A SOCIO-ECONOMIC APPRAISAL OF JAÍBA IRRIGATION SCHEME IN SOUTHEASTERN BRAZIL

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Abstract
Jaíba Project is located in the northern part of Minas Gerais State, Southeastern Brazil. The scheme, originally composed of family plots, is now receiving a large number of small, medium and large enterpreneurers in its recent expansion. The cropping pattern has gradually moved to a predominant exploitation o fruit crops, with banana as the main crop. In this article, an analysis was conducted on costs, prices, production and yield for nine crops in the scheme by means of historical series statistics (1989-1996) and moving means. It is also shown the progress of irrigated area and of some economic indicators along the period.
Keywords: socio-economic, performance assessment, irrigation, jaiba.

1 Introduction

Jaiba irrigation scheme is located in the North of the state of Minas Gerais, in Southeastern Brazil and included in the national semi-arid zone, a region subject to periodic droughts and limited job opportunities. The semi-arid represents an irrigable potential of more than one million hectares, capable to transform Brazil in a large exporter of fruits and vegetables. Through massive investment in irrigation, the State seeks to increase agricultural production and productivity, also contributing to agro-industry, trade, services and employment opportunities.

The Project was conceived to irrigate 100,000 ha at its full capacity. Construction works (main pumping stations and canals) started in 1975 and were concluded in 1988. Phase I, currently under implementation, has a total area of 32,755 ha, of which 24,076 ha are to be irrigated. It comprises 2,264 agricultural plots, dedicated to small (family) producers and private enterpreneurers. The small farmers' plots are of 5 ha each and for small and medium private business are of 20 to 50 ha.Irrigation activities started in 1988.

This work has the objectives of: (a) to present the evolution of production, production costs and productivity for selected products; (b) to analize the modifications occurred as related to changes in the structure of production from traditional food crops to fruits and vegetables; and (c) to discuss some variables related to the production under irrigation and their management, seeking to increase the technical and economic efficiency of the Project.

2 Evolution of the cultivated area.

Table 1 presents the evolution of the cropped area in the scheme, in the settlement sector, showing the percentage occupied by traditional crops (mostly grains, cassava, cotton and sugar-cane), as compared to fruits and vegetables. In 1989, the area dedicated to fruits and vegetables corresponded to 8% of the total, and in 1996, it was of 57.2%, evidencing a modification in the production pattern of the Project.

Table 1 Evolution of the cultivated area for small farmers (1989 to 1997).

Year	Traditional Crops		Fruits and Vegetables		Total	
	Area (ha)	%	Area (ha)	%	Area (ha)	%
1989	1,275.86	92.0	110.97	8.0	1,386.83	100
1990	2,092.50	92.3	173.60	7.7	2,266.10	100
1991	2,474.74	91.3	236.33	8.7	2,711.07	100
1992	2,171.72	75.6	701.91	24.4	2,873.63	100
1993	2,717.87	78.8	731.06	21.2	3,448.93	100
1994	2,928.61	79.2	769.47	20.8	3,698.08	100
1995	2,100.69	57.9	1,528.26	42.1	3,628.95	100
1996	1,785.52	42.8	2,385.01	57.2	4,170.53	100
1997	3,575.47	58.2	2,571.31	41.8	6,146.78	100

Source: PLENA Agricultural Engineering Ltda.

Table 2 presents similar data for the enterprisal area. The changes there happened more rapidly than with small producers. In 1992, the enterprises produced vegetables and traditional crops in 100% of the cultivated area. Since 1995, the production of fruits (bananas) occupies 100% of the cultivated area. The observation of tables 1 and 2 seem to indicate that (a) the enterprises were interested, from the start, in "cash crops" with better revenues and (b) the small farmers, after gaining some experience with irrigated agriculture, were influenced by the enterprises after 1992 and began shifting to the same kind of crops.

Table 2 Evolution of the cultivated area for Enterprises (1992 to 1997).

Year	Traditional Crops		Fruits		Total	
	Area (ha)	%	Area (ha)	%	Area (ha)	%
1992	235,50	100	-	-	235,50	100
1993	200,00	74	35,00	26	235,00	100
1994	117,50	53	175,00	47	292,50	100
1995	-	-	360,00	100	360,00	100
1996	-	-	350,00	100	350,00	100
1997	-	-	450,34	100	450,34	100

Source: 1ªSR CODEVASF. s/d; 1ªSR CODEVASF, 1997.

Table 3 Total annual production from 1991 to 1996.

Year	Permanent Crops (ton/year)		Annual Crops (ton/year)		Total
	Settlement	Enterprises	Settlement	Enterprises	(ton/year)
1991	5.787,28	55,03	970,50	-	6.812,81
1992	5.373,04	4.583,16	702,81	-	10.659,01
1993	7.527,43	3.061,00	3.011,12	-	13.599,55
1994	8.599,26	609,90	2.612,35	159,00	11.980,51
1995	7.173,07	-	4.334,40	3.846,55	15.354,02
1996	7.909,08	9.731,51	-	7.617,54	25.258,13
1997	13.017,21	12.722,89	8.960,56	-	34.700,66

Source: CODEVASF 1st SR - Division of Planning, sd. Data of 1996 and 1997 - PLENA Agricultural Engineering.

Table 3 shows the total production obtained in the Project for family plots and the enterprise area from 1991 to 1997. There are 6,600 ha producing a total of 34,700 tons of agricultural products, still too far from the total potential of the scheme.However, when it is considered that small farmers represent 6,146 ha and the enterprises 450 ha, a marked difference in yield is depicted. That is an obvious consequence of the higher investment capacity and market-oriented attitude of the enterprises, as compared to family farmers.

3 Behavior of some economic indicators in the project.

An analysis has been carried out in an effort to describe the behavior of some variables considered as economic performance indicators. Starting from a statistical analysis of several time series (annual medium price, amount produced annually, production cost and productivity) an attempt was made to identify the trends in the evolution of the production. For that to be possible, a basic condition should be satisfied by those time series: they needed to present a non-randomized pattern and a clearly defined behavior. Thus, of all the crops grown in the Project, the ones that complied to the above formulated hypothesis were: cotton, peanut, rice, banana, onion, cassava, watermelon, corn and cucumber (seed).

Table 4 shows the representativeness of those products with relation to the total area cultivated under irrigation, in the period 1989/97. In 1989, the proportional area cultivated with the selected crops was 26%. In 1996, the nine products selected for the analysis occupied 65% of the cultivated area, and in 1997 they represented 60%, being, therefore, quite representative of the Project.

With the results of that statistical analysis, theoretical models were adjusted, describing the long-term trend for the different time series considered. Based on those adjusted models, it was possible to determine the annual medium rate of growth (or decrease) for the produced amount, price paid to the producer, production cost and productivity of the selected products. Table 5 presents those values.

Table 4 Total irrigated area and area cultivated with the selected crops (1989/97)

Year	Total Irrigated Area (ha)	Area cultivated with Selected Crops (ha)	Percentage of Cultivated Area with Selected Crops (%)
1989	1.386,8	365,7	26
1990	2.266,1	641,6	28
1991	2.711,1	1.289,5	47
1992	2.873,6	943,7	33
1993	3.448,9	978,1	28
1994	3.698,1	1.221,0	33
1995	4.167,6	1.720,1	41
1996	4.520,4	2.938,0	65
1997	6.572,1	3.946,5	60

Source: Rodrigues, 1998.

Table 5 Medium rate of annual growth for selected crops (1989/96).

Crops	Annual Average Rates of Growth (%)			
	Amount Produced	Price	Prod. Cost	Yield
Cotton	-86,6	-5,6	120,4	-9,9
Peanut	59,3	16,7	-22,4	-6,1
Rice	-16,5	-8,7	-5,0	8,0
Banana	85,5	15,7	9,8	-9,6
Onion	68,2	-10,1	4,4	6,8
Cassava	38,4	-3,1	-20,7	7,3
Watermelon	45,0	-2,8	7,8	1,0
Corn	11,4	-4,4	3,6	1,7
Cucumber (seed)	27,6	-29,3	-13,1	48,1

Source: Rodrigues, 1998.

It can be noticed a well defined tendency of fall in prices along the time, except for peanut and banana. Contrarily, the cost tendency, in most cases, was to increase along the time. That increase in the production cost was not always associated to a productivity gain. Thus, in the analyzed period: (a) cotton and rice presented negative growth rates in production terms; (b) banana and peanut presented positive rates of annual growth in prices; (c) four products presented decreasing rates in production costs: cassava, rice, peanut and seed cucumber; and (d) three products presented decreasing productivity: cotton, peanut and banana.

Banana is the main product of the Project, in terms of planted area, production volume and revenue. The data in Table 5 indicate a marked increase in total production, growing price and production cost, and decreasing productivity. Nevertheless, this behavior raises some concern, for, in 1997, the price of banana was below the historical average of the last years, generating a crisis to small producers. Many had to renegotiate their debts with the banks and others decided to eliminate part of their plantations.

From the verified trend, attention was called to two variables with strong influence on managers, policy makers and farmers: crop yield and production cost. The first can be analized from two viewpoints: the internal economy and the pre-established goals for irrigated agriculture. Under both views, the performance level of the Project is considered low. Figure 1 presents the data on product revenue of the selected crops in comparison to the mean annual revenue of the same products in the national (Brazil), state (Minas Gerais), and regional (RMNe) markets, and to the Project itself, in the

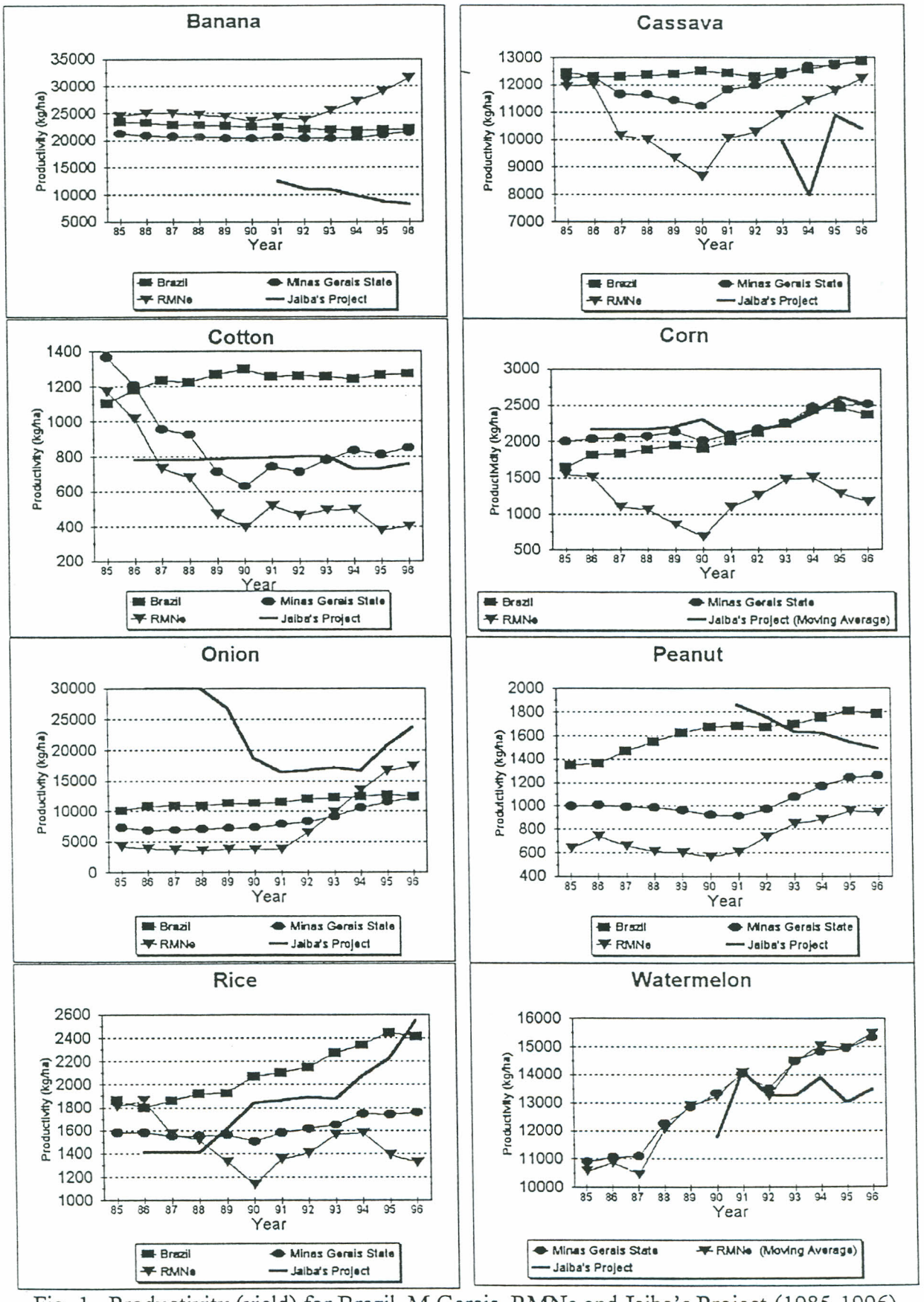

Fig. 1 Productivity (yield) for Brazil, M.Gerais, RMNe and Jaiba's Project (1985-1996).

period from 1985 to 1996. The data on the observed mean annual revenue, expressed in absolute values, were adjusted based on the on the mobile average of four years.

It can be observed that banana and cotton presented low level of economic performance in the state, in the Region and in the Project itself. As a perennial crop, the substitution of banana, that is, the shift to other crops, does not happen in a short term and without damages, as it may happen with annual crops. In the short period, a fall in the revenues might not cause great damages, if the price is rising. However, in the medium term, that situation can be shown economically unsustainable. Of the selectedproducts, four presented lower yields than the average of the internal market: cotton, peanut, cassava and banana. All products that presented lower yields than the average of the domestic economy, exception for peanut, also presented lower yields in comparison to the state average. When the yield levels obtained in the Project are compared to the one of the Region, the economic performance of the Project was better, but still considered low. Yield is an important factor to decrease the regional differences in economic development. It is also an important factor for capital accumulation.

When verifying the Project performance with respect to pre-established goals, the data in Table 6 show the expected yield for a list of crops and the maximum yields achieved by those crops in the scheme. The figures reveal that only two products (garlic and onion) presented high yields, above the goal set for irrigated agriculture in the San Francisco Valley. With respect to fruit crops, they presented low yields, while its planted area has been increasing annually. Therefore, the managers should better manage those variables that can contribute to improve that activity, such as research and technical assistence.

Table 6 Expected yields for irrigated crops in the San Francisco Valley and maximum yields achieved in the Jaiba Project.

CROPS	EXPECTED YIELDS IN THE SAN FRANCISCO VALLEY (kg/ha) (A)	MAX. YIELDS ACHIEVED IN THE PROJECT (B)		RELATIVE VALUE [(B)/(A)]*100
		YEAR	YIELDS (kg/ha)	
Garlic	5.000	1996	8.800	176%
Rice	5.000	1996	3.256	65%
Onion	15.000	1996	29.649	198%
Bean	1.900	1994	1.480	78%
Fruits[1]	22.000	*	7.258	33%
Vegetables[2]	25.000	*	9.464	38%
Watermelon	20.000	1991	16.490	83%
Melon	16.000	1993	7.330	46%
Corn	5.000	1994	3.000	60%
Tomato	45.000	1994	37.720	84%
Grape	18.000	1996	10.556	59%

Source: Agreement Brazilian Government / OEA, CODEVASF, 1989. Pp.220; PLENA-Reports of Accompaniment of the Production. Several years.

(1) banana reached 12.800 kg/ha in 1991, the largest value registered in the chronological series. Data for fruits refer to the mean value of revenue of several fruits in the Project.

(2) it refers to the mean revenue of vegetables.

The second aspect to be analized is the cost of production, including expenses such as seeds, fertilizers, chemicals, services, water tariff and the labor of the producer and its family). An economic analysis was made involving cost, price and productivity (Rodrigues, 1998). It was verified that some crops were shown as economically unfeasible. A possible explanation for that is the fact that there is not a concern for the determination of the costs per single product, but for the group of crops. Thus, in some cases, the losses of a crop are compensated by gains of others with better revenue per unit area. It is possible to improve the performance of the Project, through rationalizing the productive process, in a way to reduce costs and improve the overall productivity.

4 Possibilities to reduce costs and to increase technical-economic efficiency

An important aspect in the composition of the cost of the irrigated agriculture is the value payed for water. According to the Brazilian legislation, the water tariff is composed by two parts: (a) a portion (k1) corresponding to the amortization of the public investments in the works of infrastructure for common use, calculated annually, based on the corrected present value of the infrastructure, per hectare, for each scheme; (b) other portion (k2) corresponding to the annual expenses of administration, operation and maintenance of the civil works and equipments, calculated annually, for each scheme, per thousand cubic meters of water supplied to the users.

In a study done by the Management of Production and Operation, of CODEVASF (1991), the variation of the factor k2 was simulated, for Jaiba Project, as a function of the increment in irrigated area of its first stage (Phase I), based on the predicted timetable of implementation, on the estimated costs of energy and on other costs (personnel and maintenance services). The results showed that, for Phase I, the value of k2 would be stabilized in the 5th year, at a value of US$14.07/1000 m^3 , for the gravity systems, with an area of 20,036 ha under operation. The pressurized systems would stabilize in the 2nd year, at a k2 value of US$12.36/1000 m^3, and an area of 1,700 ha in operation. Estimates of fixed, variable and total O & M costs were calculated (Table 7).

The study recommended that the District did not charge the farmers the full value of k2 in the first four crop cycles. However, nine years after the beginning of Phase I implementation, the scheme reached only one fourth of the irrigated area foreseen in the planning stage. As a consequence, the estimated values for water tariff have covered no more than 20% of the operation and maintenance expenses of the Irrigation District, which implies that 80% fo the costs are subsidized by the State. That means that the farmers are producing without taking into account their effective costs of production.

As shown in Table 7, the total cost of operation and maintenance is growing. However, the cost per irrigated hectare is decreasing with time, as consequence of the increase in irrigated area. Therefore, the faster the implementation work of the Project, the lesser will be the costs for the farmers, relative to the operation and maintenance of the system, expressed in the form of water tariff. Following this line of reasoning, decision makers should accelerate the implementation of the Project and producers, on their side, should look for more efficient means of production, such as crops with good response to the existing conditions, in terms of soils, climate, yields and market. As the agricultural market is subject to significant oscillations in prices, a diversification in cropping pattern should be sought, including some three to four major products.

Table 7 Estimates of fixed, variable and total O & M costs as a function of the predicted implementation timetable .

Year	Fixed Cost (US$)	Variable Cost (US$)	Total Cost (US$)	Irrigated Area (ha)	Annual Cost per Irrigated Ha (US$)
Year 0	748.090,91	32.788,98	780.879,89	1.000	780,88
Year 1	1.129.181,82	110.438,31	1.239.620,13	2.500	495,85
Year 2	1.603.909,09	264.015,58	1.867.924,67	7.500	249,06
Year 3	1.962.000,00	411.229,43	2.373.229,43	11.500	206,37
Year 4	2.166.454,55	607.921,96	2.774.376,51	15.000	184,96
Year 5	2.340.181,82	852.455,13	3.192.636,95	20.036	159,35
Year 6	2.351.090,91	852.455,13	3.203.546,04	20.036	159,89

Source: Division of Maintenance, CODEVASF. Simulation of the Values of Tariff of water of Jaíba's Project 1st Stage in function of the flow of Implantation. 1991.

A serious constraint imposed to the farmers are the prices paid to their produces. First of all, the prices are imposed to them, usually by informal channels like individual intermediate buyers so that they exercise practically no influence in the price definition. As a consequence, commercialization has been a critical aspect in the Project. Farmers need to find mechanisms to have access to market wholesalers in order to improve the commercialization of their produces, through the benefits of the economy of scale. The non-existance of such facilities frequently forces the prices to drop below the average market values, especially in the case of quickly perishable produces, like fruits and vegetables.

In the most recent period, starting from 1995, of the nine products analyzed, three presented prices above the averages of the internal market: cotton, peanut, and cassava. Products with expressive production in the Project, like banana, corn and rice had prices below the average of the national market. Farmers of the Project are receiving less than the average prices of agricultural producers of the country for most of their products.

5 Final remarks

The economic feasibility of Jaiba Project, like in most irrigation schemes, depends on a group of factors, such as water availability, crop selection, credit, agricultural inputs, adequate technology, technical assistance, farmers'skills and working abilities, production infrastructure and market. The Jaiba Project presents serious constraints especially related to the last item, the market. Its success depends mainly on the factors related with the demand. Farmers need to join efforts to seeking economic cooperation among themselves in the production and commercialization of the goods, or the Project will be far from reaching the longed-for goals. Improving the market (sales) opportunities will provide better incentives to invest and subsequently to increase the revenues per unit area.

Decision makers, on the other hand, should look for ways to accelerate the implementation process, thus allowing for rapid increase of the irrigated area with a correspondent decrease in the implementation cost per hectare irrigated.

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