery, which they provide against monetary payments to other farmers who lack these capacities. The commercial contractors are specialists providing certain types of machinery services for farms and expecting monetary payments for them. Machinery rings are to be understood as system of sharing machinery and work within a limited number of farms, being members of the ring. The farmers who ask for certain services receive these from another member farmer of the circle and have to pay for them. Accordingly, the machines used within the rings do not belong to the ring but to the farmers. Hiring (renting) is to be understood as a service where a person, who possesses the equipment, rents it to farmers who need it. These farmers operate the machines themselves.

Cooperatives are formal larger groups of farmers. The cooperatives own the machines and provide them to farmers, whether they are members or not. In most cases, if the farmers requesting the equipment are not members of the cooperative they have to pay higher leasing rates, whereas the members pay annual fees. In many regions, smaller groups—the farmer groups—are found more frequently. Farmers with common interests come together to buy certain machinery. The members then can use this machinery whenever they need it. These groups can either be informal (no formal, written agreements) or formal (with a written contract or statute).

In many countries the government also has spent a lot of money in creating public machinery stations to provide services to farmers. But in many cases, the type of machinery provided is not corresponding to what farmers really need.

We therefore try to demonstrate for the Centro-Serra Region in the Brazilian state Rio Grande do Sul, which activities are on the way to becoming mechanized by contracted machinery services and which providers are available for each type of machine.

1.3 Objectives and Hypothesis

The objectives of this study are:

- a. Identifying the procedures within the farming systems of the research region, which become mechanized through multifarm machinery use;
- b. Searching for farmers' preferred multifarm mechanization providers for the different procedures and/or devices and to explain their reasons.

The following hypotheses were derived from the objectives above:

- a. The more market oriented the production, the higher the degree of

mechanization!

b. The basic machinery for animal production is mostly owned by farmers because of their frequent use as well as long term planning possibilities. On the other hand, in plant production, multifarm use of machinery is more frequent.

c. Regarding crops that are used within the farms, for example corn for feeding animals, self-help organizations like group ownership of the machines that are cooperatives and farmer groups, are found more frequently than private contractors. Because of their flexibility, contractors are used more often as providers of machinery for cash crops, which are soybeans and black beans.

2 METHODOLOGY

The Centro-Serra (research region) is located in the middle of the Rio Grande do Sul state and comprises the following municipalities: Arroio do Tigre, Sobradinho, Segredo, Ibarama, Estrela Velha, Lagoão and Tunas. For this research, the municipalities Arroio do Tigre, Sobradinho, Segredo and Ibarama have been chosen.

In a first step we had to identify the farms that are using (contracting) any kind of machinery services in the research region. For this we contacted all local agricultural extension services, agricultural cooperatives, syndicates as well as private commercial contractors of agricultural machinery and asked them to give us the names of people using any kind of contracting machinery for farm activities. Thereafter we selected a random sample⁴ of 121 farms.

After getting in contact with the selected farmers who demonstrated interest in this research, the collecting data was started. To test our hypothesis, we needed information on the whole farming system, i.e. field activities on crop cultivation and animal production, as well as information on the farm location, production purposes and aspects concerning farm size. Regarding mechanization, we looked for information on the property and using rights of the available and used agricultural machinery.

The data were collected between October 1999 and February 2000 using a standardized questionnaire with mostly closed and some open questions. The collected data were analyzed through frequencies, descriptives and correlations using SPSS and Microsoft Excel.

⁴ Using the "select random sample" of SPSS 10.0.

3 RESULTS AND DISCUSSION

According to the latest agricultural census data available on the Centro-Serra Region, more than 98% of all farms in this region have less than 100 ha (hectares) of farm area⁵. This figure indicates a stronger land division between farmers in this region compared to the Brazilian average (89.7% with less than 100 ha).

If we consider only the farms that are in some ways contracting any kind of machinery services (our target group), the percentage of farms with less than 100 ha farm area decreases to 91.7%. This indicates that some smaller farms are not contracting machinery services.

However, not the whole farming area can be mechanized. Therefore another indicator is necessary. The arable land⁶ seems to be helpful because in the research region most of the arable land is also mechanizable. If we consider only the arable land in the research region, we find that 96.7% of farms have less than 100 ha of arable land. This indicates there are some farms with more than 100 ha of farm land but with less than 100 ha of arable land, which is mechanizable (Table 1).

Table 1: Percentage of Farms Contracting Agricultural Machinery and of all Farms Between Different Farm Size Groups

Farm Size Group	Farms Contracting Machinery Services (%) [*]		All Farms (%) ^{**}
	Only Arable Land (%)	Whole Farm Land (%)	Whole Farm Land (%)
Less than 20 ha	53.7	37.2	98.6
20 up to less than 40 ha	30.6	38.8	1.4
40 up to less than 60 ha	6.6	12.4	
60 up to less than 80 ha	0	1.7	
80 up to less than 100 ha	5.8	1.7	
100 ha and more	3.3	8.3	

Source: ^{*} own research; ^{**} Data from IBGE (1996).

The most common activities within the farms are the cultivation of tobacco, soybeans, black beans, corn, wheat and rice as well as some animal production (cows, pigs, chicken and fish). Generally, the farms also cultivate some crops for subsistence like cassava, sweet potato, potato, fruits and vegetables. Fig. 1 shows the crops most

⁵ The "farm area" means the whole land area of the farm.

⁶ "Arable land" means the share of the farm area that can be used for agricultural activities.

frequently cultivated, to what extent they can be considered as cash crops and how often they become mechanized by contracted machinery.

The differentiation between cash and subsistence crops is based on the ratio of production, which becomes commercialized "in natura". Feed and food are not included. It is important to mention that for some crops a very important part – in some cases the major part - of the consumption is animal feed (i.e. corn). On the animal production side, a part of the production is generally used for household consumption.

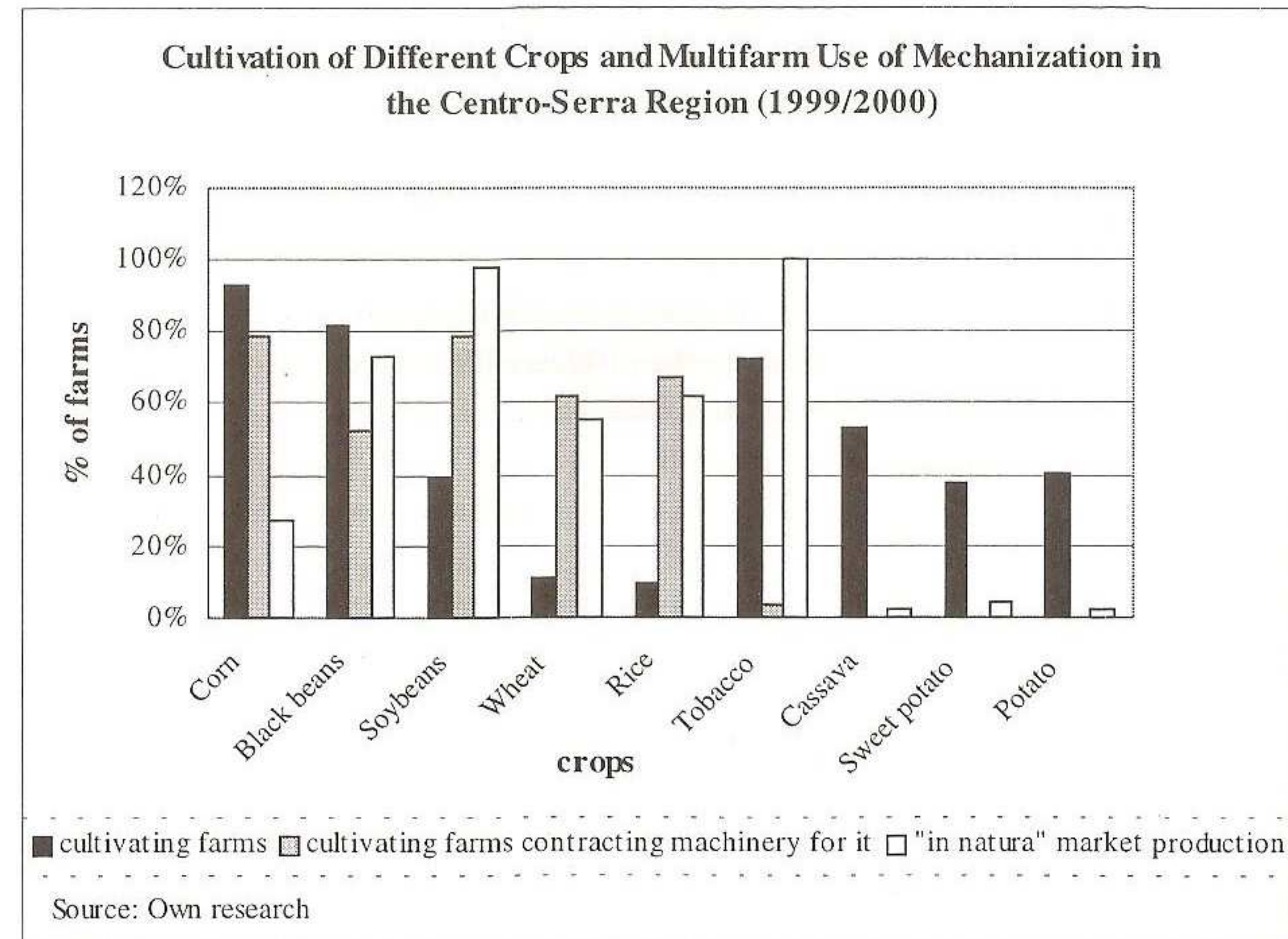


Figure 1: Percentage of Farms Contracting Machinery Services that Cultivated Different Crops, Used the Contracted Machine for its Cultivation and Percent of the Production Sold "In Natura" (Without Transformation) in the Centro-Serra Region (RS/Brazil), 1999/2000.

As shown in Fig. 1, corn, black beans and tobacco are being cultivated by most farmers contracting machinery services in the region (> 70%). Besides this, other crops like soybeans, cassava, sweet potatoes and potatoes are also being cultivated. As can be seen in this figure, tobacco and soybeans are typical cash crops. Tobacco is consumed neither by humans nor by animals. Only a few farmers are using soybeans as a source of protein to feed cows. Corn seems to be a very important crop because more than 90 percent of farmers cultivate and also consume an important share of production as food and feed. Cassava, sweet potato and potato are cultivated for food in smaller plots by about 40% of the machinery contracting farms. As a consequence of the smaller plots and the

subsistence orientation, only a few farmers utilize machinery on these plots and only if they own the machines. More market oriented crop production becomes more mechanized, with the exception of tobacco.

Mechanizing the cultivation of soybeans, corn, wheat and black beans is easier than of tobacco, mainly due to the basic machinery for preparing the soil (in tillage systems), drilling, applying pesticides and harvesting is similar. Only for the harvest of these crops, some differences can be found: the black beans are normally harvested by hand and after the plants have been dried out by the sun, they are threshed out by a stationary thresher, generally powered by a tractor; the soybeans, the corn (grain) and the wheat are harvested by combines and the silage corn is harvested by special forage harvesters. Furthermore the equipment for mechanizing these crops is cheaper than that for tobacco.

In animal production, used equipment and machinery are normally owned by the farmer. As reasons for buying the equipment for animal production, farmers argue that they need them every day and can not wait until they would become available from other providers. Only for constructing fish tanks, a few farmers have contracted services with special machines mainly from public providers.

As Table 2 shows, farms are contracting on average 2.5 different machines for their whole farming system. The four crops with common equipment (corn, black beans, soybean and wheat) have a similar number of different machines being contracted by farmers, varying from 1.25 for wheat up to 2.26 for corn. For rice, the number of different contracted machines is 3.25 on average, which is higher than that of the other crops, but only a few farmers (less than 10%) are cultivating it and contracting machinery for its production (Figure 1).

Table 2: Descriptives on Number of Machines Contracted for the Whole Farms as well as for the Production of Corn, Black Beans, Soybeans, Wheat and Rice in 1999/2000

Parameter	N*	Min.	Max.	Mean	Std. Dev.
Total # of Contracted Machines	113	1	6	2.52	1.33
# contracted machines for corn production	88	1	6	2.26	1.26
# contracted machines for black bean production	53	1	4	1.94	.95
# contracted machines for soybean production	37	1	4	1.89	.91
# contracted machines for wheat production	8	1	3	1.25	.71
# contracted machines for rice production	8	1	5	3.25	1.28

Source: Own research.

The crops that more often become mechanized by contracting machinery services are corn, black beans and soybeans (Figure 1). A closer look into the activities within each crop that becomes mechanized by contracted machinery reveals that nearly all activities become mechanized by contracting machinery services. But there are mainly three (groups of) activities that become mechanized more often through contracted machinery services: the no-tillage drilling (by no-tillage seed drill), the crop protection (by field sprayer) and the harvesting (by stationary thresher, combine harvester and silage corn harvester) (Table 3).

Knowing the main activities that become mechanized by contracted machinery we go further and try to find the main providers for each type of machinery. If we look after the providers of equipment for drilling, spraying and harvesting, we find that farmer contractors are the more often mentioned provider, except for silage corn harvester (Table 4).

Table 3: Contracted Machinery for Corn, Black Bean, Soybean and Wheat Production in the Centro-Serra Region 1999/2000

Contracted Machines	Production of							
	Corn (N1=88)		Black Beans (N1=52)		Soybeans (N1=37)		Wheat (N1=8)	
	N2	%	N2	%	N2	%	N2	%
<i>Soil Fertilization:</i>								
Bulk Lime Spreader	5	5.7	3	5.8	3	8.1	-	-
Slurry Tank Spreader	9	10.2	1	1.9	-	-	-	-
Fertilizer Broadcaster	2	2.3	2	3.9	-	-	-	-
<i>Soil preparation:</i>								
Disc plough	3	3.4	-	-	-	-	-	-
Disc harrow	2	2.3	-	-	-	-	-	-
Heavy tine cultivator	9	10.2	3	5.8	-	-	-	-
Rotary tiller	1	1.1	-	-	-	-	-	-
<i>Drilling:</i>								
No tillage seed drill	49	55.7	40	76.9	20	54.1	-	-
Tillage seed drill	2	2.3	-	-	-	-	-	-
Animal drawn no tillage seed drill	3	3.4	2	3.9	-	-	-	-
<i>Crop protection:</i>								
Field sprayer	33	37.5	23	44.2	13	35.1	-	-
Animal drawn field sprayer	3	3.4	2	3.9	-	-	-	-
<i>Harvesting, transportation and processing:</i>								
Stationary thresher	3	3.4	23	44.2	1	2.7	-	-

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Contracted Machines	Production of							
	Corn (N1=88)		Black Beans (N1=52)		Soybeans (N1=37)		Wheat (N1=8)	
	N2	%	N2	%	N2	%	N2	%
Tractor mounted corn cob picker	5	5.7	-	-	-	-	-	-
Combine harvester	35	39.8	-	-	28	75.7	7	87.5
Trailer	-	-	-	-	1	2.7	1	12.5
Lorry	1	1.1	1	1.9	1	2.7	1	12.5
Seed drier	8	9.1	-	-	-	-	-	-
Grain cleaner	-	-	-	-	1	2.7	1	12.5
Tractor mounted silage corn harvester	20	22.7	-	-	-	-	-	-

N (total farms considered) = 121 farms; N1 = number of farms contracting any kind of machinery for this crop; N2 = number of farms contracting the specific machine for each crop; % = N2/N1.

Source: Own research.

Table 4: Mechanization Providers for No Tillage Drilling, Crop Protection and Harvesting in the Centro-Serra Region (RS, Brazil) 1999/2000.

Contracted machine	Providers of contracted machinery (%)				
	Informal sharing	Farmer contractor	Cooperatives	Farmer groups	Prefeitura*
No tillage seed drill (N=57)	1.8	45.6	5.3	24.6	22.8
Field sprayer (N=34)	2.9	55.9	5.9	35.3	-
Stationary thresher (N=25)	8.0	88.0	4.0	-	-
Combine harvester (N=45)	-	77.8	20.0	2.2	-
Silage corn harvester (N=26)	7.7	-	11.5	46.2	34.6

* Government of the municipality.

Source: Own research

From the 57 statements about contracting no-tillage seed drill services, only 1.8% accessed the service by informal sharing of the equipment whereas 45.6% of farmers declared that they used farmer contractors. 5.3% reported that they use cooperatives, 24.6% that they use farmer groups as provider and 22.8% used the services provided by the government of the municipality. Herein, the main providers of no-tillage drilling services are the farmer contractors, farmer groups and the local government. Farmer contractors, as mentioned above, own the machines and use their over-capacity to increase the extent of utilization of their machinery in order to decrease fix costs. Often, farmer groups are mentioned, where farmers have more affinities to their neighbors, especially when they are family related. The local government as a provider seems to be

only a temporal phenomenon because of the political moment, where the actual administration looks for subsidies by the national government to offer this kind of services to farmers for lower rates than other providers can do. When subsidies will disappear, these services will not continue in the same quality (new machines, lower rates).

Looking for providers of field sprayers used for crop protection, we found a similar situation: mainly farmer contractors and farmer groups are mentioned. This is mainly because both technologies are inter-connected. If a farmer wants to drill without tillage, he also looks for a sprayer to apply the total herbicide before drilling. So, both machines are strongly related resulting in a somewhat technological package, which is used for many months over the year, especially the sprayer.

The harvesting technologies require some introductory explanations before we discuss the results. In the research region, the stationary thresher is mainly used for threshing out the black beans, mainly because of the low plant height so the harvest by combine is not possible. Farmers pull out the bean plants and put them in the sun for drying. After that, they collect the plants and thresh them out by stationary threshers. Other plants become harvested by combines without limitation of the low plants height. This is the case with soybeans, wheat and corn. Traditionally, corn was also harvested by hand: cobs were collected and then threshed out by stationary threshers. But this has changed during the last years, and this trend will probably continue into the future because of high demand of labor and the increasing level of wages. A very crop specific activity is the harvest of silage corn. The equipment, which is mounted on a tractor of about 45 up to 60 kW (kilowatt), is only used for corn. It is used over a longer period of time, however, because of the different drilling periods and the variation of the cycle length of the used cultivars, which are mainly hybrids.

Contracting stationary threshers, as mentioned before, are mainly used in black bean harvest. Farmer contractors are the most important providers of this technology (88% of farmers contracting it). The reason why mainly farmer contractors are providing this service could be the availability of time during the harvesting season (December-January). On the other hand, for the bean producing farmers, it is very important to clear up their fields to drill in the next crop, generally corn. In addition, the black beans can not remain for a long time on the fields after having reached maturity. Losses will otherwise take place. These reasons together with the spontaneous and flexible decisiveness makes the farmer contractors the most used provider.

If we consider the combine harvester, again farmer contractors are the providers most frequently used. In addition to that, cooperatives appear to be the second provider in frequency of mentions. But the farmer contractors are, with 77.8% of mentions, the most important providers in the research region. The farmer (contractors) has many advantages compared to the cooperatives, amongst them mainly the "less time to wait for service" is mentioned by farmers. The cooperatives as providers of combine harvesters

seem to have some disadvantages compared to farmer contractors, i.e. more waiting time for farmers to receive services as well as the problem of administrating the cooperative, which in the research region often lead to conflicts between farmers. These cooperatives were formed in the past through subsidies and special credit programs as well as through the assistance of German specialists on multi-farm mechanization. In the beginning, the cooperatives were the only available provider, but nowadays the competition is more stiff, which makes it difficult for the cooperatives to exist as a machinery provider. Here also the Brazilian laws concerning the social security of the operators of cooperative's machines are factors that contribute to the higher rates and difficulties to sustain.

The silage corn harvester seems to be a particularity: there is no farmer in our research sample that contracts it from a farmer contractor. Mainly farmer groups (46.2%) and the mechanization services of the local government (34.6%) are mentioned as provider. Cooperatives and informal sharing were mentioned, but only by a few farmers. There are many factors that contribute for farmer groups to be the most important arrangement for providing the used silage harvester:

- apart from the silage harvester, farmers need some trailers and tractors they may not have, so they can share them with the other group members;
- because of the long term planning (milk production), farmers prefer to use good relationships with their neighbors, who generally form the group.

The mechanization services of the local government again reaches its importance as a provider mainly because of its lower rates. How long this service will be provided to the farmers in the actual conditions can only be speculated at this moment.

4 CONCLUSIONS

The results of this research showed that in the Centro-Serra Region of RS mainly no tillage drilling, spraying and harvesting of corn, black beans, soybeans and wheat become mechanized by contracting machinery services.

Farmers prefer to own the machinery used for animal and feed production (or at least a share of them). This could be shown with the silage corn harvester being used mostly in farmer groups. On the other hand, for cash crops like black beans and soybeans, more flexible and adaptable arrangements like farmer contractors are preferred by farmers.

This should lead to more research especially concerning the costs of each arrangement type for the specific machinery.

5 PERSPECTIVES AND RECOMMENDATIONS

More research about farmers' costs by each arrangement concerning contracting machinery services should be conducted with a focus on monetary and non-monetary transaction costs.

The mechanization strategies of the local and regional government should take into account that the main activities that become mechanized by any kind of contracting machinery are the no-tillage drilling, spraying and harvesting of corn, black beans, soybeans and wheat.

As competition between farmers will become stronger in the future, the reduction of production costs will be just one measure to manage that. The multi-farm use of machinery could contribute to reduce the production costs and should be further locally and regionally improved. Therefore, local and regional policy decision makers as well as agricultural extension services and financing institutions are challenged to promote the existent forms of multi-farm use of agricultural machinery and also to create new arrangements of providing machinery services to the farmers.

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