IMPACTS OF ENERGY POLICIES ON NATURAL RESOURCE USE: THE CASE OF BRAZILIAN AGRICULTURE*

by

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1. Externalities of Brazilian Policies in the Agricultural Sector

1.1. Energy Conservation in Agriculture

There is a wide range of energy conservation policies available in Brazil. However, as yet their impact have been very limited in general. For the agricultural sector some emphasis has been given to the substitution of diesel oil in stationary engines. With respect of grain dryers, for example, an attempt has been made to use solar energy or charcoal, as substitutes for diesel oil. Results have so far been neglegible for the agricultural sector as a whole.

As far as conservation of chemicals are concerned, results are more encouraging. Demand for insecticides and fungicides has declined considerably over the last couple of years.Table 1 shows the sales figures of commercial pesticide sold in Brasil, for the period 76-81.

Labor shortages in peak periods are responsible for the increase in herbicide sales. Insecticides and fungicides are now faced with a shrinking volume of sales.

The recent drop in insecticide sales is mainly due to:

i) the development of more concentrated formulations;
ii) the development of integrated pest management programs, with special emphasis of the soyabean program.

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TABLE 1. Amount and percentage of the total commercial pesticide sold in Brazil during 1976-81.[1]

Pesticide	Amount (1000 t)					
	1976	1977	1978	1979	1980	1981
Insecticide	136.3	135.8	113.6	129.2	100.8	72.3
	(72.2)[a]	(70.2)	(67.8)	(63.0)	(55.5)	(50.5)
Fungicide	23.9	28.4	25.9	35.9	36.6	26.4
	(12.7)	(14.7)	(15.5)	(17.5)	(20.1)	(18.5)
Herbicide	28.5	29.3	27.9	40.1	44.3	44.1
	(15.1)	(15.1)	(16.7)	(19.5)	(24.4)	(30.9)
	188.7	193.5	167.4	205.2	181.7	142.8
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

[1]Source: YORINORI (1982a)

[a]Percentage of the total sale in each year.

This second factor is responsible for a drop in 13 million liters of insecticides and around 94 million liters of diesel oil for the state of Paranã alone (the largest soyabean region in Brazil) for the 1980 harvest, as compared with the previous three years. (YORINORI, 1982-b)

Impact on environment from less pesticide use is mainly felt in two ways:

i) at farm level, it is likely to decrease water pollution, which can cause even human casualties at the height of the cropping season in some parts of the country. Also tractor drivers without proper protection can suffer intoxication from organochlorine insecticides.

ii) at consumer level the products become cleaner and healthier.

Another point to note is that domestic pesticide industry hasn't been severely affected by the reduction of total sales. The largest drop is on the imported component. This is shown in table 2:

TABLE 2. Apparent consumption (imports + national production - exports) of pesticide in Brazil during 1972-81 and percentage of imports and domestic production in 1981[1].

esticide	Apparent consumption (1,000 t)										
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	% (81
NSECTICIDE											
Imported	25.0	18.2	30.8	26.2	20.8	23.8	22.8	21.1	19.3	8.6	44.2
Natl. prod.	14.0	16.3	14.4	15.6	7.7	10.0	19.9	17.7	12.9	10.8	55.8
Sub-total	39.0	34.5	45.2	41.8	28.5	33.8	42.7	38.8	32.2	19.4	100.0
UNGICIDE											
Imported	20.0	26.1	32.9	5.0	7.3	12.7	7.8	10.5	8.7	2.9	13.2
Natl. prod.	4.3	6.3	7.6	9.2	9.3	11.9	15.2	14.9	27.8	19.1	86.8
Sub-total	24.3	32.4	40.5	14.2	16.6	24.5	23.0	25.4	36.5	22.0	100.0
ERBICIDE											
Imported	4.7	7.9	14.1	29.7	22.8	15.6	17.3	10.5	12.8	12.1	47.1
Natl. prod.	0.0	0.5	0.8	1.7	1.5	4.3	5.5	9.6	15.5	13.5	52.9
Sub-total	4.7	8.4	14.9	22.4	24.3	19.9	22.8	20.1	28.3	25.6	100.0
OTAL											
Imported	49.7	52.2	77.8	51.9	50.8	52.1	47.9	42.1	40.8	23.6	35.2
Natl. prod.	18.3	23.0	22.8	26.6	18.6	26.3	40.6	42.3	56.3	43.4	64.8
TOTAL	68.0	75.2	100.6	78.5	69.4	78.4	88.5	84.4	97.1	67.0	100.0

[1]Source: YORINORI (1982-a).

The main implication of the results reported in table 2, is that employment in the pesticide industry may not have been too much affected by the recent drop in total sales.

Unfortunately all these effects are difficult to be measured empirically. Nevertheless tabels 1 and 2 show a very hopeful trend for the Brazilian agriculture.

1.2. Impacts of the PROALCOOL Program in the Agricultural Sector

Some attention will be given now to the impacts in rural areas stemming from the PROALCOOL program. The major target of this program is that 10.7 billion liters of alcohol are expected to be produced in 1985 in order to reduce gasoline consumption, mostly in urban areas. Environmental impacts in urban areas from automobile exhaustions in terms of alcohol vis-a-vis gasoline are reported in Yeganiantz et. al. (1982). In rural areas, massive build-up of sugarcane plantations are likely to produce impacts in land use (competing with areas intended for food crops), and or labor employment given the seasonal aspects of sugarcane.

In terms of land use, the unfortunate delay in statistical reporting makes it difficult to make any judgement as to whether sugarcane is competing with food crops. Latest official sugarcane acreage figures available go back to 1980 which is the year where the first alcohol cars started to be produced commercially. Hence more importance should be given to figures after 1980, as more and more alcohol cars became available.

TABLE 3 - Evolution of Sugarcane Acreage by States-1974/80 (1.000 ha)

State	1974	1975	1976	1977	1978	1979	1980	Growth 1980/76 (%)
São Paulo	720	621	723	791	871	945	1.060	+ 55,5
Pernambuco	303	267	329	350	353	366	365	+ 5,9
Alagoas	195	228	230	290	309	330	357	+ 20,9
Rio de Janeiro	163	162	162	192	180	194	198	+ 5,9
Minas Gerais	240	255	190	183	180	181	186	− 0,7
Paraíba	52	60	70	80	92	101	110	+ 6,6
Bahia	78	77	69	78	83	75	73	+ 0,7
Paraná	40	46	52	43	47	60	65	+ 2,1
Outros	266	253	268	263	273	289	287	+ 3,1
Total	2.057	1.969	2.093	2.270	2.388	2.541	2.701	100,0

SOURCE: FIBGE - Fundação Instituto Brasileiro de Geografia e Estatística

It can be seen that the state of São Paulo, the largest sugarcane producer in Brazil had a sizable increase in acreage over the last couple of years. Unofficial reports suggest that the pace is growing even faster in 1981 and 1982. In order to compare the acreage of sugarcane with other crops for the state of São Paulo, table 4 is shown:

TABLE 4 - Crops and Pastures Acreages - São Paulo, 1976/1980 (1.000 ha)

Activity	1976	1977	1978	1979	1980	(80-76)	80/76 (%)
Cotton	223	300	345	284	265	+ 42	+ 18,8
Peanuts	230	145	172	203	211	- 19	- 8,3
Rice	606	347	342	300	300	- 306	- 50,5
Coffee	691	637	775	768	805	+ 114	+ 16,5
Sugarcane	723	790	871	948	1.060	+ 337	+ 46,6
Beans	240	350	486	392	449	+ 209	+ 87,1
Oranges	282	286	326	399	427	+ 145	+ 51,4
Castor Nuts	23	18	34	21	25	+ 2	+ 8,7
Manioc	30	33	36	28	23	- 7	- 23,3
Corn	1.250	1.134	972	1.055	1.030	- 220	- 17,6
Soyabeans	394	449	559	536	560	+ 166	+ 42,1
Other	222	287	271	363	292	+ 70	[illegible]
Subtotal	4.914	4.776	5.189	5.297	5.447	+ 533	+ 8,5
Pastures	10.245	10.144	10.092	9.970	9.546	- 699	- 6,8
Total	15.159	14.920	15.281	15.267	14.993	- 166	- 1,1

SOURCE: Homem de Mello e da Fonseca (1981)

Pastures, rice, manioc and corn are losing ground to other crops. Sugarcane, beans, oranges and soyabeans display the major acreage gains, over the 1976-80 period. Notice that among food crops only beans are not losing ground, but the lack of 1981 and 82 figures makes the analysis less clear cut.

In terms of potential land use, some areas in Brazil (like the center-south) are approaching their limit, and it is precisely on those areas that the sugarcane expansion is at full speed.

Table 5 shows the 1980 figures of land use in Brazil and the potential figures by state:

TABLE 5 - Actual Land Use and Availability of Suitable Land for Crops (under Modern Management) in 1980.

States	(1) Suitable Land Total (1.000 ha)	(2) Under Cultivation Annual Crops-1980 (1.000 ha)	(3) Total Under Cultivation-1980 (1.000 ha)
NORTH	79.540	754	786
Pará	31.150	336	369
Other	48.390	389	417
NORTHEAST	20.180	4.581	4.986
Maranhão/Piauí	5.940	2.763	3.002
Bahia	14.240	1.818	1.984
	3.690	4.157	7.085
Ceará	830	1.000	2.364
Rio Grande do Norte	460	333	770
Paraíba	490	896	1.556
Pernambuco	760	1.160	1.448
Alagoas	920	601	699
Sergipe	230	167	248
CENTER-SOUTH	106.400	31.834	35.557
Minas Gerais	830	3.529	4.159
Espírito Santo	620	322	656
Rio de Janeiro	4.830	307	376
São Paulo	5.600	3.888	5.421
Paraná	9.000	7.995	8.984
Santa Catarina	2.300	2.324	2.348
Rio Grande do Sul	7.900	8.178	8.210
Mato Grosso	49.890	2.843	2.904
Goiás	25.430	2.448	2.509
Brazil	209.810	41.317	48.414

SOURCE: Homem de Mello and da Fonseca (1981).

Some states like Espirito Santo, Santa Catarina and Rio Grande do Sul have already surpassed the amount of suitable land available for modern management, in terms of intensive machinery use. This is the sort of land required by large sugarcane plantations. Other important states, such as São Paulo and Parana, are approaching the limit of machinery intensive land. These figures suggest that competition between sugarcane and other crops (for food consumption and exports) is likely to become a problem in the near future.

Turning now to labor employment, current figures suggest the growth of labor demand for sugarcane as indicated in table 6:

TABLE 6 - Change in Labor Demand in São Paulo - 1980-76

Activity	80/76 Change in Acreage (1.000 ha)	80-76 CHANGE IN MAN/DAYS - TOTAL	
		Ordinary (1.000 days)	Tractor Drivers (1.000 days)
Cotton	+ 42	+ 1.884	+ 111
Peanuts	- 19	- 266	- 63
Rice	- 306	- 3.029	- 796
Coffee	+ 114	+ 6.646	-
Sugarcane	+ 337	+ 8.155	+ 1.955
Beans	+ 209	+ 3.532	+ 167
Oranges	+ 145	+ 3.567	+ 624
Castor Nuts	+ 2	+ 68	+ 3
Manioc	- 7	- 244	-
Corn	- 220	- 1.562	- 418
Soyabeans	+ 166	+ 183	+ 299
Other	+ 70	+ 1.715	+ 189
Pastures	- 699	- 1.398	-
Total	- 166	+ 19.251	+ 2.071

SOURCE: Homem de Mello e da Fonseca (1981).

The implication of these figures is that a seasonal unemployment can be expected if the rate of growth in sugarcane acreage continues. It is well known that sugarcane demands labor mostly for the manual harvest period, covering only the period May-November each year.

2. What are the Alternatives?

Section 1 suggested some potential negative impacts of the PROALCOOL program. These negative impacts are based on the assumption of current policies, based on sugarcane as the only raw material for alcohol production and on large distilleries already under construction and financed by government agencies. This section shows that it is possible:

i) to avoid raw material specialization, by introducing sweet sorghum as a complement to sugarcane.

ii) to stimulate food production by utilizing by-products of alcohol fermentation as organic fertilizer to complement chemical formulations.

These features can become operational if government policies are changed so as to boost alcohol production at farm level under an integrated system. Research efforts are already under way to develop integrated bio-energy systems at farm level (Dias et. al., 1982; Gorgatti Netto and da Cruz, 1982). A possible version of such an integrated system is shown in Figure 1.

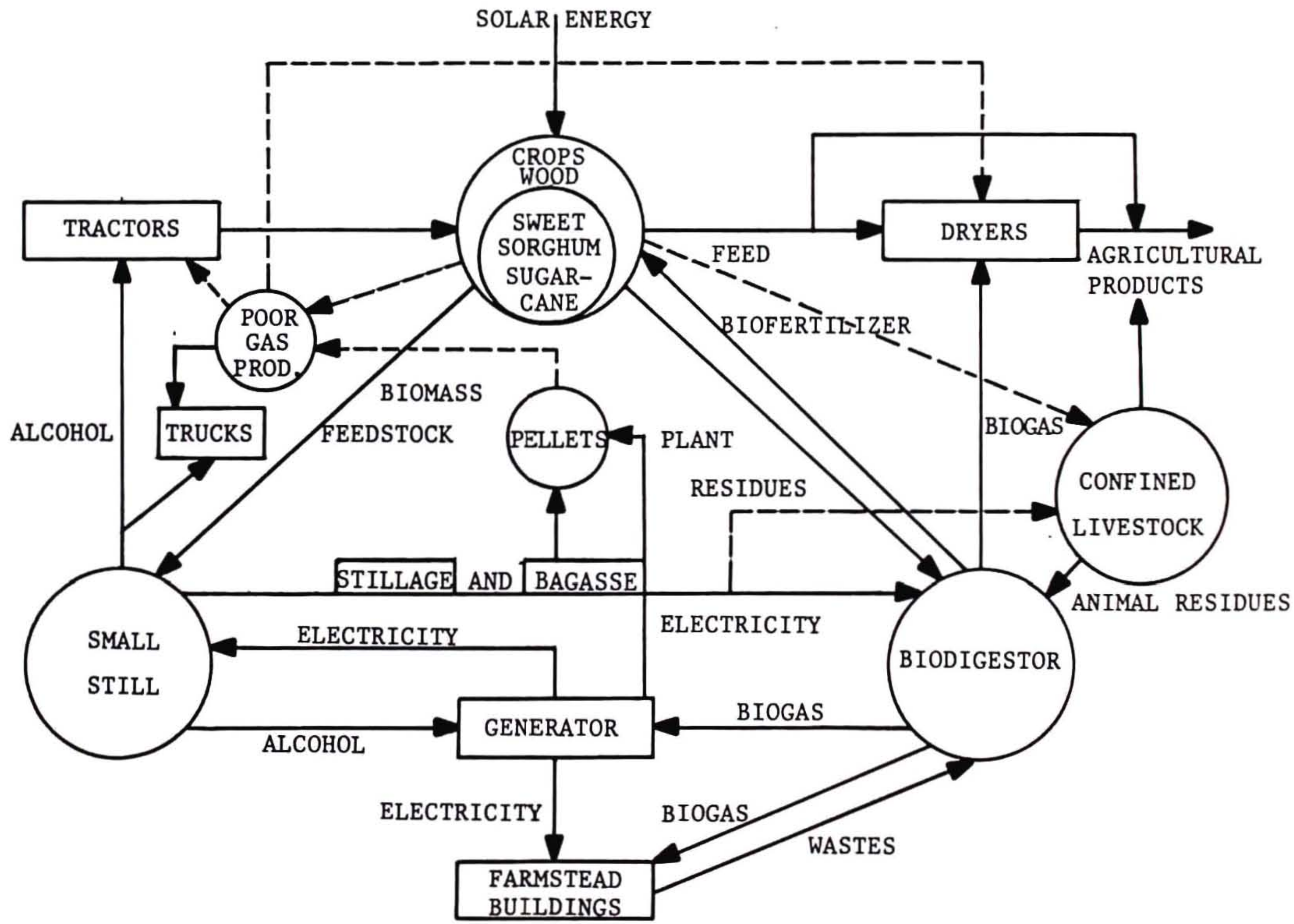

FIGURE 1 - Simplified Flowchart of on-farm bio energy systems

Fig. 2 shows the material balance of a potential system consisting of a microdistillery (Fig. 3), biodigestor, electric generator, crop dryers and pelletizer. The system can produce 55 liters of alcohol, equivalent to 37 liters of diesel oil, from one ton of sugarcane. Surplus bagass left after extracting alcohol from this one ton can be pelletized to produce 117 kg of pellets. These when used in a gasogene engine are equivalent to an additional 36 liters of fuel or diesel oil. The stillage, in addition to producing 9 m^3 of biogas, will produce 0,72 m^3 of biofertilizer that will satisfy all potassium and 1/4 of nitrogen needs of sugarcane.

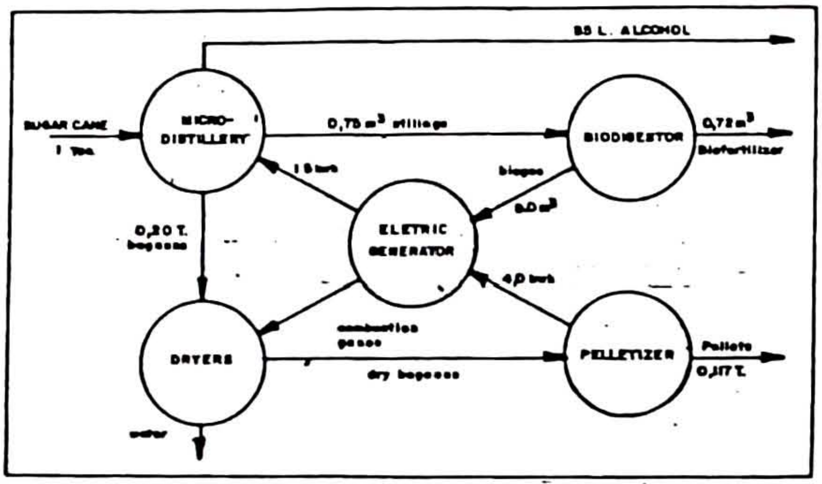

FIG. 2 - MATERIAL ENERGY BALANCE OF AN "ON FARM BIO-ENERGY SYSTEM".

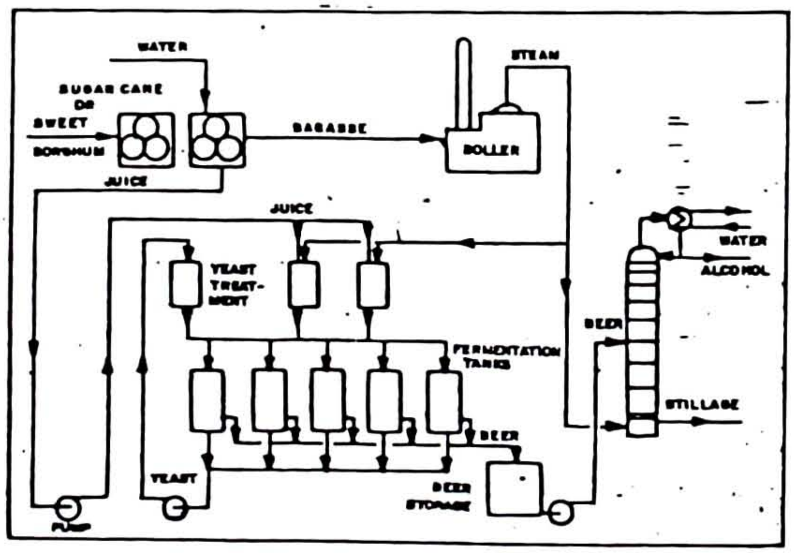

FIG. 3 - A SIMPLE FLOW DIAGRAM OF A MICRODISTILLERY.

The integrated bio-energy system at farm level can generate more benefits to society than alcohol production from large distilleries. The main impact of these on-farm energy systems is on water polution. Usually large distilleries cannot handle properly the stillage from alcohol fermentation. For each liter of alcohol, there is a production approximately 13 liters of stillage, to be disposed in alternative ways, but in many cases this by-product is simply thrown away in rivers, killing fish and other animals. The stillage from a small system at farm level can be used as biofertilizer for the major crops as indicated above.

If the government target is to produce 15% of the diesel oil needs of the agricultural sector in alcohol oil-equivalent, then the amount of 525 million liters of alcohol would be required. This could involve the construction of 2,100 small stills having 2,500 liters/day capacity each, using sugarcane and operating 150 days per years. Alternatively, the same amount of alcohol can be produced by 44 large distilleries, having a capacity of 120,000 liters'day for example, in which case total investment would be US$ 375 million at 1981 prices. The investment involved in the above-mentioned 2,100 units of 2,500 liters/day capacity, would be US$ 165 million only.

Additional fuel for transportation can be provided by use of surplus bagasse to produce pellets for gasogene engines. This would substitute another 520 million liters of diesel or fuel oil. Pelletization of surplus bagass will cost an additional 30% in terms of investment, but will double the amount of diesel and/or fuel oil substitution. The investment will be slighty higher if microdistilleries having less than 2,500 liters/day capacity are used, due to economies of scale.

An "On-Farm Bio-Energy Systems" program aimed at 15% fuel self-sufficiency in the Agricultural Sector could be implemented if 50% of the annual new machinery purchases of farmers were of equipment designed to use alcohol and gasogene (poor gas).

However, the major impact of on-farm energy systems to ensure 15% of substitution of diesel oil in agriculture, would be on the employment in the rural sector. (Da Cruz et. al., 1980). The labor requirement of 2,100 micro-destilleries is estimated to be 31,500 workers located in rural areas. If the same amount of alcohol is produced by 24 autonomous distilleries of 120,000 liters per day, the labor requirement falls to 5,720 workers. In terms of seasonality of labor, one should not forget that a large part of work in sugarcane distilleries does not coincide with peak labor requirement periods of other crops. Thus this program could contribute somewhat to employment stability in rural areas, assuming that increased crop acreage will keep employees of small stills busy during the period when the still is not operating.

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