MODERNIZATION AND COMPETITIVENESS AMONG MILK PRODUCTION SYSTEMS

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ABSTRACT - This paper examines two questions: a) why do small farmers maintain their activities while earning an income for their labor that is below the opportunity cost? and b) why do these farmers persist in using traditional production techniques, knowing that improved techniques could increase the productivity of their labor and capital? The results of this study indicate that a small farmer may increase his family income more effectively using traditional production techniques that increase the use of family manual labor than by technological modernization that requires capital investments and scale to become profitable.

Key words: Competitiveness, milk production system

INTRODUCTION

Technological agriculture modernization is a progressive process. During this process some farmers innovate earlier than others and may be able to achieve higher profits, determined by how much the new technologies reduce costs and the stability of the product price. This situation can be transitory if the innovators' larger gains begin to attract imitators, thereby increasing product supply to a point which provokes a reduction of the price received by the producers.

The producers who adopt cost reducing technological innovations in the expansion of their enterprise elevate their gains. However, to the measure that the product prices are reduced due supply expansion, the

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innovators' additional gains can disappear. Should prices rise, producers who were unable to reduce their costs may be unable to continue operating in the activity, (Veiga, 1991) or may have to produce with a very reduced remuneration.

Empiric observations indicate that technological improvement generally comes accompanied by an increase in the scale of and an increase in productivity which causes a product supply increase. In this sense " the technology that has been developed for agriculture resulted in a larger production capacity in each property or per person, in such a way that a smaller number of people are able to produce the food and raw materials requirements demanded and consumed by the whole population (...)." As consequence, many farmers can be forced to leave farming (Ciprandi, 1996, p.139) or be forced to live at the very low income level that their farming activities generate.

In this "squeezing out," many competitors will be excluded from the unless they accept operating at a remuneration for their factors that is inferior to the opportunity cost. This exclusion is a distinct possibility for the smallest productive units or in the ones that delay the modification of their productive methods.

The research presented in this paper was derived in an attempt to better understand why many small commercial dairy farms continue to have relatively inferior per per-cow productivity rates when well-known technology to improve productivity exists.

The analysis is based on the assumption that many small family farmers cannot enlarge the physical scale of their activity due to investment capital restrictions; and that under these restrictions, they cannot increase their family incomes by using highly productive technologies. We then study the hypothesis that the continued use of an intermediary technology which makes maximum use of internally available factors and minimizes monetary outlay is a reasonable option for small producers.

Advanced technology, if adopted on an appropriate scale, reduces costs in milk production, and conserves both labor and capital; yet there is no general consensus that an advanced technology which maximizes per cow productivity will always provide the small producer a higher income. In certain contexts, the adoption of less advanced technologies which increase, but can't maximize, per animal productivity

may be the best method to improve family income.

The small family farmer's economic survival is linked with the economic feasibility of commercial milk production using an intermediary technology that depends on inputs produced within the farm property rather than external industrial inputs.

Thus, the productive organization with smaller productivity which expands the use of internally available factors, particularly labor, can be rational and provide a better family income. This is especially true for the small family farmer who cannot afford to expand and lacks alternative external employment opportunities for his family labor force.

Section 2 of this research paper describes the factors which led to the expansion of milk production in Rio Grande do Sul during the decades of the 1980's and 1990's and provides some indicators of the predominant technology used in this production. Section 3 then develops a theoretical basis for the hypothesis that the continued use of labor intensive intermediary technology is a rational option for small producers. In Section 4, the costs and profitability of several milk production systems is comparatively examined using a conventional approach to opportunity costs of owned factors. Section 5 tries to identify those systems that provide larger remuneration per unit of product. In this paper's conclusion, we give a rationale for the small family farmers continued use of traditional, low yield, labor intensive production techniques.

SOURCES OF THE MILK SUPPLY INCREASE IN RIO GRANDE DO SUL

By definition, the amount of a product produced is equal to the number of factors in use multiplied by the productivity of that factor. In the case of milk production, the physical size of the activity, corresponds to the number of cows in production, multiplied by the physical productivity of the cow.

Increase in production can come from expansions in the scale of the activity (an increase in the number of cows), from technological improvements (production increases per cow) without increases in the physical scale, or by the sum of those changes, when simultaneous.

These relationships are expressed, for the example of milk as:
Q =A x Q/A, for:
Q = amount of milk produced
A = number of cows in production; and,
Q/A = median production of milk per cow in production.

The application of these relationships to milk production in Rio Grande do Sul shows that during the decade of the 1980's the observed increases in milk production, slightly above one percent a year, resulted only from increases in the number of animals producing (variation in A), while productivity (Q/A) decreased annually at a rate of 0,94% (Table 1).

In all of Rio Grande do Sul's Great Regions (Mesorregiões), the number of cows increased, but productivity slightly improved in only one of the Regions and decreased in the rest of the state.

Table 1 - Rio Grande do Sul: annual relative variation in the number of milked cows and in the productivity of the animals.

Great Regions	Variation 1980-1990		Variation 1990-1993	
	No.of cows	Produtiv.	No.of cows	Produtivity
Northwest Rio-grandense	3.09	0.07	3.19	3.08
Northeast Rio-grandense	3.32	-0.78	4.42	1.77
Western Center Rio-grandense	2.12	-0.67	4.14	-0.31
Eastern.Center.Rio-grandense	0.33	-0.13	-4.14	-3.93
Metropolitan Region of P.Alegre	0.61	-2.83	-0.40	2.82
Southwest Rio-grandense	1.66	-2.47	0.76	0.63
Southeast Rio-grandense	0.75	-0.69	-2.07	0.82
Total of the State	2.04	-0.94	1.52	1.45

Source: FIBGE, Agricultural Censuses, 1980 and 1985; FIBGE, Researches of Municipal Cattle Production, RS, 1990 and 1993.

However, beginning in the first years of the current decade; component productivity (Q/A) began to contribute significantly to the increase in total milk produced. The number of milked cows also continued to grow in most of the Mesorregiões, thus in the entire state. Some milk producers had adopted technological improvements, yet the main reason for the increase in the quantity of milk produced con-

tinued to be an increase in the number of cows in production.

Two regions, the Northwest and Northeast Rio-grandense, expanded the size of their dairy herds and improved their herd's productivity. The Metropolitan Region of Porto Alegre improved productivity but did not expand the size of their herd. In the Western Center Rio-grandense and Southwest Rio-grandense, little or no improvement in productivity was observed but herd size increased. In terms of total state production, the evidence points to a change in productivity's contribution to the growth of total milk production. From 1990 to 1993, herds grew and productivity increased at a similar rate of nearly 1.5% a year.

In spite of this increase in productivity, small scale production using low level traditional or intermediate level improved production techniques continues to prevail. This can be verified in the information contained in Table 2. This Table presents statistical information regarding the milk suppliers contributing to the Central Cooperative Gaúcha of Milk Products - CCGL, who, at the time of the research, accounted for 60% of the state's commercial milk production, equivalent to 412 million liters in 1991.

The milk received by CCGL was supplied by 22 affiliated Cooperatives that operate throughout the state. Thus, the information provided by CCGL's research can be considered a representative sample of commercial milk production in Rio Grande do Sul.

Table 2 - Technological Indicators of Milk Producers Associated with CCGL; divided by Size of Production Units; - CCGL, 1990-91.

Indicators	Strata of Area of Productive Units (hectares)							
	- x - *	0-5	5-10	10-20	20-30	30-50	>50	Average
% of observations * *	3.6	6.0	16.6	34.9	18.6	12.3	8.0	-
Milk production Area (ha.)	5.7	1.9	2.7	3.9	5.7	7.7	17.6	5.6
Cows in Production	4.5	4.0	4.5	5.4	6.5	7.4	12.0	6.1
Daily production (liters)	23.7	20.7	22.3	27.9	34.8	42.5	69.7	33.2
Daily prod. Per cow(liters)	5.3	5.2	5.0	5.2	5.4	5.7	5.4	5.4
% Income from Milk * * *	34.8	40.6	36.1	32.5	27.2	24.7	20.0	30.6

* - Without indication of the area of the productive units

* * - The total number of observations was 19470.

* * * - Percentage of the total income of the productive unit, obtained with the milk production activity.

Source: LAUSCHNER et alii: Diagnóstico da produção de leite no Rio Grande do Sul e opções para o vseu desenvolvimento; final Research Report; São Leopoldo, 1997, Table 12, p. 33.

The research conducted by CCGL clearly indicates that the majority of milk producers in Rio Grande do Sul are small productive units. The units of production of up to 20 hectars total area correspond to 57.5% of the researched total, and their median daily milk production is below 30 liters. The number of cows in production is slightly above 4.0, and the daily productivity per cow is nearly 5 liters.

Nearly one third, 30.9%, of the dairy farms are between 20 and 50 hectars, but the area occupied with the milk production activity varies from 5.7 ha in farms of 20-30 ha and 7.7 ha in farms of 30-50 ha. The daily median production of these groups of producers is 34.8 liters for the first group and 42.5 liters for the second. The median productivity per milked cow is slightly superior to that of the previous group but below 6 liters a day.

At the time of the research, 8.0% of the producers that supplied milk to CCGL had a total land area above 50 hectars and they produced, on average, about 70 liters daily. But the average productivity of their cows (5.4 liters/day) was not superior to the one of the previous groups.

These statistics show that milk production in Rio Grande do Sul

continues, at least through 1990, with few cows in production and low per animal productivity. There is little marketed product; consequently, the income derived from the activity is small.

To exemplify: a daily delivery of 30 liters at a producer price of R$0.22/ltr represents a monthly gross income of around R$200. If monetary costs, plus depreciation of capital correspond to 60% of that income, the producer's monthly income from the sale of milk is approximately R$80.

The assumed production level or below and the corresponding economic results or smaller are representative of the great majority of the state's milk producing units. This is also true of the low productivity numbers which are caused by the limited adoption of improved technology.

Such results frequently lead to technical and academic discussions of the low income level of families in the dairy business and the appropriate technology to be used by milk producers. Evidently, it is thought that technology and production scale are the direct determinants of the income level reached by the dairymen if the price paid to small dairy operators is not above the one assumed in this exercise.
This leads to a comparative analysis of the two following productive strategies' effect on farm family incomes: technological improvement with diminished use of family labor but increased productivity, or increased use of family labor combined with more traditional technology and lower expenditures.

WHICH TECHNOLOGY IN MILK PRODUCTION?

According to basic suppositions of economic theory, the permanence of producers in the activity of milk production requires that they be competitive in the market, assuring remuneration at least equivalent to the opportunity cost of the factors allocated to the activity. This opportunity cost, when considered in the context of the effective options for factor occupation in alternative activities within the production unit or outside of it, can represent very small or no value.

A farmer who doesn't consider as an option the abandonment of farming activities to work in urban activities, even if limited or no opportunities of rural salaried work exist, experiences minimum or nil

real opportunity cost.

In such a case, a remuneration below the commonly specified salary for equivalent factors acting in urban or rural activities can correspond to the effective opportunity cost. This cost can be characterized as the minimum remuneration that the farmer demands for not being lazy and continuing to produce. Consequently, decisions made by agricultural families can be based on options that provide better employment of the internal factors, although at a price that is less than those usually considered as opportunity cost.

One may need to be reminded that the criteria that define the decisions of rural producers are not always the ones that correspond to an accounting analysis guided by maximum profit. In certain contexts, rural producers don't rationalize in these terms. A farmer's objectives depends a lot on his stage of economic development. The objectives of the farmers, mainly the objectives of small farmers, "may have a stating point equivalent to a minimum - survival. As time passes, they seek improvements, growth, and a increased profit; and in a later stage they establish as their objective the effort to reach maximum profit and prestige " (Konzen, 1993, 108).

A recent study conducted by the technicians of The Center of Research for Small Properties - CPPP, - Chapecó, Santa Catarina, recommends as technological option for the production of milk in the western Santa Catarina, "a scale of six to ten cows for the representative farm and per cow productivity of 8 to 12 daily liters of milk per cow" (Testa, 1994, p. 179). The recommended system supposes that the activity of milk production be shared as only one of many other commercial farm activities. According to the authors, "the basic point to be defined is the degree of desirable diversification that is adequate for the available production factors of land, capital, and labor...," if the main objective is the maintenance of a family farm (Testa, 1994, p. 179). The scale of the recommended combined activities should be compatible with the farmer's resources, allowing for internal utilization of wastes that result from farm activities. The sum of the activities should also provide a satisfactory income to the rural family and not require special investments in technology, such as: special buildings,

genetic interference with animal reproduction, and commercial animal feed.

Under the proposed conditions, milk production is an activity that absorbs a great amount of labor; and the yearly family income per cow should vary between R$230.00 and R$420.00 according to the study's authors (Testa, 1995, p. 179).

The family income derived from milk production is important for the small producers as it constitutes their main consistent cash flow during the year. Milk production, although contributing less than 40% of the total annual income for most of the milk producing farmers in the State of Rio Grande do Sul (Lauschner, 1997), can be essential for financial viability and family survival within the rural sector.

It is known that highly improved technology may demand a larger scale of productive activity beyond the resources available to many small family farmers. In such cases, technological improvements may lead to an inefficient occupation of available resources. Specifically, it can lead to the under-use of the family labor force, and provide a smaller total family income.

In such cases, the farmer may be better off maintaining productive technologies that are more traditional and less productive by unit of factor employed. Using traditional farming methods, the farmer may better use of the available resources and increase his family income; although, this may result in lower unitary remuneration for use of some own factors.

COMPARATIVE ANALYSIS OF MILK PRODUCTION SYSTEMS

The modernization of the country's agricultural, cattle, and dairy production methods is characterized by the growing incorporation of commercial inputs (originating from within the sector or of industrial origin), and an increase in farm expenditures for external services (technical, commercial, or financial services). The production costs associated with highly technical production systems imply a greater proportion of monetary costs than those associated with less technical production processes.

This can be observed in the comparative analysis of production costs

linked with the different levels of technology used in milk production which will be presented throughout the remaining sections of this paper. The analysis is based on evidence comes from comparisons between milk production systems in Brazil's South.

A first focus will determine the differences in profitability derived from use of the farmer's own factors among more or less technified systems of milk production within the scale of activities as indicated by the sources of data: The investigation intends to establish which systems provide better remuneration for the labor and capital employed in milk production. This analysis uses normal methods of interpreting cost and profitability.

In a second focus, it is assumed that the framing unit producing milk has underutilized labor and capital for which no alternative use exists; in other words, those factors have a minimum or null opportunity cost. In these cases, the option of maintaining the dairy's production doesn't depend on a payment for labor equivalent to the minimum legal wage; but it can be of another minimum income which the farmer accepts to continue producing.

As long as such a farmer persists in the rural activity, he doesn't demand that his own factors are paid in advance at market price levels as a condition to continue working. He makes no advance computation to determine the labor "wage" level, nor for "the rate of interest to capital allocated." Both factor prices become residual prices.

Comparative Analysis of Milk Production Systems' Profitability

The profitability analysis is based on three sources of milk production costs from the Brazil's South. Several levels of technology adopted by farmers are compared. The information was provided by secondary sources and from several technical publications. The data is appropriate for the purpose of this research.

The first source consists of an analysis by Masutti (1989) who analyzed the milk production systems that prevailed during the middle of the 1980's in Santo Ângelo, R.S. The second source consists of an analyses made by Pelini (1995) which characterized and analyzed systems of

milk production which used traditional technology, intermediate technology, and advanced technology. Pelini used, among other information sources, data provided by CEPA/SC and OCEPAR on three production systems. The third source of data was provided by a partnership between several entities in the State of Paraná, EMATER/PR, FAEP, IAPAR, OCEPAR, SEAB (1996), and analyzed systems of milk production and the accompanying costs of this production in the State of Paraná.

The production costs of each of the production systems considered in this analysis are presented in the form of percentile values relative to the total revenue of the activity, and include both milk production and the revenue that results from the sale of animals (young males and old cows). The most profitable production system is shown by the largest percentage value of the difference between revenues (= 100) and costs when this result is positive, and by the smallest percentage difference between revenue (= 100) and total costs when this result is negative.

The Research in Santo Ângelo

The comparison between two productive systems studied in Santo Ângelo, RS, one employing a low technological level and the other an advanced technological level, indicates a lower variable cost in the system of traditional technology than in the system of high technology. In the same sense, a smaller fixed cost is verified in the low technology production system. In Santo Ângelo, total production costs using traditional dairy technology is 103.9% of total revenues, while costs rise to 139.5% of revenues in the system using advanced technology (Table 3).

The results of the Santo Ângelo research point to a more economically favorable result from using less technologically advanced production methods. But none of the systems remunerated at the expected level for the factors used in milk production. Remuneration was small but close to the expected value for the producers that operated with more traditional production technology, while remuneration using the more advanced production system was not more than 71.7% of the expected.

In the case of the most advanced technology, the author verified

that no adequate productivity increase was obtained to compensate for the elevated costs associated with the new adopted practices.

Analysis of the Milk Production Systems in Santa Catarina

The Institute of Planning and Agricultural Economy of Santa Catarina - CEPA/SC, computed the milk production costs for three productive systems used in the state. They estimating that 80% of all commercial milk producing units in the State of Santa Catarina used at least one of the three systems which levels of dairy production technology.

System 1 dairies used a very low technological level production system characterized by daily milk production per farm of around 30 liters and annual per cow production of approximently1200 liters. This system was used by more than one-half of the producing units in the state.

System 2 dairies incorporated a relatively low level of production technology and corresponded to a daily per farm milk delivery of around 60 liters and median annual cow productivity of approximately 2.200 liters.

System 3 dairies used an intermediate level of production. Annual productivity per cow was 3.500 liters, and daily farm production was around 100 liters.

Table 3 - Costs of milk production, as a percentage of total activity revenue, for different technological production systems used in the South region of Brazil

Systems	Variable costs	Fixed costs	Total cost	Profitability: (Percentage of income / costs)
Santo Ângelo, RS				
Low Technology	54.18	49.68	103.86	96.28
High Technology	62.95	76.51	139.46	71.71
Santa Catarina				
Sys. 1 - Very Low Technology.	125.56	58.46	184.02	54.34
Sys. 2 - Low Technology	104.93	42.62	147.55	67.77
Sys. 3 - Average Technology	81.78	31.25	113.05	88.46
Paraná - OCEPAR				
Sys. 1 - Traditional Technology	107.71	40.30	148.01	67.56
Sys. 2 - Intermediate Technology	69.48	27.43	96.94	103.16
Sys. 3 - High Technology	66.34	19.59	85.93	116.37
Paraná / 1996				
Sys. 1 - Traditional Technology 70.90	52.58	123.47	80.99	
Sys. 2 - Intermediate Technology	87.13	35.24	122.37	81.72
Sys. 3 - High Technology	85.23	31.31	116.54	85.81
Sys. 4 - Most advanced Technology	75.69	27.93	103.62	96.51

Source: MASUTTI, Vilson: "Estudo das relações entre custos, tecnologia, nível de produção e escala de exploração na pecuária leiteira, S. Ângelo, RS;" MS thesis in Agricultural Economics - IEPE/UFRGS, Porto Alegre, 1989;
PELLINI, Tiago: "Estrutura de custos da cadeia produtiva do leite na Região Sul do Brasil;"
MS thesis in Agricultural Economics - IEPE/UFRGS, Porto Alegre, 1995
EMATER/PR - FAEP - IAPAR - OCEPAR - SEAB: "Sistema de acompanhamento do custo de produção de leite no Paraná," -Curitiba, PR. 1996

Production is quite small scale in all the systems, each having 8 to 10 producing cows per farm. The scale of the activity does not appear to grow when the adopted technology becomes more modern (Table 3).

The economic results, when compared among the systems, are more favorable for systems of production incorporating a higher level of technological (Sys. 3). A clear inverse relationship is verified between total costs and technology. It is appropriate to remember the scale of production, measured by the number of cows in production, remains small at all technological levels in Santa Catarina; the number of cows in production is almost the same in each one of the systems.

The variable costs are very high in the very low and low technology systems (Sys. 1 & 2) mainly as a consequence of the amount of labor employed. In the more technologically advanced system (Sys. 3), the high variable cost derives animal feed expenditures.

In the case of Santa Catarina, none of the productive systems in use generate a profit; but the losses decrease as production incorporates a higher level of technology. The remuneration reached in comparison to that expected is just 54.3% in the system of very low technology, 67. 6% in the system of low technology, and 88.5% in more advanced technological system.

Comparison of Technological Systems of Milk Production in Paraná

Two sets of comparative costs for milk production in the State of Paraná are analyzed: the first set is an analysis of three productive systems and was made by OCEPAR in 1988; the second set consists of four productive systems in an analysis carried out by many entities in 1996. The data is representative of the production systems most frequently employed in Paraná.

In OCEPAR's study, system 1 represented the producer who used a low technological level. This system used a great deal of family labor, operated with animals without race quality improvement, and was a small scale operation with 8 cows in production. The per dairy daily average was around 33 liters, with annual productivity of around 1,500 liters per cow.

System 2 represented the producer with medium animal race improvement, producing about 200 liters of milk daily, and operating with yearly productivity of 2550 liters per cow. Milking was mechanical; about 30 cows were in production; and part of the labor force was

hired.

System 3 represented the specialized milk producer with improved animal quality. The daily volume of production was about 800 liters, obtained from 64 cows, each producing 4.500 liters of milk annually. Milking was mechanical, with a milk cooling process on the property. Labor is partially supplied by the family and part is hired.

The economic results, in agreement with the established cost sheets computed by OCEPAR, show that milk production was economically profitable for the larger producers using average and high technology production systems. The result for the small scale farmer using traditional production technology showed that income covered only two-thirds of total costs. Thus, the effective remuneration for use of internal resources corresponded to 67.6% of the expected income.

In the second set of comparative costs associated with different milk production systems in Paraná, the first system is representative of the producer who supplies 36 liters of milk a day, using10 unimproved unspecialized cows, and whose annual per cow productivity does not exceed 1,310 liters. The management of the animals is extensive, feeding is based on perennial summer pastures; and the labor supply is provided by the family.

The second system is representative of the farm unit that provides 175 liters of milk daily, has 20 cows in production, and an annual per cow productivity of approximately 3,200 liters. Half the dairy animals are genetically improved milk producers; handling is extensive; and, besides perennial pastures, annual winter pasture is planted, and sugar cane and other feed are grown. Part of the labor force is provided by the family, but this is complemented with hired labor.

The third system represents the milk producers who deliver about 600 liters of milk a day, with 40 cows in production, and average annual per cow productivity of 5,400 liters. The handling is semi-intensive; there are perennial pastures, annual pastures for summer and winter periods, ration and silage is provided throughout the year. The labor force is predominantly hired from outside the farm.

The fourth system represents highly specialized production system using extensive current technology. Daily production is 1,400 liters, obtained from 70 cows with a median annual productivity exceeding 7,200 liters per cow. Animal management is intensive and the animals

are often confined. Perennial pastures with alfalfa are planted; and feeding occurs in winter pastures, summer pastures, and in confinement. Feed rations and silage are always treated, and the labor is hired from outside sources.

The economic results across the systems again demonstrate that the most technological production systems are more profitable than the ones using inferior technology. The top technological system remunerates almost all individual factors at the expected remuneration level, but it doesn't provide extra profit to the producer. The effective remuneration equals 96.5% of the specified value. For the other systems, the costs surpass the revenues from between 16% to 23%. Which means that the producer factor are not paid at the expected opportunity cost level and expected from the adopted methodology. The remuneration reached in the systems of traditional and intermediary technology is close to 80% of the expected value, and income is within 85.8% of supposed remuneration level in the system using high technology.

In this case, it is likely that the difference between total costs and total revenues is not larger between systems because the authors determined that the labor cost per man was equivalent to 25 cows in production This differs from the economic conditions set-up in other studies. Usually, the assumption is that the amount of labor used per animal unit in traditional, low technology production systems is greater than that needed in an improved technology production system. On review of the figures presented, it becomes possible that the cost of labor in the traditional system is under-estimated, and conversely, overestimated in the case of the higher technology production systems.

Summary of the Comparative Analysis of Milk Production Systems

The several sources of data indicated that milk production becomes more profitable when more technologically oriented production systems are in use. However, in none of the studied cases did the production system provide a profit significantly above the assumed opportunity cost for the use of the owner's time and material.

In 85% of the studied productive systems, the total costs surpassed

the total revenues. Among all analyzed cost schedules, only two systems, the average and the high technology systems studied by OCEPAR, had total costs below total revenue. Those were larger than average scale dairies in the country's South, with an average of 30 cows milked in the medium technology productive systems and 64 cows producing in the systems using advanced technology.

In the other cases, none the most technologically advanced systems provided net profit in the analyzed scale of production. Those systems just reached a remuneration for the owner factors near to the assumed opportunity costs.

Therefore, it seems correct to generalize that the level of remuneration for each unit of the owner's factors is greater if employed in milk production in appropriate scale, technologically improved dairies, than from production using more traditional technology.

But, the amount of owner's factors used to produce each unit of product is significantly less in the more technologically sophisticated production system. Thus, the hypothesis that the income obtained by the farm family for each unit produced is higher using the traditional production system, then when using the more technologically advanced production system. This is the subject of the last focus of this comparative analysis of milk production systems.

FARM FAMILY INCOME BY UNIT OF MILK PRODUCTION: COMPARATIVE ANALYSIS AMONG PRODUCTION SYSTEMS

The data shows that milk production systems using more advanced technology obtained a higher return per unit of labor and capital. The return was close to the owner's opportunity costs, but the amounts of owner factors, mainly labor, used was less per unit of product.

We must next determine if more advanced technological systems also provide higher incomes to the producer per fixed amount of produced milk. That may not be the general case. The small farmer is justified in using less advanced technology if he disposes of enough labor, has no alternative occupation, and he doesn't have necessary investment capital to increase scale and the technological level of production.

A more direct way to analyze the above question is to consider the proportion of total farm family revenue that is generated by milk production using different levels of technology. That will be computed through the accounting measure "Income of the Agricultural Enterprise" (ROA). For that computation the costs of production are presented differently: Remuneration for the owner's factors are distinguished from the other variable and fixed costs (columns 1 and 2, of Table 4, present the costs without the inclusion of remuneration for the owner's factors). In column 3 the expected (opportunity cost) remuneration for the owner's factors is indicated. Thus, the sum of columns 1 to 3 correspond to "total cost" in the previous analysis (Table 3). The owner's actual remuneration for his factors is equal to the revenue received minus the variable and fixed costs.

The expressed values in column 4 of Table 4, correspond to the revenue that the farmer actually receives for his labor and capital, the owner's factors - (ROA), and is only a fraction of the total revenue from the activity. The Table's last column indicates what percentile of the expected income (the opportunity cost for the owner's factors) was actually earned by the owner/farmer.

Table 4 - Milk production costs and farm revenue per unit of product, measured as percentage of price received

Source of the Costs * rem.	Var cost minus Labor.	Fixed cost minus interests	Expected remun.for own factors	Effective remun for own factors	Effective as %, of expected rem.
Researche in Santo Ângelo					
Low Technology	33,33	25,19	46.58	41.48	89,05
High technology	47,46	45,87	46.13	6.67	14,46
Costs in Santa Catarina - CEPA/SC					
Wery low Technology	45.77	21.54	116.71	32.69	28.01
Low Technology	57.47	19.40	70.68	23.13	32.72
Average Technology	59.76	15.61	37.68	24.63	65.37
Costs computation by OCEPAR					
Low Level Technology	4.02	10.96	93.03	45.02	48.39
Intermediate Technology	53.05	8.78	34.71	37.72	108.67
High Level Technology	61.04	5.14	19.74	33.82	171.33
Costs Computation - Paraná. 96					
Low Level Technology	42.23	30.21	51.00	27.56	54.04
Intermediate Technology	73.83	18.56	29.98	7.61	25.38
High Level Technology	77.14	16.50	22.90	6.36	27.77
Top Technology	69.56	13.37	20.69	17.17	82.50

Source: Table 3.

* Obs.: The costs are percentile values relative to the price received for milk. For each source of information this price was the same in all systems.

A analysis of the data indicates the following:

First, the variable costs, not including the remuneration of owner's family labor, are smaller, per unit of product produced by the least technological systems (column 1). There was one exception; the "Top Technology" case (Paraná, 96), which produced on a large scale production.

Second, fixed costs with an exclusion of interest on owner capital (column 2), are higher per unit of product when produced by the less technological systems. One exception is found in the Santo Ângelo research, in which the "High Technology" system operates with more capital invested per produced liter.

Third, the costs for labor and capital, if paid at the median oppor-

tunity cost, are higher in the traditional systems. This form of production requires more man-hours and capital to produce one unit of product than the technologically more advanced systems (column 3). The exception is again in the Santo Ângelo case where the values are nearly equal for the two technological levels.

Fourth, the portion of the revenue corresponding to remuneration for the owner's factors (labor and capital) is always higher among the traditional productive systems than it is for the more technologically advanced systems in these studies(column 4). The inverse relationship between effective remuneration for the owner's factors and technological level hold in all but one case. In the Paraná, 96 sample, the "Top Technology" productive system compensated the owner for his factors more than the "Medium" and "Advanced Technology" productive systems.

This means that a small family dairy farmer obtains, in general, a higher family income by using traditional dairy production methods.

The family income obtained from milk production increases as production technology advances only in the measure that the scale of production increases using the same amount of labor, and the additional capital spending increases are proportionally less than the production increases. Technological improvement is labor and capital saving in milk production .

FINAL CONSIDERATIONS AND CONCLUSIONS

Convergent verification by several studies indicated that the small dairy can obtain a larger family income per unit of product using more traditional production technology. This seems to contradict current thought lauding the advantages of technological innovation and progress.

A large number of families continue milk production using economically inefficient systems when other more efficient more profitable technological options are available. Although decisions made by small farmers do not always appear to be motivated by maximum profit through remuneration for use of their factors above the opportunity cost, one should not suppose that the small farmer is not trying to be efficient within his limitations

This efficiency can consist in choosing activities and technologies that maximize remuneration for all the owner's factors, although this remuneration may still remain below the opportunity cost. Many small commercial milk producers use traditional, non-technologically advanced production methods because it is often impossible for them to increase the scale of milk production enough to justify utilizing improved technology, or they don't want to make milk production their predominant enterprise.

The conclusion is that many small family dairy producers are only able to remain in production using traditional or slightly advanced animal production technology. But, their ability to stay in the market is precarious as the remuneration for their labor is very low. This persistence can only be justified by the absence of alternative employment options or an overriding desire to maintain a family dairy farming tradition. Using this antiquated form of production, the farmer will always be "poorly remunerated" for his labor. The limiting condition for his remaining in the activity will be the minimum remuneration he accepts for his labor.

In the measure that milk processors require minimum daily deliveries from their suppliers and request product quality necessitating genetically improved animals, many small dairies may be unable to continue production due to external exclusion. Although most of the commercial milk producers in Rio Grande do Sul should still be classified as small producers using rudimentary technology, in the future they will probably be moved by market forces to increase their scale and improve the technological level of their operation.

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APPENDIX

Appendix 1 - Composition and Costs of Milk Production and Economic Results of Milk Production in Santo Ângelo, RS, 1985.

VARIABLES	Total Sample	Low Technol	High Technol
Number of observations	91	53	38
VARIABLE COSTS			
Feeding	18,51	14,71	22,12
Labor	18,11	20,85	15,49
Sanity	5,33	4,33	6,26
Transport	8,84	8,62	9,05
Taxes and Other Rates	2,59	2,52	2,65
Several	5,32	3,15	7,38
Total of Variable Costs	58,70	54,18	62,95
FIXED COSTS			
Interests on Land Value	11,15	10,02	12,23
Interests on Value of Animals	17,10	15,71	18,41
Costs with machines	19,90	9,12	28,94
Costs with Buildings and Structure	15,91	14,83	16,93
Total of fixed Costs	64,05	50,92	76,51
TOTAL COST	122,75	105,11	139,46
REVENUES			
Milk Price Received	82,38	79,98	84,61
Consumed Milk	17,64	20,03	15,37
Total	100,02	100,01	99,98
REVENUES - TOTAL COST	-22,73	-5,10	-39,48

Source: MASUTTI, Vilson, J.: Estudo das Relações entre Custos, Tecnologia, Nível de Produção e Escala na Pecuária de Leite, S. Ângelo, RS, 1989 - MS Thesis in Agricultural Economics - IEPE/UFRGS.

Appendix 2 - Milk Production Costs for Systems of Different Technological Levels in the State of Santa Catarina

Components of Costs - (%)	System -C	System -B	System A
1. VARIABLE COSTS			
1.1 - feeding	17,48	28,43	36,05
1.2 - vaccines	0,38	0,30	0,19
1.3 - medications	2,94	3,18	2,01
1.4 - artificial insemination (reprod)	1,68	1,06	0,67
1.5 - energy and fuels	1,68	1,54	0,97
1.6 - conservations and repairs	5,70	3,81	2,74
1.7 - interests on working capital	0,90	1,15	1,28
1.8 - transports (freights)	12,21	14,97	12,78
1.9 - "Funrural"	1,98	2,14	2,17
1.10 - Technical Assistance	0,82	0,89	0,90
2.6 - labor employed	79,79	47,46	22,02
Subtotal of Variable Costs	125,56	104,93	81,78
FIXED COSTS			
2.1 - Interest on Land Value (4% jearly)	9,68	5,76	3,64
2.2 - Annual depreciation	21,21	18,40	14,54
- Structure improvements	17,64	9,71	6,33
Machinery and equipments	3,56	8,70	8,21
2.3 - Interests on fixed capital	27,24	17,46	12,02
Animals	10,13	6,03	3,81
Structure improvements	16,04	8,82	5,75
Machinery and equipments	1,07	2,61	2,46
Non perennial pastures	0,00	0,00	0,00
2.4 - Calcareous	0,00	0,80	0,95
2.5 - Tax on Land	0,33	0,20	0,12
Subtotal C. Fixed	58,46	42,62	31,27
Total Cost / Total Revenue	184,02	147,55	113,05
II -Iindirect Revenues:			
Saile of animals	21,32	13,52	12,12
ICMS (12%) + Funrural (2,5%)	(-) 3,11	2,70	1,71
Price received / total revenue	81,78	89,18	89,58
Total revenue of the activity	100,00	100,00	100,00

Source: PELLINI, Tiago: Estrutura de Custos da Cadeia Produtiva de Leite na Região Sul do Brasil; MS Thesis in Agricultural Economics; IEPE/UFRGS, 1995.

Appendix 3 - Milk Production Costs, according to Cost Sheets elaborated by OCEPAR, 1988

.Componentes of Cost - (%)	System 1	System 2	System 3
1. VARIABLE COSTS			
1.1 - feeding	22,42	29,38	38,65
Rations	10,47	21,11	26,15
Annual Pastures	0,00	4,63	6,62
Perennial Pastures	9,97	3,54	3,56
Silage	0,00	0,00	1,67
Salt and Mineral Salts	1,99	0,11	0,64
1.2 - vaccines	0,33	0,23	0,11
1.3 - medications + insemination	2,48	1,43	1,40
1.4 - energy and fuels	1,88	3,35	3,48
1.5 - conservations and repairs	1,47	3,68	2,02
1.6 - interests on working capital	0,99	1,28	1,49
1.7 - transports (freights)	9,05	9,22	9,27
1.8 - "Funrural"	2,11	2,14	2,16
1.9 - Technical Assistance	3,29	2,75	2,46
2.6 - labor employed	63,69	16,03	5,30
Subtotal of Variable Costs	107,71	69,48	66,34
FIXED COSTS			
2.1 - Interest on Land Value (4% yearly)		17,03	6,81
3,82			
2.2 - annual depreciation	5,70	4,95	3,78
Structure Improvements	3,89	3,06	1,96
Machinery and equipments	1,81	1,88	1,82
2.3 - interests on fixed capital	12,31	11,87	10,62
Animals	7,61	7,35	7,24
Structure Improvements	4,38	3,54	2,57
Machinery and equipments	0,32	0,98	0,81
2.4 - calcareous	4,40	3,50	1,17
2.5 - Tax on Land	0,85	0,34	0,19
Subtotal of Fixed Costs	40,30	27,46	19,59
Total Cost / Total Revenue	148,01	96,94	85,93
II - Indirect Revenues:	20,83	18,78	18,08
Price received / total revenue	84,44	85,98	86,50
Total revenue of the activity	100,00	100,00	100,00

Source: PELLINI, Tiago: Estrutura de Custos da Cadeia Produtiva do Leite na Região Sul do Brasil; MS Thesis in Agricultural Economics; IEPE/UFRGS, 1995.

Appendix 4 - Milk Production Costs, for Several Production Systems;in Paraná; - Several Institutions, 1996.

ITEMS	System 1	System 2	System 3	System 4
VARIABLE COSTS				
Concentrates				
- Cotton pit	0,00	3,80	0,20	1,63
- Commercial ration	0,00	17,87	31,81	26,38
Minerals (salt)	1,45	1,42	1,26	1,59
Forages				
- Seeds	0,30	2,31	1,92	1,99
- Fertilizers	0,51	10,15	8,64	10,11
- Herbicidas	0,00	0,54	0,86	0,72
Vaccines and medications	5,73	7,80	3,61	2,11
Artificial insemination	0,00	3,57	3,81	3,06
Energy and fuels				
- Oil (diesel)	8,33	5,15	3,93	2,31
- Electric energy	1,08	0,92	0,75	0,52
Transport of milk	9,31	7,07	7,23	7,32
Conservations and repairs				
- Machinery and equipments	8,23	3,73	3,34	2,43
- Structure Improvements	2,56	1,69	1,26	1,47
Technical attendance	0,40	0,46	0,90	0,92
Interests on working capital	2,26	4,73	4,91	4,34
Taxes and Other Rates				
- INSS	1,79	2,04	2,08	2,11
General expenses	0,27	0,58	0,63	0,56
Permanent labor	28,67	13,30	8,09	6,13
TOTAL VARIABLE COST	70,90	87,13	85,23	75,69
B - FIXED COSTS				
Depreciations				
- Machinery and equipment	13,96	7,23	9,39	6,37
- Structure Improvement	9,98	6,50	5,30	5,29
- Perenial Pastures	3,81	1,54	0,00	0,16
- Calcareous	1,25	2,57	1,57	1,39
Interests on				
- Machinery and Equipment	5,70	2,73	2,67	1,99
- Structure Improvement	8,74	5,88	4,40	5,21
- Animals	7,89	8,07	7,74	7,36
Tax on Land	1,25	0,73	0,24	0,16
TOTAL FIXED COST	52,58	35,24	31,31	27,93
TOTAL COSTS	123,47	122,37	116,54	103,62
Price Rec. for liter of Milk	77,57	88,39	90,34	91,52
Sales of Animals	22,43	11,61	9,66	8,48
TOTAL INCOME	100,00	100,00	100,00	100,00

Source: EMATER/PR - FAEP - IAPAR - OCEPAR - SEAB - Sistema de Acompanhamento do Custo de Produção de Leite no Paraná, Curitiba, 1996.