Comparative Analysis of the Diversity and its Implications for the Development Potential of Small Farming Systems in the Savannah of Brazil

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Abstract

This research explores the role of family income sources diversification in the development of small farming systems in the Savannah of Brazil. The questions addressed are: Does the diversification of family income sources reduce or increase the living standard of the families and the use of modern inputs? The results suggest that ecological factors play a limited role in determining income sources mix. When income sources diversification is used to test for differences in the factors influencing the living standard and the use of modern inputs, univariate analyses fail to show significant relations. This result is important to understand the use and adoption of modern inputs in agriculture.

Keywords: Agricultural Economics, Small Farming Systems, Income Diversification, Savannah, Brazil

Introduction

Decision-makers are looking for the potential contribution that marginal areas can make to avoid increasing scarcities of resources as causes of tensions endangering peace and stability. This research deals with the level of family income sources diversification in small farming systems in the Savannah of Brazil. By diversifying income sources, different questions may arise: Does the diversification of family income sources reduce or increase the living standard of the family? Does diversification of family income sources reduce or increase the use of modern inputs?

Methodology

This research followed the farming systems approach of Doppler (1994). Data are collected from 75 farmers families in two marginal areas, the

Jaurú Valley in Mato Grosso State and the Iraí de Minas Valley in Minas Gerais State during the agricultural season 1997/98. Both study areas were considered as being representative for two reasons: (1) agricultural activities being carried-out in these areas include all important production activities to be found in marginal areas with small farming systems; (2) the areas are distributed over the savannah region reflecting the different ecological, economic, social and political conditions and possibilities offered to farmers. Farms are put into categories according to their degree of income sources diversification using cluster analysis. Similarity is based solely on the percentage contribution of each income source category to total family income. Different products and by-products perceived to be single production activities are combined. Since the idea is to identify farms by their income sources mix, other variables such as total returns and/or farm area are not included in the cluster analysis. A regression analysis is used to explore the relation among variables related to the scale of operation, the farm area, the degree of income sources diversification and the expenditures on modern inputs.

Cluster Analysis

At farm level most farmers produce in average 3 or more crops and 2 or more livestock products in both study areas. In the Iraí de Minas Valley the common crops grown are maize, rice and coffee and in the Jaurú Valley fruits, vegetables, cotton and coffee (Table 1). At a regional level a relatively high degree of concentration of income sources in crop production can be observed, especially from maize in the Iraí de Minas Valley and from fruits and coffee in the Jaurú Valley. A high concentration of income sources in dairy products has taken place in the Iraí de Minas Valley at regional level and farm level (Table 2). Nevertheless, other activities like mother cows and poultry also make a substantial contribution. In the Jaurú Valley a similar trend can be observed, but here the major contribution comes from selling male calves from mother cows to fattening ranches in the region.

Table 1: Average revenue from different cropping activities and contribution to crop revenue at regional and farm level in small farming systems in the Savannah of Brazil, 1998

Items	Maize	Rice	Beans	Fruits	Vetch	Manioc	Cotton	Coffee	Rubber
Iraí de Minas (Minas Gerais)[1]									
Revenue	1,009	515	2,132	-	-	395	-	377	-
(R$)	(1,213)*	(301)*	(2,820)*			(378)*		(361)*	
Region	45%	15%	12%	-	-	15%	-	13%	-
Farm	49%	38%	20%	-	-	28%	-	31%	-
Jaurú Valley (Mato Grosso)									
Revenue	926	-	922	9,708	2,603	282	4,124	6,151	1,054
(R$)	(980)*		(1,805)*	(10,604)*	(3,351)*	(170)*	(1,199)*	(6,043)*	(151)*
Region	8%	-	4%	43%	10%	1%	4%	29%	1%
Farm	33%	-	22%	53%	43%	13%	64%	50%	4%

Source: [1] Santacoloma (2000)
* standard deviations
Exchange rates: 1.00 R$ = 0.82 Euro or 1.00 R$ = 0.88 US$

Table 2: Average revenue from different livestock activities and contribution to livestock revenue at regional and farm level in small farming systems in the Savannah of Brazil, 1998

Items	Dairy	Mother cows	Cattle		Pigs	Poultry	Others
			rearing	fattening			
Iraí de Minas (Minas Gerais) [1]							
Revenue	5,123	1,332	1,031	1,120	282	489	139
(R$)	(7,825)*	(3,773)*	(2,211)*	(2,204)*	(268)*	(268)*	(156)*
Region	73%	25%	-16%	3%	5%	8%	2%
Farm	65%	26%	-23%	2%	9%	21%	6%
Jaurú Valley (Mato Grosso)							
Revenue	2,243	5,145	182	4,203	585	1,476	112
(R$)	(1,296)*	(4,042)*	(617)*	(6,043)*	(807)*	(1,046)*	(484)*
Region	19%	46%	2%	16%	5%	11%	1%
Farm	21%	57%	10%	25%	6%	19%	9%

Source: [1] Santacoloma (2000)
* standard deviations
Exchange rates: 1.00 R$ = 0.82 Euro or 1.00 R$ = 0.88 US$

In the statistical cluster analysis five major groups of small farming systems were identified according to the main income sources (Table 3). In all groups, the income from dairy activities plays an important role. In the cluster ”Dairy and Small Animals” the activities ”Small Animals” and ”Food Crops” have been aggregated, since the main crops maize and cassava are mainly used for feeding pork and poultry.

Table 3: Family income sources mix of clusters of small farming systems in the Savannah of Brazil, 1998

Clusters	*Off-farm*	*Dairy*	*Dairy & Small Animals*	*Coffee*	*Perishables*
Off-Farm	**48%**	9%	1%	20%	20%
Dairy	31%	**77%**	**57%**	26%	29%
Beef	3%	2%	0%	3%	2%
Small Animals	10%	8%	**21%**	4%	6%
Perishables	2%	0%	0%	5%	**41%**
Food Crops	4%	2%	**18%**	3%	0%
Coffee	2%	2%	3%	**37%**	3%
Total	100%	100%	100%	100%	100%

Some statistics that describe farmer and farm characteristics are provided for the clusters (Table 4). These highlights the similarities and differences across and within the five clusters. The demographic composition of households is quite similar, but when the agricultural characteristics of farms are analysed, the similarities seem to disappear. Average farm size varies from 50 hectares for farms specialising in coffee to 84 hectares for farms producing food crops mainly as feed for pork and poultry. The value of total output for coffee producers is nearly two times that of dairy and small animals farmers. Farm families specialising in off-farm labour earn six times more off-farm income than those specialising in dairy. Farms specialised in coffee and perishables with seasonal labour peaks also register high incomes from off-farm employment.

Table 4: Descriptive statistics of clusters of small farming systems in the Savannah of Brazil, 1998

Items/Clusters	*Off-farm (n = 30)*	*Dairy (n = 20)*	*Dairy & Small Animals (n = 12)*	*Coffee (n = 6)*	*Perishables (n = 7)*
Mean age of household head (years)	51.4 (12.0)*	52.8 (9.1)*	47.2 (11.6)*	54.2 (13.0)*	44.3 (12.1)*
Education index of household heads (2 = primary to 3 = secondary level)	2.5 (0.5)*	2.7 (0.9)*	2.5 (0.5)*	2.7 (0.5)*	2.7 (0.5)*
Family size (number of persons)	5.9 (4.2)*	5.1 (2.3)*	4.6 (1.8)*	5.2 (1.1)*	5.7 (1.3)*
Dependency ration (0-15+755/16-54)	0.64 (0.72)*	0.56 (0.99)*	0.20 (0.19)*	0.83 (0.51)*	1.44 (1.51)*
Farm size (hectares)	64.6 (65.7)*	79.6 (56.0)*	84.5 (67.7)*	49.8 (29.47)*	53.8 (42.9)*
Value of total family income (R$)	13,637 (9,545)*	13,046 (12,160)*	7,131 (5,068)*	19,940 (6,020)*	17,624 (11,162)*
Value of on-farm production (R$)	7,361 (5,468)*	11,720 (11,823)*	7,111 (5,087)*	15,536 (4,219)*	13,246 (8,852)*
Value of off-farm labour (R$)	6,276 (5,347)*	1,326 (1,786)*	20 (66)*	4,404 (2,864)*	4,378 (3,784)*
Percent of output in top two products	79.0 (9.6)*	85.9 (11.0)*	77.9 (10.8)*	63.8 (16.4)*	69.3 (10.1)*
Percent who owned transport vehicles	32.3	63.2	75.0	33.3	57.1
Total expenditures for inputs (R$)	6,323 (5,655)*	6,470 (5,825)*	5,824 (3,948)*	11,679 (7,431)*	17,153 (16,560)*
Total expenditures for modern inputs (R$)	1,196 (1,601)*	3,371 (7,966)*	4,591 (7,529)*	5,568 (9,642)*	1,552 (2,126)*
Percent of expenditures for modern inputs from total input expenditures	0.19%	0.52%	0.79%	0.48%	0.09%
Total modern input use/total revenue (crops and livestock)	0.21 (0.30)*	0.16 (0.11)*	0.29 (0.12)*	0.12 (0.10)*	0.10 (0.10)*

* standard deviations
Exchange rates: 1.00 R$ = 0.82 Euro or 1.00 R$ = 0.88 US$

In absolute terms farmers in the ”Coffee” and ”Perishables” clusters have the highest expenditures for inputs. Relative to the value of total crop and livestock production, farms in the ”Dairy and Small Animals ” and the ”Off-farm” cluster are the most intensive users of modern inputs. Measured in terms of absolute expenditures coffee producers led the way, while at the other end of the spectrum farmers in the ”Off-farm”

cluster reported using in average the lowest amount of the expenditures for modern inputs. Regarding expenditures on modern inputs the composition of expenditures varies substantially across clusters (Table 5). Farms in the cluster ”Dairy and Small Animals” use consistently more of all types of modern inputs except for pesticides. Dairy farms and small animal farms use more modern feeds and veterinary services than the other farming systems.

Table 5: Components of the index of modern inputs, mean values, by cluster of small farming systems in the Savannah of Brazil, 1998

Components	*Off-farm (n = 30)*	*Dairy (n = 20)*	*Dairy & Small Animals (n = 12)*	*Coffee (n = 6)*	*Perishables (n = 7)*	*Total (n = 75)*
Hybrid seeds	15 (33)*	69 (176)*	339 (435)*	0 (0)*	21 (51)*	80 (228)*
Chemical fertiliser	170 (264)*	107 (148)*	531 (612)*	433 (222)*	254 (211)*	240 (354)*
Pesticides	74 (124)*	37 (57)*	112 (99)*	217 (111)*	127 (106)*	87 (114)*
Total crop	259 (386)*	213 (356)*	981 (1,056)*	650 (332)*	401 (341)*	407 (607)*
Modern feeds	585 (752)*	958 (871)*	973 (966)*	344 (404)*	711 (1,100)*	734 (863)*
Veterinary services	343 (1,068)*	352 (562)*	303 (168)*	130 (118)*	48 (19)*	294 (753)*
Total livestock	928 (1,489)*	1,310 (1,137)*	1,276 (1,059)*	474 (492)*	759 (1,107)*	1,028 (1,274)*
Total (crops & livestock)	1,196 (1,601)*	3,371 (7,966)*	4,591 (7,529)*	5,568 (9,642)*	1,552 (2,126)*	2,669 (6,037)*

* standard deviations
Exchange rates: 1.00 R$ = 0.82 Euro or 1.00 R$ = 0.88 US$

Univariate Analyses

This chapter examines some relationships between the scale of operation (as measured by area of farm or total revenue), farm-level

diversity of product mix and measures of agricultural modernisation (based on modern input use).

Table 6: Univariate relations by cluster of small farming systems in marginal areas in the Savannah of Brazil, 1998

	Groups				
	Off-farm	Dairy	Dairy & Small Animals	Coffee	Perishables
Independent Variable:	Dependent variable: total revenue from crop and livestock products				
1. Intercept	4,656.05	-470.210	4,257.84	9,518.29	8,297.60
Total area	41.88	153.08	33.78	120.85	92.02
R^2	0.25	0.52	0.20	0.71	0.20
Independent Variable:	Dependent variable: total expenditures for modern inputs				
2. Intercept	391.53	4,515.82	1,494.68	-21,549.90	2,702.19
Total revenue	0.11	-0.09	0.44	1.75	–0.09
R^2	0.14	0.02	0.09	0.58	0.13
Independent Variable:	Dependent variable: modern input expenses in crop production				
3. Intercept	198.10	173.71	437.11	175.80	699.92
Total crop revenue	0.05	0.13	0.39	0.06	–0.07
R^2	0.11	0.04	0.56	0.35	0.30
Independent Variable:	Dependent variable: modern input expenses in livestock production				
4. Intercept	1,134.60	898.44	782.74	722.69	183.64
Total livestock revenue	–0.05	0.04	0.15	-0.04	0.15
R^2	0,02	0.13	0.26	0.08	0.07
Independent Variable:	Dependent variable: total modern input expenses				
5. Intercept	1,898.60	17,857.70	2,929.00	-51.13	-5,138.93
Percent of revenue from top two products	–879.56	–17,563.80	2,286.62	7,281.85	9,042.27
R^2	0.02	0.21	0.01	0.03	0.11
Independent Variable:	Dependent variable: modern input expenses in crop production				
6. Intercept	542.13	293.34	1,123.92	1223.84	1426.11
Percent of revenue from top crop product	–395.00	–192.68	–261.06	–736.30	–1315.82
R^2	0.05	0.02	0.002	0.18	0.35
Independent Variable:	Dependent variable: modern input expenses in livestock production				
7. Intercept	1,340.06	1,057.20	628.72	-1,437.25	-2,144.78
Percent of revenue top livestock product	–725.17	484.39	968.97	3,986.98	6,250.60
R^2	0.01	0.01	0.02	0.44	0.22

	Group				
	Off-farm (N = 30)	Dairy (N = 20)	Dairy & Small Animals (N = 12)	Coffee (N = 6)	Perishables (N = 7)
Independent Variable:	Dependent variable: Percent of revenue from top two products				
8. Intercept	0.80	0.76	0.71	0.82	0.71
Total revenue	6.81e-07	4.68e-06	2.23e-06	–3.04e-06	2.46e-06
R^2	0.003	0.07	0.002	0.003	0.08
Independent Variable:	Dependent variable: Percent of revenue from top crop product				
9. Intercept	0.73	0.68	0.59	0.64	0.61
Total revenue from crop products	1.33e-05	4.95e-06	–3.27e-05	1.78e-05	4.06e-05
R^2	0.02	0.02	0.12	0.09	0.48
Independent Variable:	Dependent variable: Percent of revenue from top livestock product				
10. Intercept	0.63	0.68	0.64	0.53	-0.39
Total revenue from livestock products	–1.51e-05	–3.51e-06	6.87e-06	–9.67e-06	1.71e-05
R^2	0.12	0.04	0.02	0.15	0.16
Independent Variable:	Dependent variable: total modern input expenditures				
11. Intercept	769.05	4772.80	4,551.36	618.05	2,766.52
Off-farm labour	0.07	–1.06	1.96	1.12	–0.28
R^2	0.05	0.06	0.003	0.11	0.24
Independent Variable:	Dependent variable: modern input use / crop and livestock revenue				
12. Intercept	0.26	0.19	0.29	0.03	0.12
Off-farm labour	–9.20e-06	–1.91e-05	7.96-03	1.93e-05	–3.24e-06
R^2	0.03	0.10	0.01	0.32	0.02

Regarding the relation between total farm output versus total farm area shown in section 1 in Table 6, all slope values seem to be different from one another as well as the intercept terms also differ. The main difference is the ”Off-farm” and the ”Dairy & Small Animals” clusters, whose slope coefficients are markedly lower than the others. The slope coefficients for the other three groups, whose major outputs are on-farm products, are similar. The next set of regressions in the section 2 deals with the relation of total use of modern inputs for crops and livestock and the scale of farming operations measured by the total revenue. Here again slopes differ across the clusters. To test the consistency of this relationship across crops and livestock products an additional equation is estimated for each. In section 5 the percent of total output accounted for by the top two products is a measure of the degree of farm-level

output specialisation. The regression analysis dealing with the relation modern input use versus percent of total revenue accounted by the top two products indicates that there are differences in slope coefficients between clusters, with the cluster ”Dairy & Small Animals”, ”Coffee” and ”Perishables” responding positively to increased specialisation, and the other farmers displaying just the opposite tendency. A negative relation indicates a tendency for farms that spend more on modern inputs to be less specialised. Sections 8, 9 and 10 of Table 6 present the relation between the total revenue accounted for by the top two products versus the total revenue. The results show small differences only among farmers of different scale (measured in total revenue) with respect to diversity in production across different clusters. The livestock regression shows a negative relation between specialisation in livestock production and total livestock revenue for all groups except the ”Dairy & Small Animals” cluster. For the crop regression the relation is just the opposite. The regression slopes between the use of modern inputs and the off-farm labour use differ significantly from one cluster to another.

Conclusions

In the detailed analyses product and family income sources mix are found to vary substantially across small farming systems in the studied marginal areas. There is little evidence of complete specialisation, but dairy activities predominate to a certain extent in all small farming systems. Off-farm employment is an important source of family income of many small farming systems in the Savannah of Brazil and there are evidences that its importance may even increase in the future. When income sources diversification is used to construct by cluster analysis a series of farm types and to test for differences in factors influencing living standard and expenditures on modern inputs within farm types, univariate analyses fail to show significant relations. In sum, empirical results suggest no significant impact of income sources diversification on the use of modern inputs. The differences or lack of differences are important to understand the use and adoption of modern inputs in agriculture. First, if the univariate analyses are correct and the use of modern inputs varies with the scale of all farms, regardless of product or

income sources mix, then focussing efforts on particular types of farming systems or farm size probably will not be more efficient than approaching farms more uniformly. Finally a substantial number of farms have a very differentiated income sources mix suggesting that ecological factors play a limited role in determining income sources mix, and that farmers in marginal areas in the Savannah of Brazil have the ability to react positively to consistent economic and other incentives.

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