

# BIOLOGICAL VARIABLES OF WATERSHEDS IN THE NORTHWESTERN REGION OF SÃO PAULO STATE (BRAZIL) USED FOR IRRIGATION\*

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## INTRODUCTION

Water quality is measured by a number of direct or indirect parameters which may indicate the effective presence of microorganisms that can compromise it on an aesthetic or health level (Tundisi et al., 1999). The main source of river pollution originates from large volumes of raw sewage spilled into this superficial water source produced by urban areas (Camargo; Pereira, 2003). The northwestern region of the State of São Paulo, Brazil, is characterized by cities where irrigation is used in fruit trees destined to *in natura* consumption. In this situation, microbiological indicators as total and fecal coliforms might be an indicator of problems with the ingestion of contaminated food. The main objective of this experiment was to evaluate the biological variables of the water in creeks of this region when used for irrigation.

## MATERIAL AND METHODS

The sites in this research were the creeks in the northwestern region of the State of São Paulo, Brazil. The variables evaluated were fecal and total coliforms. Five points along each creek bed were georeferenced, for sample collecting (Figure 1). Samples were collected every month between January 2007 and December 2009. Results were presented as the average for each creek basin. The samples of water were collected in 0.6 liter polyethylene bottles and stored in a polystyrene cooler box containing ice. The Ecolit analysis procedure V124 (Alfakit, 2007) was employed. Samples were kept in an oven at 36° - 37°C for 12 hours, and results were presented as the Most Likely Number (MLN) per 100 ml sample.

## DISCUSSION

There were statistically significant differences, within each season, among average fecal coliform means (Figure 2 and Table 1). The high fecal coliform values for Três Barras creek are likely due to the spill of the STS at point 3 (Figure 1), in Marinópolis. These results were similar to those obtained by Franco et al. (2007), who analyzed samples from each collection point in Três Barras creek.

TABLE 1

fecal coliforms <sup>1</sup>	Rainy	Min	Max	mean±STE	classification	
					adequate	inadequate
					(% samples)	
Boicreek	0.00	15360.00	1057.95±349.68	83.08	16.92	
Coqueiro creek	0.00	5340.00	522.60±101.42	85.71	14.29	
Três Barras creek	0.00	65280.00	6669.37±1817.1	69.84	30.16	
					4	
	Dry					
Boicreek	0.00	21000.00	619.13±358.25	95.65	4.35	
Coqueiro creek	0.00	2400.00	219.79±34.47	96.84	3.16	
Três Barras creek	0.00	34560.00	2050.39±690.95	84.42	15.58	

Adequate (< 1000 MLN/100 ml)

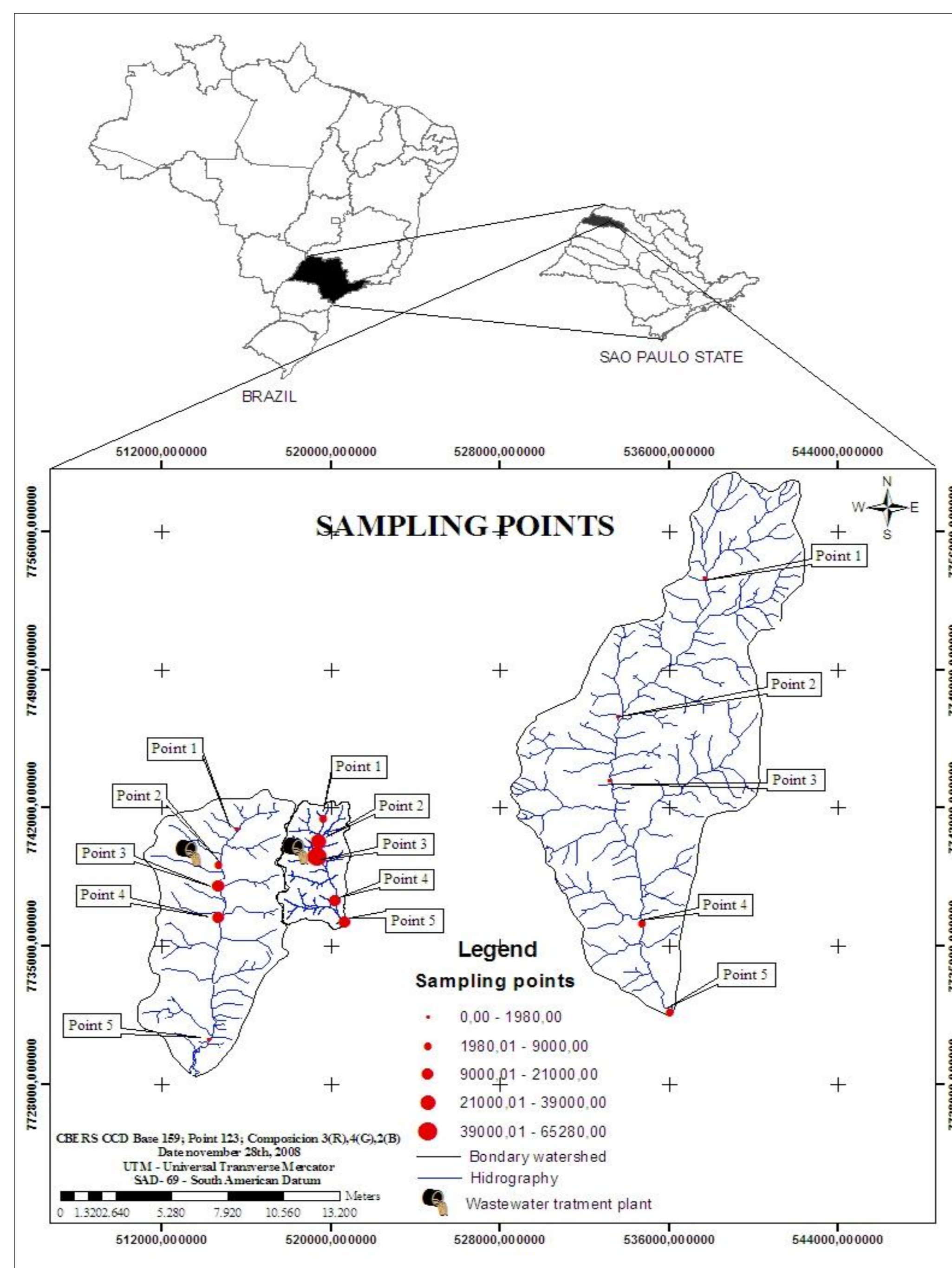


Figure 1. Watersheds Boi, Coqueiro and Três Barras, northwestern region of the State of São Paulo, Brazil and the mean of fecal coliforms found.

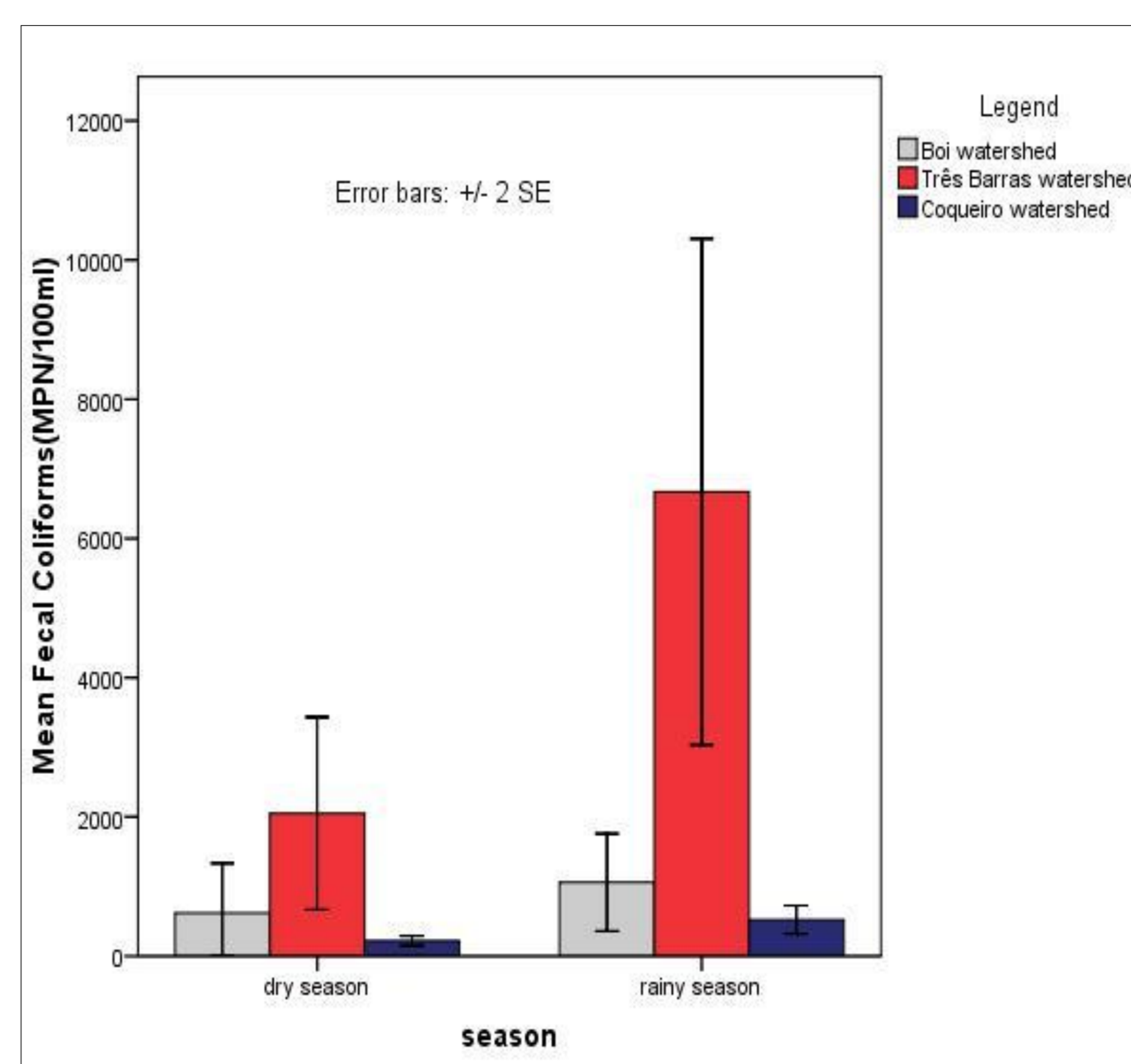


Figure 2. Mean fecal coliforms for creeks Boi, Coqueiro and Três Barras between seasons. Northwestern region of the state of São Paulo, Brazil.

The results show that the worst basin and season for irrigation, based on fecal coliforms, were Três Barras creek and the rainy season. An average of 30.16% of samples taken during the rainy season from Três Barras creek were classified as inadequate, while these values were of 16.92% and 14.29% of the samples for Boi and Coqueiro creeks, respectively.

There were also statistically significant differences, within each season, among coliform concentrations. For both seasons, the highest total coliform means were found at Três Barras creek, followed by Boi and Coqueiro creeks (Table 2, Figure 3).

TABLE 2

Total coliforms <sup>1</sup>	rainy	min	max	mean±STE	classification	
					adequate	inadequate
					(% samples)	
Boicreek	0.00	42000.00	3789.46±971.01	84.62	15.38	
Coqueiro creek	120.00	5340.00	1461.34±138.57	98.57	1.43	
Três Barras creek	240.00	150000.00	21172.65±4859.8	71.43	28.57	
				3		
	dry					
Boicreek	0.00	102540.00	3903.48±1777.05	94.20	5.80	
Coqueiro creek	0.00	3660.00	806.42±77.53	100.00	0.00	
Três Barras creek	0.00	138000.00	26820.65±17019.9	76.62	23.38	
				88		

Adequate (< 5000 MLN/100 ml)

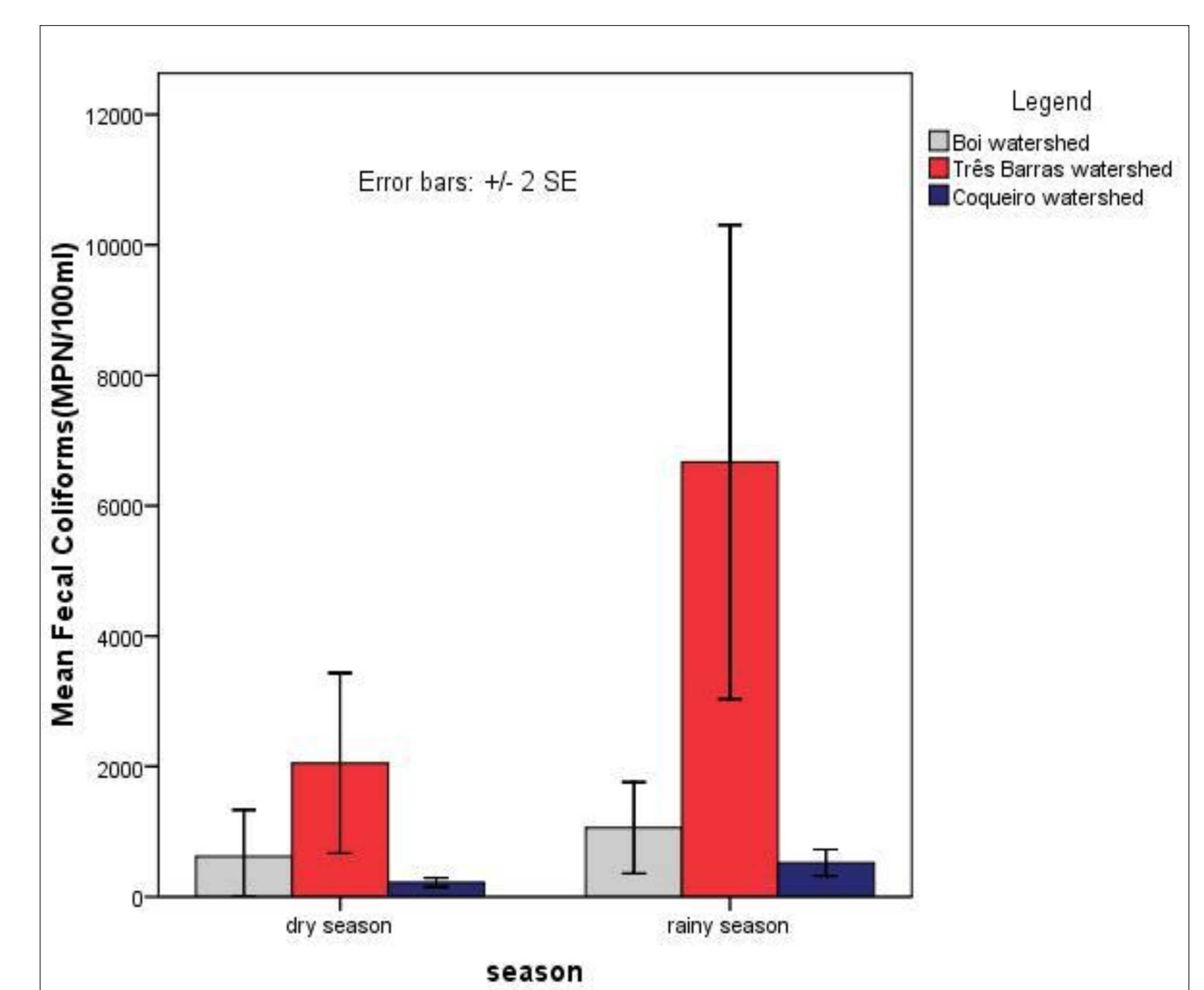


Figure 3. Mean total coliforms for creeks Boi, Coqueiro and Três Barras between seasons.

The results of the total coliforms confirm the Três Barras creek as the worst water quality with average of 28.6% and 23.4% of samples classified as inadequate, in the rainy and dry season, respectively.

## CONCLUSION

Creek Três Barras presented, from all creeks evaluated, the highest concentrations of fecal and total coliforms. As a result, 30% of the samples in the rainy season and 16% in the dry season were unsuitable for irrigation. The highest mean values of fecal coliforms were found in the rainy season, when the highest air temperatures were found. Hence, it is important to monitor for coliforms, and raise awareness among irrigation farmers on the use of techniques which minimize a direct contact of irrigation water with food. The government should also make more efforts to improve sewage treatment stations and to implement programs of environmental education among all sectors of the society as well.

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