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TECHNOLOGICAL CHANGE AND THE TRADITIONAL SMALL FARMER OF RIO GRANDE DO SUL, BRAZIL

Norman Rask

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June 1972

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This paper concerns research on the determination and evaluation of capital formation and the relationship of this process to technological change and economic development for the small farmer of Rio Grande Do Sul in Brazil. The author provides a general background of the geographic region and settlement patterns and a general description of small farm agriculture as it is practiced in Rio Grande do Sul-Brazil. this Brazilian state

The study reports on rates of technological change on farms as related to farm size, ~~to the~~ technology available, and ~~to~~ institutional settings. Findings are ~~that small~~ farms are not keeping pace with rates of technological change and growth on large farms. related to farm size

A case study of more than 6500 small farms located in the municipio of Lajeado is presented. Farm characteristics are provided on land use, cropping patterns, livestock numbers, labor supply, number of people residing on farm and years of schooling completed by farm operator.

A summary of the principal costs and return components are presented. This is followed by an analysis of two factors affecting income: use of technology and farm size.

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	Page
Background	2
Geographic Regions and Settlement Patterns	5
Small Farm Regions	7
Cattle and Wheat Regions	8
Small Farm Agriculture in Rio Grande do Sul	9
Lajeado -- A Case Study	13
Major Farm Enterprises	16
The Corn Enterprise	16
The Hog Enterprise	18
The Dairy Enterprise	20
The Tobacco Enterprise	21
Economic Performance	23
Costs and Returns	23
Use of Improved Technology	24
Farm Size Consideration	27
Conclusions	29
FOOTNOTES	31
BIBLIOGRAPHY	33

Technological Change and the Traditional Small Farmer of Rio Grande do Sul - Brazil

by Norman Rask

Rapid technological change in agriculture is a recent phenomenon for most developing countries. Where rapid change has taken place, the impact on farm families and rural communities often differs greatly from one area to another. In some areas farmers make dramatic changes in their production practices while in other areas change comes very slowly. These differences in the rate of technological change result from several factors including, (1) the characteristics of the available technology, (2) the structural form of agriculture into which technology is introduced, and (3) the composition and orientation of the institution serving agriculture.[1]

Technology comes in many forms. From an economic point of view we can identify at least two. One is that technology in which economies of size are related to its use. Most forms of mechanical technology fall in this category. Tractors, for example, generally require a minimum size of farm before they can be economically utilized. Non-divisibility and direct substitution for other inputs--in this case labor--are usually important characteristics of this form of technology. A second form, is that which is highly divisible in its use and therefore neutral toward size. Fertilizer, hybrid seed, and pesticides are examples of this form.

The most common structural difference in the organization of agriculture relates to size of farm. The distributional nature of farm sizes in any given agricultural society may range from uni-modal where all farms are relatively uniform in size to bi-modal where significant numbers of farmers are found at both extremes of the size continuum. Size also has

implications for the amount and composition of other required inputs. Many forms of mechanical technology for example, can be appropriately employed only on large farms. Enterprise choice and combination are additional characteristics that distinguish farms in the use of technology.

A third force that helps shape the development and use of new technology is provided by the institutions that directly or indirectly serve agriculture. From the allocation of resources among areas of public research to policies that encourage or discourage the use of specific forms of technology, these institutions can have significant impacts on the rate and direction of technological change in agriculture. Credit and price policy are two examples of important institutional forces that effect technological change.

The interaction of these three forces; the form of available technology, the structure of agriculture into which it is introduced, and the institutional setting together determine the path technological change will take. The primary focus of this chapter is on the structural component, and more specifically one aspect of that structure, namely small farms. The form of technology and the institutional setting are treated where appropriate.

Background

Rio Grande do Sul is the southern most state of Brazil. Its agricultural structure is essentially bi-modal with significant areas of both small and large farms. Today, the small farm agriculture of this state finds itself at a crossroads of development. The recent introduction of new and profitable production techniques has encouraged many farmers of the state to intensify and broaden the use of technology. The early adopters, however, have been the medium and larger farms while small farmers have lagged behind. Why is this true? In Rio Grande do Sul, several structural factors have contributed to the problem of the small farmer in a time of technological change.

First, many small farmers are constrained by a small resource base which limits their ability to acquire and utilize economically many of the new forms of technology. Further, this resource base commonly exists in a less than optimum combination. That is, capital in its many forms is traditionally scarce relative to labor. Thus, forms of technology that substitute for labor are often inappropriate. Others that require substantial cash outlays cannot be financed from current income, forcing the farmer to enter the credit market for resources to acquire the new technology.

A second obstacle relates to the farm organization. Most small farms are diversified. Several crop and animal enterprises are combined to make the best use of the limited resources. Technology, however, is often crop or livestock specific. Thus it is easier for a single-enterprise farmer to learn about and apply technology for his operation than it is for a diversified situation that may involve several different forms of new technology.

A third factor is concerned with the manner in which institutions serving agriculture relate to the farmer. Again, it is apparent that educational and communication services (extension), credit institutions, government price and credit policies, and technology development (research) are usually more oriented toward the larger commercial farmer. In many cases the establishment of these services and institutions may not consciously favor the larger farmer, but in their operations this bias evolves [12].[2]

The impact of these structural factors is further reinforced by the specific geographic conditions and settlement patterns that resulted in the initial establishment of the small and large farm areas in Rio Grande do Sul. As new technology is introduced into these situations a further polarization of the agricultural structure occurs.

Today, there are two major farm groups in the state. One group, the large farms, is characterized by medium and large cattle and wheat farms. It has made substantial use of modern technology, agricultural credit, and enterprise specialization with a concomitant increase in output and farm income. This is in sharp contrast to an area of small farms which is lagging behind in the adoption and employment of new technology. The small farms located in a mountainous region, include about one fourth of the land area of Rio Grande do Sul. However, this region is considerably more important in terms of people since its 375,000 farms include over two thirds of the farms in the state. It is characterized by rugged terrain, small diversified farms and traditional forms of cultivation. Continued subdivision of farm units is further restricting the ability of the small farmers to adopt modern technology and generate sufficient incomes.

The small farmers are decendants of European settlers who came to Brazil during the 1800's. In most instances, they have maintained language and customs from Europe until recent years. They are considered traditional not in the absolute sense, but because they have lagged behind while significant changes in technology use, productivity, and economic growth have occurred in adjacent rural areas and in the general Brazilian economy. Some recent advances have been made by the small farmers, however, the changes are generally in areas of technology requiring very little cash outlays.

We begin our discussion of the small farmer of Rio Grande do Sul with a description of the area, including its geography, settlement and present economic situation. This is followed by an in depth case study of one representative community, Lajeado, within the region of small farms. Detailed farm level data was originally collected from a sample of farms in this community in 1965. The same farms were revisited in 1969 to measure the changes that had taken place in the intervening four years.

Geographic Regions and Settlement Patterns

Rio Grande do Sul is bordered on the east by the Atlantic Ocean, on the south by the country of Uruguay, on the west by Argentina, and on the north by other states of Brazil. This area is located in the temperate zone of the southern hemisphere at about 30° latitude. Altitude variations coupled with favorable latitude location have allowed most tropical and temperate climate crops to be grown in close proximity.

An important geographical feature of southern Brazil is an escarpment located near the Atlantic Ocean at an altitude of approximately 3,000 feet above sea level (figure 1). This escarpment is prominent along the eastern coast of each of the four southern states with the exception of the southern half of Rio Grande do Sul, where it turns inland. The escarpment is the beginning of a great plateau which is inclined from the sea to the west. The tilt of the plateau to the west has resulted in almost no major river systems on the east coast of southern Brazil. Rivers beginning near the escarpment, only a few miles from the sea, flow hundreds of miles before entering the Atlantic Ocean as part of the Platte River system in Argentina.

In contrast to the high plateau, there are two low-level plains in this area. One is a narrow coastal plain along the Atlantic coast. The other is an interior open range land area in the southern half of the state of Rio Grande do Sul.

A fourth geographical area is a mountainous region connecting the escarpment to the low-level plains.

Each of these areas is represented in the agriculture of Rio Grande do Sul and is characterized by distinctive soil, topography, vegetation, and climate conditions which have resulted in different patterns of settlement and systems of agriculture.

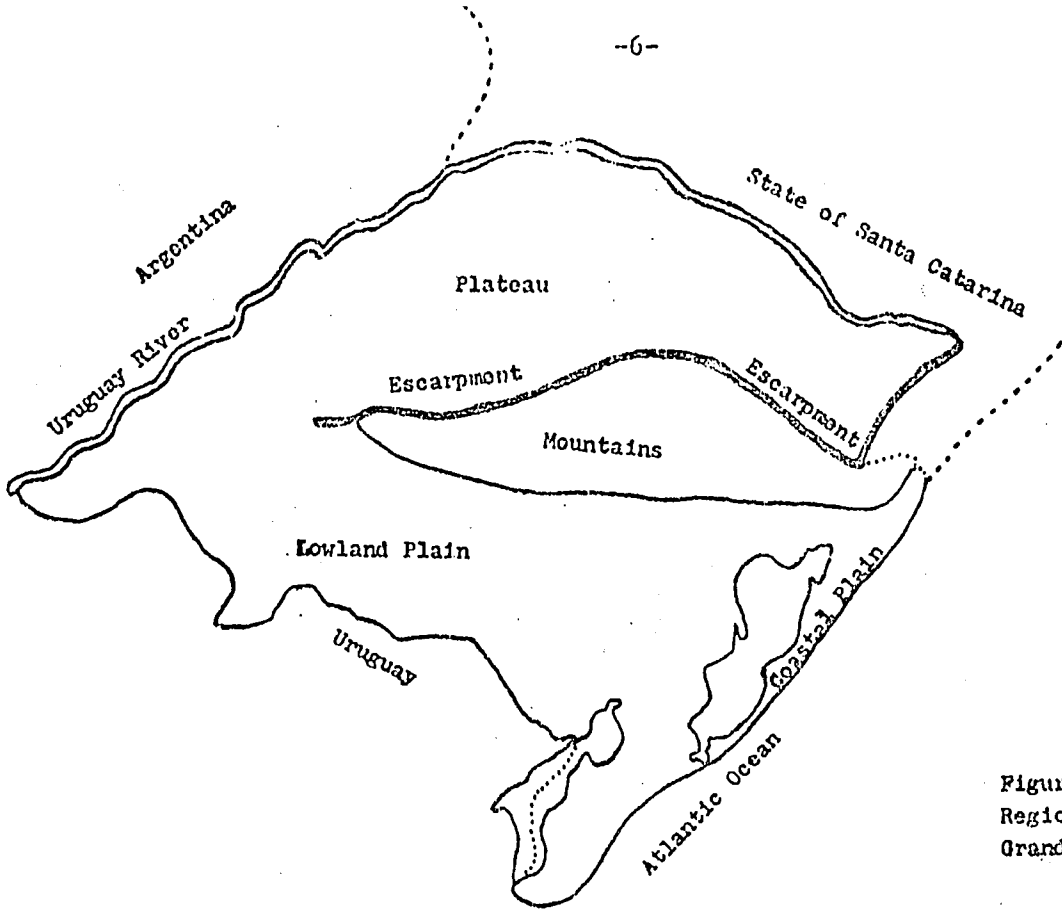

Figure I. Geographic Regions - State of Rio Grande do Sul - Brazil

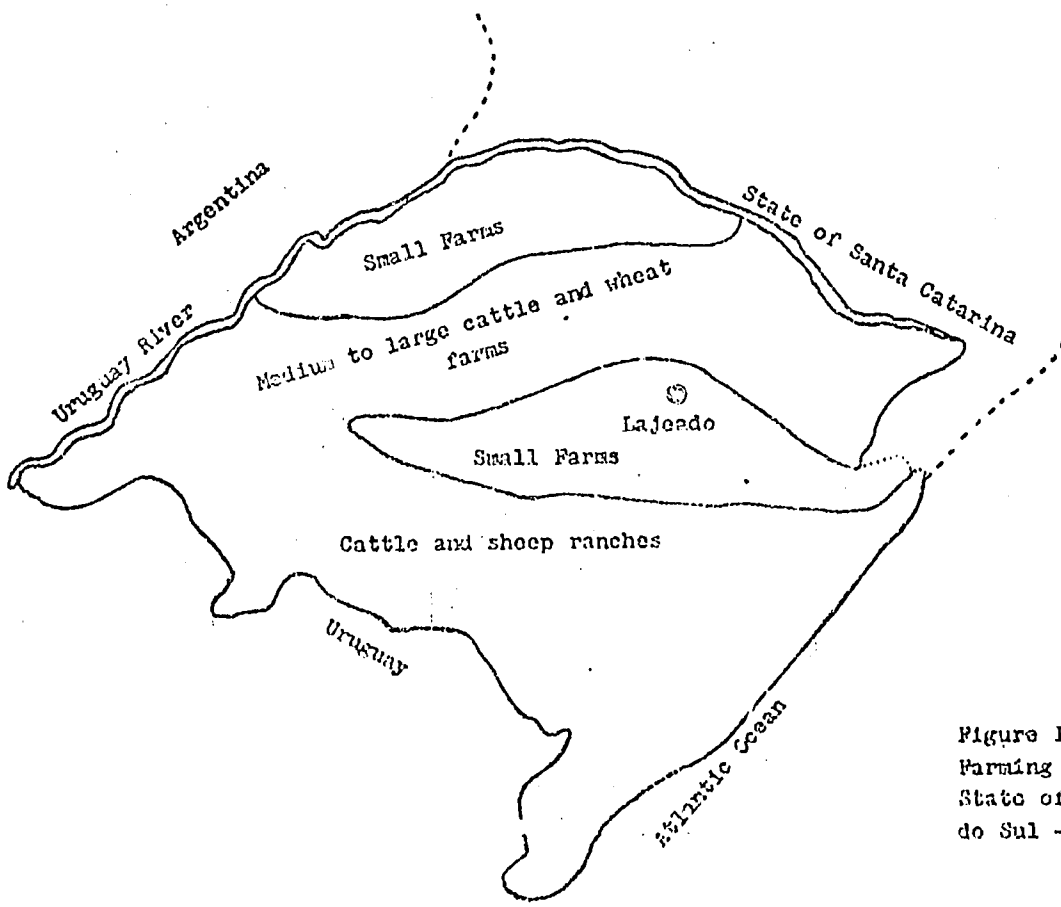

Figure II. Type of Farming Regions - State of Rio Grande do Sul - Brazil

Small Farm Regions.

The mountains that extend from the coastal plain to the high escarpment are composed of a series of very steep hills and valleys. The rapid increase in elevation results in substantial annual rainfall. The natural vegetation is tropical forest of deciduous trees. The soils are relatively fertile, but because of topography problems do not lend themselves well to intensive cultivation or mechanization. This area was settled by European immigrants coming to Brazil in the middle 1800's and later. Many people still retain their native language, principally German and Italian. The immigrants were settled on small farms (25-30 hectares). Most of the potentially tillable land has been cleared and presently is under cultivation. Farm subdivision is resulting in a sharp increase in the number of smaller farms.

Agricultural production is carried on in a part subsistence, part market oriented economy and consists of essentially mixed farming: corn and beans are the most important crops, and hogs the most important livestock enterprise. In regions close to major cities, a substantial amount of dairy products are produced.

The coastal mountain range continues inland through the middle of the state of Rio Grande do Sul connecting the southern extremity of the high plateau with the lowland plain. The municipio of Lajeado is located in this geographical area.

A second area of small-farm agriculture is located in "mountainous areas" on the high plateau.[3] Where the rivers are cut very deeply into the plateau, climatic and topographic situations and settlement patterns similar to those of the coastal mountain range are found. These interior mountainous regions were settled in the early 1960's by second and third generation descendants of Germans, Italians, and other European immigrants moving from the

coastal mountain range into the interior valleys. Also, the types of agricultural production found in the interior valleys are similar to those of the coastal mountain range.

Cattle and Wheat Regions

The open plain of the plateau was the first area settled for agricultural purposes. It was settled in large estates for the Production of beef cattle. The present agricultural production is still predominantly range livestock carried on under reasonably large farm situations. However, agriculture on the open plain of the plateau has recently undergone a partial transition to highly mechanized wheat and soybean production. The farms are medium to large. Due to the transitional nature of the agriculture, systems of farming run the gamut from traditional to the most modern of mechanized units. Also, because of the high cost of mechanization and reluctance on the part of traditional cattlemen to shift to more intensive land use, different tenure systems have evolved. Initial impetus for change was given by professional or business people in the city who purchased machinery and rented land from cattlemen for the production of wheat.

The introduction of mechanization for the purposes of wheat production and the resulting cultivation of land has also led to the use of these machines for the establishment of improved pastures for cattle grazing.

The lowland plain of the southern half of the state of Rio Grande do Sul is an open grassland area which, like the high plateau, was settled by Spanish and Portuguese settlers interested in cattle raising. The type of agriculture is mixed sheep and cattle production on large farms using traditional ranching practices. Some wheat is produced here also; however, climatic conditions are less favorable than on the plateau.

Some irrigated rice is produced along the principal waterways. Farms are relatively large, generally ranging in size from several hundred to several thousand hectares.

In summary, the present form of agriculture of southern Brazil and Rio Grande do Sul is a result of the distinct geographical and climatic base found in each area and is partly dependent on the settlement patterns which have evolved over time. Three commercially important types of farming can be identified. First, in the open area on the high plateau and on the low grassland area of Rio Grande do Sul is found an extensive cattle and sheep grazing agriculture based on large farms. Second, within these same areas, many farms are now undergoing a technological revolution in the use of modern agricultural inputs as they change to mechanized cash grain production. Third, in the mountain regions, mixed farming of various kinds with a predominance of corn and hogs is found on medium and small farms. This latter area has lagged behind in the adoption of modern technology. An existing disparity in levels of farm income between these two major regions is further accentuated by the differential impact of technological change.

Small Farm Agriculture in Rio Grande do Sul

The number of farms in Rio Grande do Sul has increased dramatically in recent years. During the decade 1950-60, farm numbers increased by one-third, while the number of farms of less than 10 hectares (22 acres) doubled. Estimates of total number of farms in 1970 show an even greater increase during the last decade (45 percent). This increase in farm numbers, and greater concentration of farms in smaller size categories demonstrate the increasing importance of small farm agriculture in Southern Brazil, and the need to more clearly understand the particular characteristics of this segment of agriculture.

The purpose of this section is to present an overview of the general characteristics of the small farm regions. Small farms, while displaying considerable variability do have certain general characteristics which set them apart from the larger, more commercial farms of adjoining regions. These characteristics are the following:[4]

1) Farm ownership - The farms are almost always owned by the person operating the farm business. Studies in the small-farm regions indicate that about 97 percent of the farmers own the property they work. In some areas the number is nearer to 90 percent, partly because of the incidence of tobacco farming in which a share-crop system is quite common. Also, about 15 percent of the farmers rent some additional land to enlarge their farm operation.

2) Farm Size - The number of hectares operated, varies from one to over fifty. A majority of the farms, however, have from 10 to 25 hectares. Farms with less than 25 hectares constitute almost three-quarters of all farms in the region. Crop land normally occupies from one-third to more than one-half of the total land area operated.

3) Labor supply and utilization - The labor supply is composed almost totally of members of the immediate family. In some cases small amounts of seasonal labor are employed during periods of peak labor requirements. The incidence of full-time employed labor is very rare. On most farms the supply of family labor is often in great excess of that needed to perform the productive farm operations.

In addition to being in abundant supply, this family labor has little alternative use other than on-farm employment. The amount of productive farm labor available averages from two to more than three man equivalents

per farm. The smaller farms have the lower values of available family labor, indicating a greater necessity for some members of the family to seek other forms of employment.

The contrast between available family labor and the amount of productive labor needed to operate the farms is very apparent, especially on the smaller farm sizes. For example, the farms under 15 hectares have about two times as much labor available as they can productively utilize. Farms under five hectares have from three to four times more labor than is needed [15].

Crop production accounts for the greatest use of the labor supply (60 to 70 percent). This is generally true for both large and small farms.

4) Crop and livestock diversification - Though the farms are small, many forms of livestock and crops are found on each farm. For instance, almost all farms will have milk animals, poultry, and hogs, and will raise a variety of crops for both sale, and animal and family consumption. Corn is the principal crop grown and normally occupies from one-half to two-thirds of the cultivated acreage. It is used principally as a livestock feed for hogs, which in turn constitute the principal livestock enterprise and source of income. Cash crops, with regional variations include corn, soybeans, wheat, tobacco, and black beans. Commerical dairy herds are located near urban centers; however, on the typical farm, dairy product sales are seasonal and consist of surplus supplies above family consumption needs.

5) Productivity levels - Levels of both crop and livestock productivity demonstrate two important points. 1) They are generally very low, and 2) the difference between the high level producers and the average is very great, often achieving the magnitude of two and three times. For example, in one study [9], the high ten percent of the farms in the production of corn achieved yields of over 3,000 kilograms per hectare, while the average

for all farms was about 1,200 kilograms per hectare. In milk production the high ten percent achieved levels twice as high as the average. In hog production the number of market hogs raised each year for one sow was three times as high and the average age for selling fat hogs was less than half when the more efficient farms (high ten percent) were compared with the average.

6) Home consumption - A significant portion of the annual livestock and crop production is consumed on the property by the farm family. The actual percentages will vary depending on farm size. On the larger farms studied, an average of from 20 to 30 percent of total production was consumed at home, whereas on the very small farms this percentage approached 80.

7) Power sources - The necessary agricultural operations are performed largely by hand methods with limited animal power. The incidence of tractors or modern land preparation, cultivation or harvest equipment is very small. Often dairy animals serve a dual role as work animals.

8) Little modern technology - Hand methods of performing farm operations is one indication of low use of modern technology. Others are: little use of fertilizer, hybrid seeds, seed innoculation, etc., with crops and the lack of use of modern sanitary and feeding practices with the livestock enterprises. The lack of application of technology results in general low levels of productivity in the crop and livestock enterprises and to substantial differences between these low averages and the results obtained by the few farmers employing improved methods as noted in the discussion of productive levels above.

9) Low incomes - The resulting economic performance as measured by farm income is very low. Enterprise diversification and little use of modern methods combined with a small land base result in low levels of productivity per acre or animal, and do not allow for any of the benefits of speciali-

zation. Thus, the possibility for a large volume of production, already hampered by small farm size, is further reduced by the low per-unit levels of production. To this is added an abundant and, in most cases, excessive labor force (even with hand methods of work) which further dilutes the small volume of production when considered on a per-man basis.

The cumulative effect of these typical conditions in the small farm area is a low level of productivity for each agricultural worker and, hence, a low economic return for the work he performs.

It has also been reported that as farm size increases, the productive capacity of labor is still not sufficient to reward itself with an adequate return [9]. This indicates that whether farm size is increased or not, there has to occur some increase in the productive capacity of labor. This can be accomplished in part through the application of new technology. The utilization of currently available technology however, is not widespread, though some advances have been made recently in the use of low cost technology.

The above description typifies in a general way the major characteristics of the small farmer. The remainder of the study is devoted to an in depth case study of one municipio (county), Lajeado, within the small farm region. Ninety-one farmers in three districts of Lajeado were interviewed in 1965 and again in 1969. This was a period of time in which significant gains in the use of technology and credit were being experienced by many farm regions in Brazil. The small farm region unfortunately did not share equally in this growth. Use of output-increasing technology and the necessary conditions for its introduction and use are a central part of the following analysis.

Lajeado -- A Case Study

The municipio of Lajeado is located near the center of the state of Rio Grande do Sul. The topography of the area is varied, but generally

mountainous. There is a central river valley bordering Lajeado on the east. In the extreme northern part, the mountains blend into the high plateau. Altitude variations range from 100 to more than 2000 feet above sea level. Many of the farms are located on very steep slopes. It is an area of small farms producing primarily pork, dairy products, tobacco, and corn. The soils are basically lateritic developed from a basalt base. They are highly acid (about 5.0 ph), low in phosphorous and high in potassium. Aluminum toxicity reduces yield potential in most areas, while erosion is a problem, especially on steeper slopes. Annual precipitation averages 48 inches, with good seasonal distribution. Light frost may occur occasionally at night during the months of June through August.

The area was first settled by German immigrants in the middle 1800's. The original colony was established in 1836. A smaller, more recent Italian settlement is located in the northern part of the municipio. The immigrants were originally settled on farms of about 25 hectares in size. The process of population growth and subdivision of property has resulted in a gradual decline in the average size of property. Today, there are more than 6,500 small farms in Lajeado and more than 50 percent contain less than 15 hectares.[5]

There are two distinctly different institutional frameworks serving the agriculture of the region. One surrounds the production of tobacco and tobacco products and is composed of a highly vertically integrated industry with one dominant company acting as a price leader. The other framework includes all other agricultural enterprises and displays the more typical situation of a variety of institutions serving the farm people. In the case of tobacco, the companies buying tobacco from the farmers also supply

the seed, fertilizer, insecticides, fungicides, small implements, and curing barns which are necessary purchased inputs for growing tobacco. With little exception, these items are advanced to the farmer and their cost subtracted from the value of his crop at the end of the season. In addition, the companies furnish technical consultants who instruct the farmers in the proper methods of growing tobacco.

For other agricultural enterprises, a variety of institutions serve the farmers. ASCAR, an autonomous extension service supported with federal funds, maintains an office in Lajeado and employs two agents, one man and one woman, to instruct the farm people in proper farming methods and to disseminate other information of general help to the agricultural community. The state government also maintains an agricultural extension office with one agronomist and one rural technician.

There are several banks and other financial institutions giving credit to farmers. The most important for the small farmer is the Bank of Brazil. The county government purchases some items for resale to small farmers, such as hybrid corn, fertilizer, some types of feed and medical supplies. These are sold at cost, with only a small extra charge to cover handling costs (about ten percent).

There is one slaughter house which purchases most of the hogs and sells some hog feed. Much of the dairy production is marketed privately by the producers or consumed at home. The rest is sold to local distributing or processing plants, hospitals, and other similar establishments.

Farmers were interviewed in three of the eight districts in Lajeado. Each of the three districts represents a different market and resource situation. District one is located along the river valley, has superior soils

and topography, and includes the county seat. District two is located in the foothills of the mountains. It has relatively good access to markets. Topography and soil conditions are less favorable than district one. The third district is situated at the higher elevations near the edge of the plateau. The region is extremely mountainous, with poor soils. Consequently, farms need to be considerably larger to provide enough tillable land to support a farm family. A major all-weather highway completed in 1969, now links the plateau area of Rio Grande do Sul with the state capital. This road passes close to but does not pass through each of the three districts. Districts one and two, with previous access to markets did not evidence major adjustments following completion of the road. However, new patterns of agriculture and employment are already evident in district three.

Major Farm Enterprises

Farming in Lajeado includes a variety of farm enterprises often on the same farm. Four principal enterprises, two livestock and two crop, are selected for detailed description here. They are corn, hogs, dairy, and tobacco.

The Corn Enterprise

It has been estimated that 40 percent of the cultivated land in the small farm area is devoted to corn production. Farms in Lajeado clearly follow this pattern as corn accounts for more acreage than any other single crop (Table 1). Furthermore, corn is a multi-purpose crop. It is the principal feed input for fattening hogs on the more advanced farms. It is consumed in large quantities in the farm household where it serves as the flour for making bread. And finally, it can be sold or purchased, depending on the manner in which the farm operator combines the various farm enterprises.

Until recently the common system of corn production utilized very little advanced technology. Traditionally, a white variety of corn has been used because this is better for making the corn flour that is used in the household. Recently, however, improved varieties of field corn have been introduced. Use of fertilizer on corn is practically nonexistant. The common method of planting is to place 3-5 seeds in a hill and space the hills about a meter and one-half apart, (four and one-half feet). Often other crops such as pumpkins, black beans, soybeans or cassava are planted between the hills of corn. This intertilling of crops is more common on the smaller farms. For example, in the first two districts sampled, over 90 percent of the farms followed this practice. On the larger farms of district three over 60 percent planted planted companion crops with corn. The planting is done during the months of August, September, and October. When the crop is mature the farmer passes through the fields and breaks each corn plant below the lowest ear. This is done so the ear will be pointed downward and thus prevent the penetration of water inside the husk. The corn is then harvested over a several month span, March to June, as needed, depending on the use, storage facilities, and time available.

On most farms storage facilities are not adequate. Therefore, when hogs are kept on the farm as well, the harvest period serves as a hog fattening period and when the corn is consumed the hogs are marketed. If the corn is produced for sale, it is generally sold at harvest. The price of corn, therefore, displays a pronounced cycling effect each year. It drops 30-50 percent in price soon after harvest begins and remains low throughout the harvest period. It begins to increase gradually in July and reaches a peak in February. It then falls off rapidly as the new years production comes on the market.

The Hog Enterprise

Hogs are found on more than ninety percent of the farms in Lajeado. They are the most important single source of cash income and an important part of the meat consumed in the farm home. Fifty percent of the annual commercial slaughter is processed during the four month period June through September. Another thirty percent is slaughtered in October, November, and December. The remaining twenty percent is processed during the five months January through May. The price drops about ten percent during the heavy slaughter period of June through September. Until recently there has been very little price incentive for the meat type hog and a discounted price when the weight of the hog does not fall within the 80-140 kilogram category.

The enterprise was originally established on the basis of a fat-type hog. At the present, the Duroc Jersey is gaining increasing approval among the more advanced farmers.

The sows generally have one litter per year, usually in the summer months January to March. The litters are small and mortality is high. There is considerable variation among farmers. For example, about 30 percent weaned fewer than five pigs per sow each year. Only fifteen percent weaned more than ten. The timing of reproduction is tied closely to the seasonality of feed production with heavy marketing in the winter, June through September. This is because corn is harvested in April, May, and June. With little adequate storage available it is fed out and the hogs marketed. Prior to the few months of fattening the hogs subsist on cassava, sweet potatoes, pumpkins, and pasture. Often many of these ingredients are mixed together and cooked before being fed to the hogs. This process is called "lavagem."

TABLE I

Farm Characteristics
Lajeado - 1969

Farm Characteristics	District I	District II	District III
Land Use (hectares)			
Cultivated	7.8	6.7	7.7
Pasture	2.0	3.7	9.4
Other	5.6	4.3	14.3
Total operated	15.4	14.7	31.4
Cropping Pattern			
Corn	3.4	2.8	3.7
Soybeans	2.7	1.9	.4
Wheat	.1	.1	1.7
Cassava	.8	1.1	.5
Tobacco	.3	.3	.9
Other	.5	.5	.5
Total	7.8	6.7	7.7
Livestock Numbers			
Cattle	9	11	11
Hogs	22	25	17
Poultry	54	48	52
Draft animals*	2.6	1.9	3.0
Labor Supply (man-equivalents)**			
Family	2.7	2.7	3.0
Hired	.1	.1	.1
Total	2.8	2.8	3.1
No. of People Residing on Farm	5.0	4.8	7.5
Years of Schooling Completed by Farm Operator (% of Total)			
0	4	2	30
1-2	7	6	18
3-5	89	92	52
	100	100	100

*In many instances, dairy animals served a dual role as both dairy and work animals. Therefore, this value is somewhat underestimated.

**A man-equivalent is defined as 300 days of productive labor available on the farm and is determined by age and sex for family members.

The principal problems limiting the productivity of this enterprise are health, sanitation, feeding and breeding.

Health and sanitation are the most important problems and severly limits any potential benefits from better feeding and breeding. The State Department of Statistics shows a 20 percent mortality in the hog herd of the state each year. Some veterinarians working in the field place the estimate as high as 30 percent. The greatest loss occurs prior to weaning. Poor care of the young pigs, dirty pens, exposure to wind and rain and a general lack of health management are the principal causes of the high mortality rate.

Other than the fattening period, the hogs are not fed corn and in general are not fed well. Balanced rations are used by only a very few farmers. The present feeding method, with the fat type hog and late marketing, results in a feed conversion ratio of six or seven to one.

The Dairy Enterprise

Milk production is a secondary enterprise on most farms in Lajeado. While dairy cows are commonly found on the majority of farms (92 percent of the farms have at least one cow), the average number of cows per farm is only 3.3. When specialized dairy farming is found, it occurs near several major market outlets. Lack of good all weather roads, suitable transportation and cooling facilities limit the production of milk for fluid sales to the proximity of the markets.[6] For example, while most farms have dairy animals only 30 percent actually sell dairy products. This indicates that the presence of dairy cows on many farms is for home use only and that sales are generally the result of seasonal over-production that cannot be consumed in the household.

With the marked regionality of commerical milk production and the benefits that accrue to farmers located near marketing outlets, the possibilities for expansion in the near future will be limited to the present milk production areas. Expansion of commercial milk production into the interior of the municipio must await the development of new market outlets.

The principal limiting factor in milk production is proper feeding. Native grasses do not provide year round feed and few farmers go to the trouble of providing more than the minimum requirements for animal life during the winter period.

The Tobacco Enterprise

Tobacco occupies a special position in the agricultural life of Lajeado and when viewed in a time perspective presents an unusual paradox. It is the principal income generating enterprise and the only crop alternative for the very small farmer who does not have enough land to economically produce any other crop. But, on the other hand, it is a contributing cause to the gradual decline in farm size. As population pressure increased and available new land became increasingly more difficult to find, it was easy for farmers to divide their properties among their sons and with the cultivation of tobacco, each could maintain an economic unit. Also the development of share cropping, especially in tobacco, has led to further intensification of people on the land.

Tobacco has unique features which have given rise to the present system of production. First, it has a heavy labor requirement and a low land requirement. Tobacco does not lend itself to mechanization. It requires hand labor and constant attention throughout all phases of planting, growing, harvesting and curing. Furthermore, the diverse operations are ideally

suited to a family labor supply as some tasks are better or at least equally well conducted by children, such as the first harvesting of bottom leaves of the plants. A few norms have been established with regard to this family source of labor. A curing barn capable of handling normal production from 1.6 hectares of tobacco is considered capacity for a family of five to six people. When a property has two or more curing barns, each is typically handled as a separate unit by separate families. This is the basis for the "parceiro" or share cropping arrangement in which a landowner furnishes the land for growing tobacco, the curing shed, a small house, enough other land for producing food for home consumption, and often some animal power. The annual inputs are supplied on credit by the tobacco company and the landowner and parceiro divide the profits, usually on a 50-50 basis. Estimates of the number of share croppers reach as high as 30 percent of all tobacco producers.

The tobacco companies are vertically integrated, manufacturing and selling finished tobacco products. On the production side, they provide all inputs and services except land, labor and animal power, including a very systematic management service. The necessary production inputs are provided to the farmer by the company. Payment for the inputs is merely deducted from the value of the crop at harvest time. The reason for company control of the basic production process is that the company needs certain types and qualities of tobacco in specified amounts to make their finished products. By controlling the basic production they are able to specify the variety of tobacco a particular farmer may grow, and through their management service they guide the planters to produce the qualities necessary for their particular blends.

The organization is efficient and it would appear that the costs of inputs to the farmer are minimal. The system, however, is not without drawbacks. Agronomists admit that on the various soils of the region several different types of fertilizer should be used. However, they buy only one analysis for convenience. The rigid control of all phases of the production process leaves little room for effective experimentation, and a general attitude of non-cooperation with extension agencies dampens the opportunity for new ideas to penetrate the established system of work. Finally, much of the management is based on the technical questions of how much, what kind, and what quality of tobacco the company wants and not on the economic well-being of the producer.

Economic Performance

This section looks at some of the economic factors, and resulting incomes on the farms in Lajeado. First a summary of the principal costs and return components are presented. This is followed by an analysis of two factors affecting income: use of technology and farm size.

Costs and Returns

Livestock, particularly hogs, are the principal source of cash income on farms in Lajeado (Table 2). Among the crops, soybeans and tobacco are major sources of cash income. Corn, the crop occupying the most acreage is almost totally consumed within the farm (less than one percent of total production is marketed). Tobacco is relatively more important on farms in the third district. Non-farm income is of less importance, however, it has increased sharply in recent years, especially in the third district, where it accounted for about one-fourth of total cash income in 1969.

Among the expense categories, livestock expenses are the largest single item. This reflects the importance of the hog enterprise. Capital expenditures increased greatly in the third district during 1969. Cash living expenses are quite uniform for each area and account for about one-half of total farm and family expenditures.

It is difficult to evaluate the changes in income levels, between 1965 and 1969, since inflation rates of 20 to 40 percent were encountered during this period. However, when the monetary values are expressed in terms of constant 1969 dollars, it appears that modest gains were experienced in family income. Similarly the cash requirement for family living went up slightly while the value of home produced consumption items declined.

The substantial changes noted in the third district, including an increased emphasis on wheat and tobacco, a ten-fold increase in non-farm income, expanded agricultural credit and capital improvements all point to a fundamental adjustment of the economic life of this area. These changes probably result from increased opportunities presented by the construction of a major farm-to-market, all-weather highway passing close to this area. Wheat and tobacco are both market crops requiring purchased inputs and market outlets. Improved transportation facilities also open up employment opportunities in neighboring cities. The new road has increased the economic opportunities available to the farm people and it appears that they have quickly taken advantage of these new possibilities.

Use of Improved Technology

The small farm agriculture of Rio Grande do Sul has not kept pace with a major expansion in the use of new technology in neighboring areas of Southern Brazil. Lajeado, reflects this general trend. However, several interesting patterns of technological change have emerged in recent years. Fertilizer use, for example, did not increase during the period of study in

TABLE 2 Cash Flow and Income Measures
Lajeado - 1965 and 1969

Cash or Income Category	District 1965 I	1965 II	1965 III	1969 I	1969 II	1969 III
	(1969 dollar equivalents)					
Receipts						
Hogs	$450	$285	$137	$343	$334	$163
Other Livestock	169	176	90	237	284	168
Wheat	1	4	9	0	5	80
Soybeans	110	76	9	153	111	15
Tobacco	28	65	152	82	57	125
Other crops	7	15	99	19	16	41
Other farm receipts	51	56	15	49	30	33
Total farm receipts	816	677	511	883	837	625
Capital sales	46	0	0	91	45	26
Non-farm income	55	5	24	189	114	237
TOTAL CASH RECEIPTS	917	682	535	1163	996	888
New Credit	35	51	80	148	76	156
Expenses						
Crop costs	19	29	49	43	18	35
Livestock costs	181	99	147	157	123	66
Other operating costs	83	67	69	127	91	99
Total operating costs	283	195	265	327	232	200
Capital purchases	215	121	9	261	159	325
Loan payments (principal)	40	2	14	42	42	11
Cash living expenses	415	453	462	500	479	484
Income Measures						
Inventory change	30	22	66	-55	78	-9
Depreciation	107	24	8	34	21	16
Perquisites	289	283	358	244	196	287
Gross farm output	1031	880	825	921	972	812
Net family cash income	634	487	270	836	764	688
Net family income	846	768	686	991	1017	950

districts one and two (Table 3). However, it more than doubled in district three. A close analysis of the data demonstrates that fertilizer use is almost exclusively tied to two crops, tobacco and wheat. Both crops showed substantial increases in district three in 1969, hence the dramatic increase in fertilizer use there. Further, each of these crops has a special institutional incentive for the use of modern inputs. In tobacco, the purchasing companies provide the necessary inputs, including fertilizer.

Table 3 Change in the Use of Selected Technologies Lajeado - 1965-1969

Technology	District I	District II	District III
	(percent of farms using)		
1965			
Fertilizer	25	27	30
Improved seed	21	23	24
Insecticides	46	47	30
1969			
Fertilizer	32	23	64
Improved seed	75	70	76
Insecticides	71	53	58

In the case of wheat, the government provides special low interest credit for production expenses associated with wheat growing. Two other components of crop technology were accepted by more farmers in 1969. Insecticide use

increased about fifty percent in this time period, and the use of improved seed showed the most dramatic change, with a three-fold increase.

It is interesting to note that these latter practices are both relatively inexpensive, while adequate inputs of chemical fertilizer require substantial cash outlays. Further, farmers were willing (or able) to purchase fertilizer only when outside financial resources were made available to them either through company financing (tobacco) or special credit programs (wheat). This experience gives additional support to the key role of credit as an important prerequisite for significant increases in the use of output increasing technology in small farm areas.[7] It is often argued that the real benefits from technological change come only after a series or package of new inputs are adopted.[8] Certainly fertilizer is a major component of the crop technology package.

Similar situations are apparent in the livestock enterprises, where some non-cash or inexpensive technologies were accepted, but little use of high cost technology such as balanced rations was apparent.

Farm Size Consideration

Farms in Lajeado are considered small within the context of all farming in Brazil. However, there is considerable size variation among the farms in Lajeado ranging from one to over fifty hectares. The purpose of this section is to look briefly at some of the differences between farms based on size. For purposes of our discussion, the most meaningful measure of size, is the number of hectares productively utilized. A concept of land equivalents was used to separate the 91 farms into three groups.[9] Farms with less than ten hectares of land equivalents were placed in the first group, those with from 10.0 to 19.9 land equivalents in the second group

Table 4 Farm Size Comparisons
Lajeado - 1969

Characteristics	Farm Size Groups (Land Equivalents)* under 10	10 to 19.9	20 and over
No. of Observations	13	43	35
Land operated (hectares)	7.2	15.1	33.3
Land cultivated (hectares)	3.4	6.4	12.0
Income**			
Gross output	$358	$754	$1,276
Cash Income	158	445	722
Farm Income	256	547	1,011
Family consumption of farm products:	$153	$232	$289
as % of Gross output	44%	31%	23%
Man equivalents of family labor	2.0	2.4	3.4
Percent of farms using:			
Fertilizer	23%	42%	60%
Insecticides	77%	65%	49%
Improved seed	46%	81%	74%
Credit	46%	44%	46%

*One land equivalent is equal to one hectare of cultivated land or three hectares of natural pasture.

**Expressed in 1969 dollar equivalents.

and those with more than 20 in the last group (Table 4).

First, as we look across farm size groups, there is little evidence of economies or diseconomies of size. That is, larger farms do not use their land resources more (or less) efficiently than smaller farms. Gross output and farm income measure, on a per cultivated hectare basis are relatively constant for each size group.

The smaller farms are more subsistence oriented in that they consume a larger percentage (44) of their farm production than do the larger farms (23). Family labor supply is also less on the small farms, indicating a lack of employment opportunities and a need for family labor to find jobs away from the farm property.

Perhaps the most significant differences are in the use of modern technology. Improved seed and fertilizer use are much less prevalent on the small farms. When this finding is considered along with a greater subsistence orientation and consequent low levels of cash income, it is again apparent that limited capital resources may be in part responsible for the low levels of technology use.

Thus, it is apparent that the selective process in the use of new technology favors larger farms, within the small farm region as well as between regions.

Conclusion

The small farmers of Rio Grande do Sul are not keeping pace with the general rates of growth experienced by larger farms. Small size, significant quantities of subsistence production, enterprise diversification and low levels of technology use result in little surplus income available for making the necessary investments in output-increasing technology.

Enterprises with assured markets, and production financing (tobacco and wheat) are exceptions to this general rule. While many small farmers are making modest advances in the use of low cost technology, investments in fertilizer, improved rations, and other forms of more expensive technology have been limited to a few farms and even then for selected enterprises only. The failure to include these forms of technology in the production process not only deprives the farm operators of their direct effect on output, but also diminishes their complementary effect on other forms of technology such as improved seed. Thus the advantages of the "package effect" are not realized.

Access to credit markets and assured product prices have been successful precursors to technology use on larger farms and with selected enterprises in the small farm region. These incentives must be provided on a broader scale to small farmers if this segment of Brazilian agriculture is to keep pace with other areas in the use of new technology, and to share in the increasing levels of productivity and income made possible through the use of this technology.

FOOTNOTES

[1]For an excellent treatment of the dynamics of technological change at the community level see Gotsch [5]. He considers four factors, 1) the characteristics of technology, 2) the absolute magnitude and relative distribution of productive assets (especially land), 3) the types of institutions and organizations that exist at the local level and the distribution of their services and 4) social customs and traditions.

[2]A more favorable situation has existed throughout the decade of the 1960's in the large-farm areas of Rio Grande do Sul. Guaranteed prices for wheat and favorable credit policies for wheat production costs, and machinery acquisitions have created an environment that has stimulated massive changes in the use of technology and enterprise combinations. These policies have resulted in tremendous increases in output and farm income and have increased domestic wheat production from 10 to 50 percent of Brazil's domestic consumption needs in a period of eight years. Small farmers have shared only marginally in these government incentives.

[3]The first of these regions is located in the valleys and on the mountain slopes that rise from the east and central part of the state toward a high grass plain that runs from the northeast to the southwest. Most of this area is included in the region commonly called "Encosta Inferior do Nordeste." The second area lies in the north and west extreme of the high plain and is called "Alto Uruguai." Both areas were originally covered with forest and first settled by European immigrants and their descendents, principally from Germany and Italy. The first area was settled in the mid-1800's and the second area within the last 50 years.

[4]A series of farm and community level studies carried out by the Institute of Economic Studies and Research (IEPE), of the Federal University of Rio Grande do Sul serve as the basis for this general description of small agriculture in Rio Grande do Sul. While the discussion is limited to one state, the small farm situation described here is common to each of the three southern states of Brazil. Problems associated with small-farm agriculture can be found throughout Brazil; however, the physical and economic setting in other areas will be different, though many general conditions will have wide application.

[5]For more complete description of the municipio of Lajeado see [8].

[6] A study of dairy farms in a neighboring municipio found the specialized farms situated around the major city [14]. This small group of specialized dairy farms averaged 11.5 cows per farm and in general was more technologically advanced than the average producer. The differences in the dairy enterprises noted between the commercial group of dairy farms and other small farms are substantial. For example, the average annual production per cow is more than two times as great on the commercial farms near the city. Furthermore, the price received for the milk is from 50 to more than 100 percent greater. This difference reflects (1) lower transportation costs, (2) a greater percentage of fluid milk sales, and (3) the assimilation of some market and distributing functions by the farmer located near the city.

[7] One may argue that perhaps the more expensive technologies are not economically for the small farmer. However, the widespread use of fertilizer in other areas would appear to indicate otherwise.

[8] For example, a study by Sorensen [17] of hog farmers in the small farm regions showed little return to individual practice adoption. It was only after a package of new inputs had been accepted that substantial differences in income were noted.

[9] One land equivalent is equal to one hectare of cultivated land or three hectares of natural pasture.

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