INSTITUTO DE FÍSICA

preprint

IFUSP/P-236

A NOTE ON THE ENERGY CONSUMPTION OF URBAN SLUMS AND RURAL AREAS IN BRAZIL

by

V.R. Vanin, G.M.G. Graça, T.T. Higa, M.S. Droichi and J. Goldemberg

Instituto de Física, Universidade de São Paulo
São Paulo, Brasil

UNIVERSIDADE DE SÃO PAULO
INSTITUTO DE FÍSICA
Caixa Postal - 20.516
Cidade Universitária
São Paulo - BRASIL

A NOTE ON THE ENERGY CONSUMPTION OF URBAN SLUMS AND RURAL AREAS IN BRAZIL

V.R.Vanin, G.M.G.Graça, T.T.Higa, M.S.Droichi and J.Goldemberg
Instituto de Física,Universidade de São Paulo,S.Paulo, Brasil.

The low energy consumption "per capita" in rural areas of India[1] is frequently used to indicate that there is a large increase in energy consumption associated with urbanization.

We have investigated this question in detail for rural, urban non-metropolitan and metropolitan areas in the State of São Paulo, Brazil[2] and reached the conclusion that the energy consumption per capita is solely determined by income: the low energy consumption of the rural areas merely reflects the fact that the personal income of people in those areas is very low.

In addition to that we conducted a survey of energy consumption in slum areas in the city of São Paulo[3] and compared the results with rural areas. We learned from this study that the energy efficiency is higher in slum than in rural areas. So, although the total energy used is quite similar in those two areas the slums have advantages because they use energy with higher efficiency achieving more services with the same energy amount.

The direct energy consumption[4] in the slums

areas of the city of São Paulo (a metropolis with 13 million people) and the rural area in the State of São Paulo is shown in Table I. As a comparison the consumption in rural areas in India is also given[1].

TABLE I

DIRECT ENERGY CONSUMPTION PER CAPITA PER DAY (kcal)

Region	Energy	Reference
Slum area of São Paulo (Brazil)	2,300	3
Rural area of São Paulo	2,600	2
Rural area (India)	4,500	1

It is interesting to notice that the consumption in rural areas of India is larger than in São Paulo. This clearly is due to a lower efficiency of cooking methods. In São Paulo slums woodstoves are not used at all and only 50% of the people in the rural area use them, as shown in Table II.

TABLE II

FUEL EFFICIENCIES IN SLUMS AND RURAL AREAS

Cooking device	% of households using the indicated combination of fuel and device (ref.5)		efficiency (%) (ref.6)
	slum	rural	
gas (surface burner*)	100	53	48
wood (closed fire)	0	25	10 a 43**
wood (open fire	0	35	5 a 10
TOTAL	100	113***	

* Low income households don't use ovens, only surface burners
** This efficiency depends on the existence of a chimney
*** 13% of the families have both gas and firewood cooking stoves.

In order to avoid problems connected to different lifestyles and different income distribution between India and Brazil we restricted our analysis to the data of the State of São Paulo.

The expenditure distributions of slums and rural areas are given in Figure 1; surprisingly as it might seem they are almost identical except for 12% of the rural population which has income higher than 7 W.U. (Wage units - see reference 7).

Table III shows the consumption of different sources of energy for slums and rural areas, in São Paulo.

TABLE III

DIRECT ENERGY CONSUMPTION PER HOUSEHOLD IN SÃO PAULO IN kCAL PER DAY

fuel	slum area (ref.3)	rural area* (ref.2)
electricity**	7,400	1,500
gas + firewood	6,200	10,100
kerosene	100	1,600***
gasoline	200	900
TOTAL	13,900	14,100
average income or expenditure per household in W.U.****	2,7	2,8
average number of members of a household	6	5

* The data exclude the families of expenditures greater than 7 W.U.
** Thermal equivalent of electricity. The distribution losses are also included.
*** Average consumption in rural area - it was not possible exclude the households with income greater than 7 W.U.
**** Income for the slums and expenditure for the rural area (see figure 1 and references 7 and 8).

As one can see in this Table the energy used in cooking food is larger in rural area than in slums; this is due to the fact that LPG (Liquefied petroleum gas) is used in 100% of the slum units as compared to the partial use of firewood in the rural area. The total direct energy consumption is however rather similar in the two areas.

Therefore, from an energy point of view, the migration from rural to slums areas, which is very strong in Brazil, means that the total energy consumption does not increase but that it is used more efficiently.

The greater use of electricity in slums reflects the fact that urbanization - with the same income as in rural areas - permits access to more amenities (such as TV) and commodities (lighting and refrigeration) than in the rural areas.

REFERENCES

1. R. Revelle - "Energy in Rural India" - Science 192, 973 (1976).

2. V.R.Vanin, G.M.G.Graça and J.Goldemberg - "Energy Consumption in Rural, Urban Non-metropolitan and Metropolitan Areas in the State of São Paulo" - 1980 unpublished.

3. T.T.Higa and M.S.Droichi - "Consumo familiar de energia nas favelas da cidade de São Paulo" - Internal Report, IFUSP (1980)

4. We call "direct energy consumption" the consumption of firewood, gas, electricity, kerosene and gasoline by the members of the household. These fuels account for about 40% of the total energy consumption of the people living in the rural area (ref.[2]).

5. Estudo Nacional da Despesa Familiar - ENDEF - Despesas das Famílias, Região II - Estado de São Paulo, IBGE (1978), Rio de Janeiro.

6. J.Goldemberg and R.I.Brown - "Cooking Stoves: The State-of--the-art" (1979).

7. We define Wage Unit (W.U.) as the biggest minimum monthly salary in Brazil.

8. The abscissa scale is different for the two distributions. In the slums, it refers to 1979's W.U., which equals US$78 of november, 1979, and includes only monetary income. In the rural area, the W.U. refers to 1974 and equals US$52 of november, 1974. Also, the expenditures include both monetary and non-monetary expenditures, the last accounting for about one quarter of the total expenditures.[5]

Non-monetary expenditures are not very large in the slums. The average non-monetary expenditures in the metropolitan area is 18% of the monetary expenditures, mainly concentrated in housing.[5] Since the slums are caracterized by bad housing conditions the non-monetary expenditures in slums are smaller than the metropolitan average.

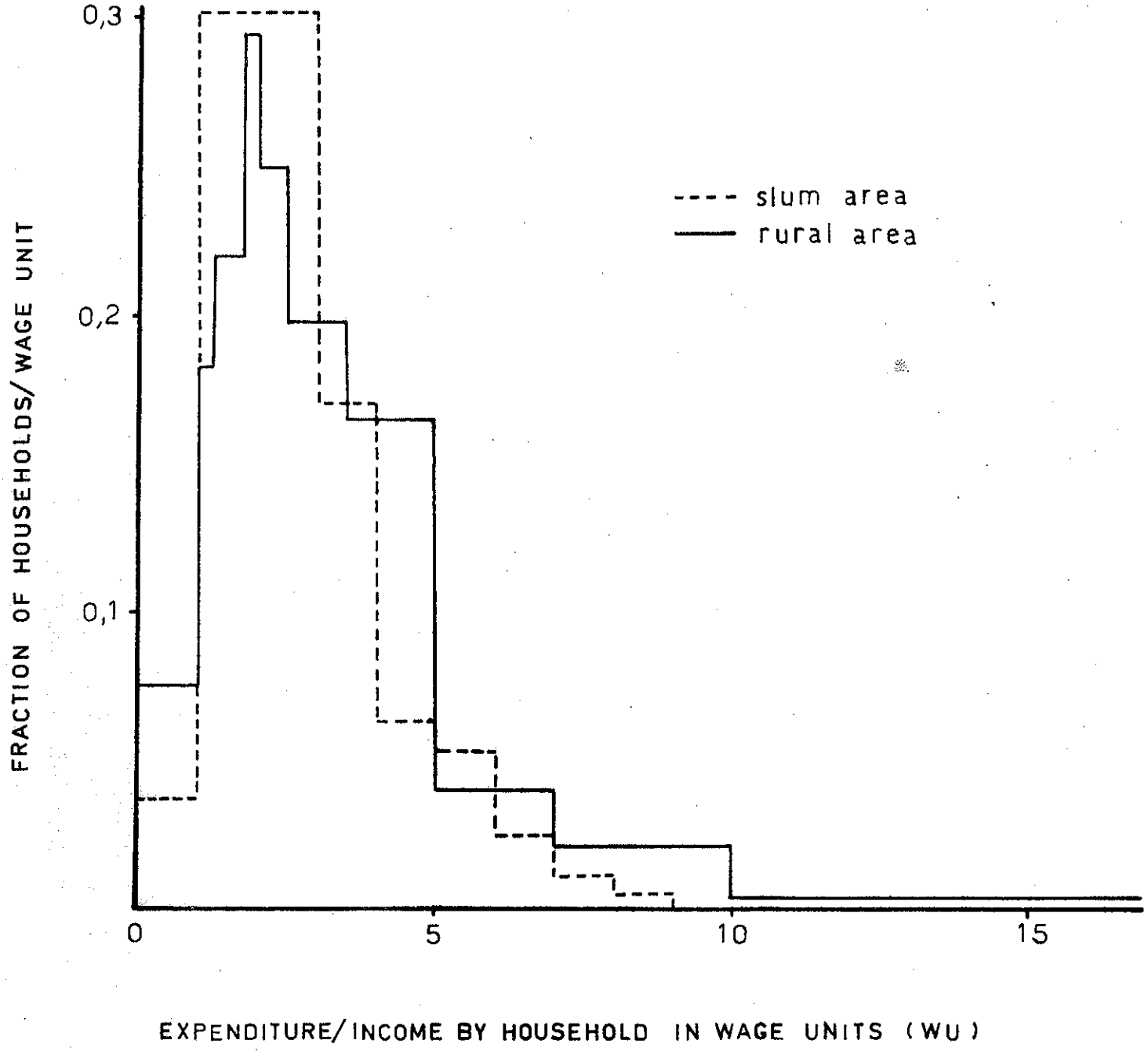

FIGURE 1 - Income distribution in slums in the metropolitan area of the City of São Paulo and expenditure distribution in the rural area of the State of São Paulo (see ref.8). In the evaluation of the energy consumption in the rural area the households with expenditures greater than 7 wage units was excluded.