


Water  Energy

Enerwat

Nexus

Da água à energia

Caracterização, modelação e medidas para a diminuição dos consumos domésticos urbanos e rurais



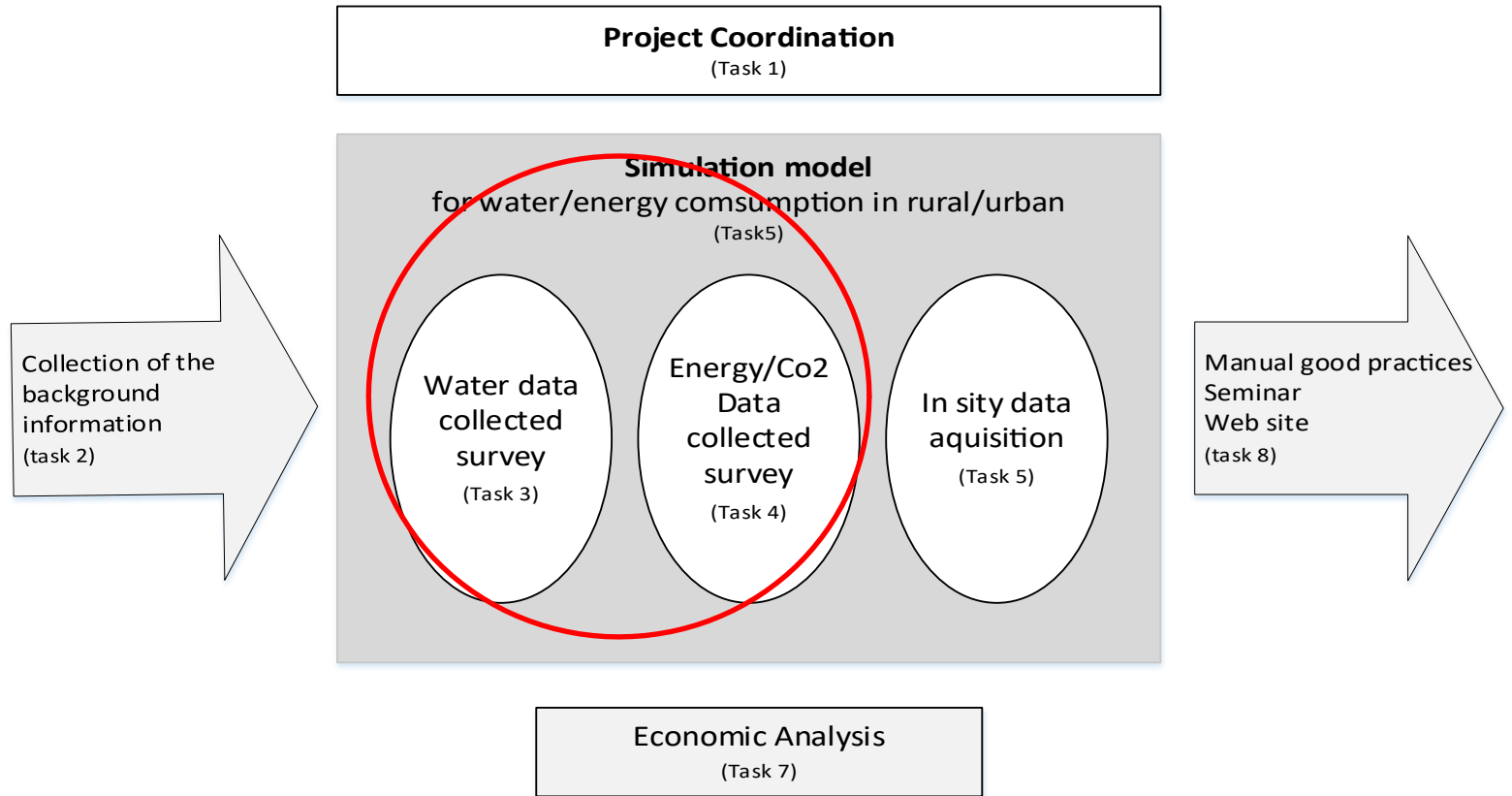
Fatores Determinantes na relação entre água e energia

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- Introduction
- Methods
- Results
- Work in progress
- We hope to find...

Introduction



What's rural or urban????



A rural environment :

- Which belong to small villages inserted in the agricultural neighbourhood;
- Which had a population density equal to/or < 100 inhabitants per km^2 at the community level;
- In which the inhabitants have full or part-time primary sector activity.

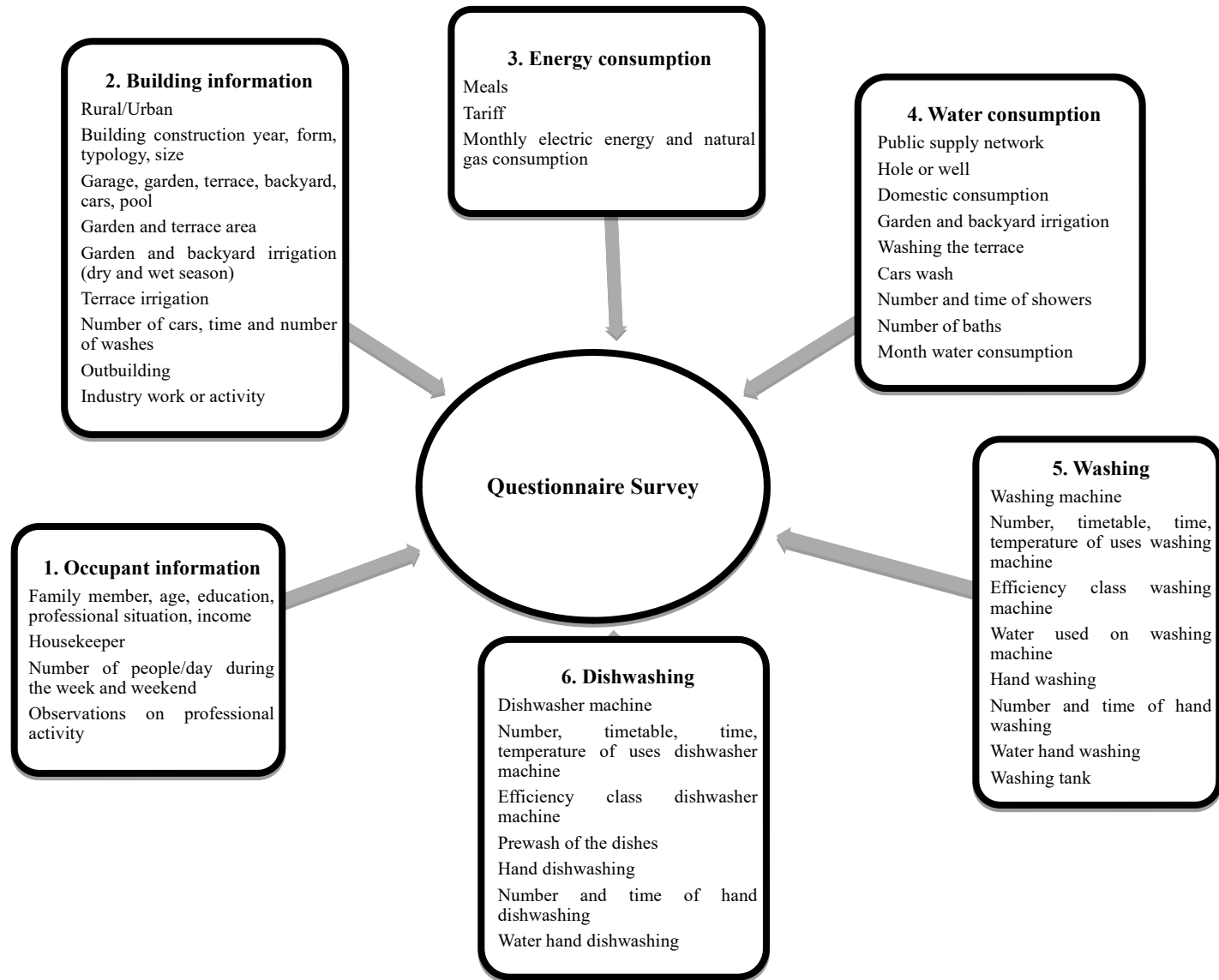
In relation to **urban areas**, the following criteria were considered:

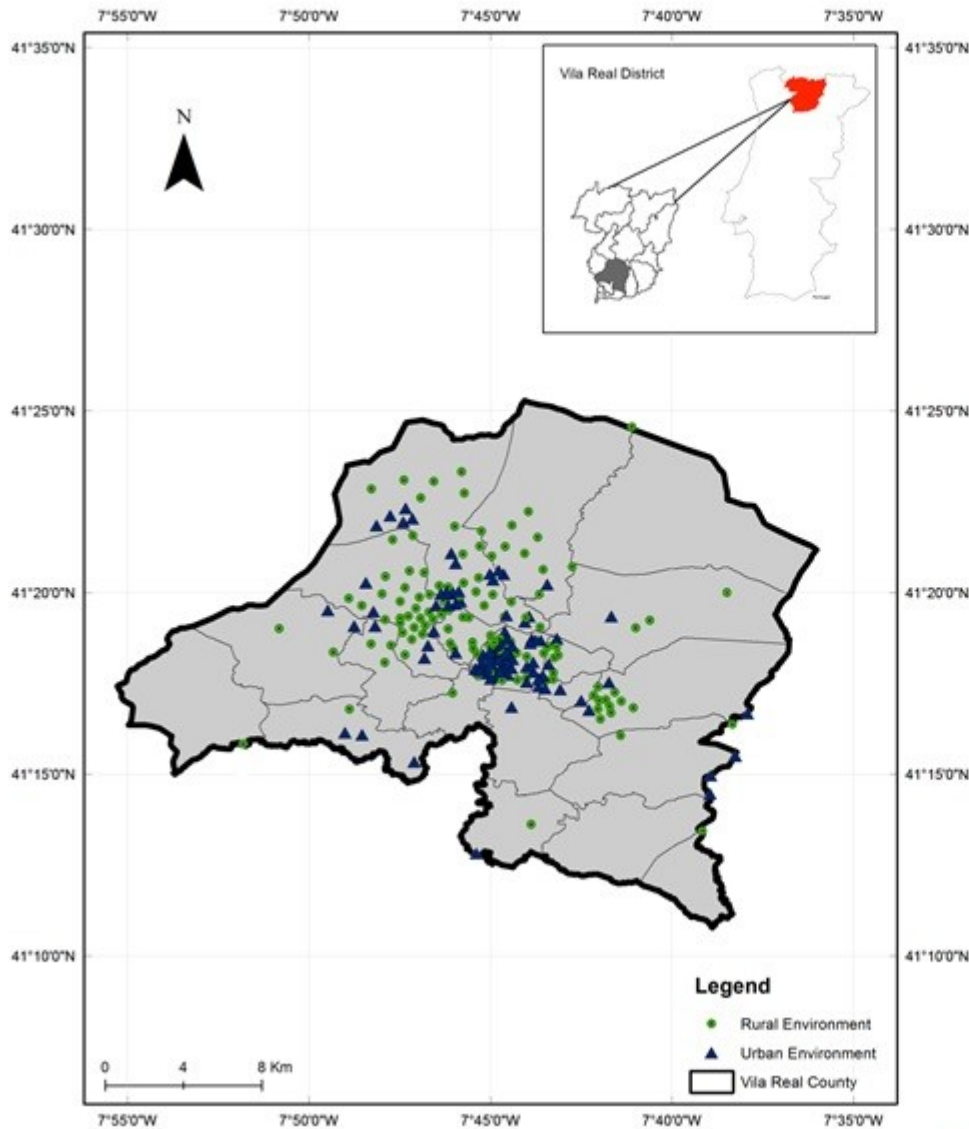
- The households would have to be located in a medium/large agglomerate not inserted in the agricultural area;
- The area should have a population density >100 inhabitants per km^2 at the community level;
- The inhabitants should have their professional activity in secondary and tertiary sectors.

Methods

- A face-to-face interview in each household was later performed by two trained interviewers in order to tackle with inconclusive responses and other difficulties emerging from the interpretation of the survey items.
- The main fieldwork took place between December 2016 and January 2017.
- A total of 256 households were surveyed (N = 256). However, 11 surveys were discarded due to missing data.
- 110 urban households (45%) and 135 rural households (55%) were considered for this research.
- The final version of the survey integrates 74 questions grouped in six categories

Methods





- Vila Real County is located in Northern Portugal, with 378.80 km² divided between urban and rural land classification
- This county has 20 parishes, 8 mainly urban (40%) and 12 mostly rural (60%), according to the National Statistical Institute (INE, 2015).

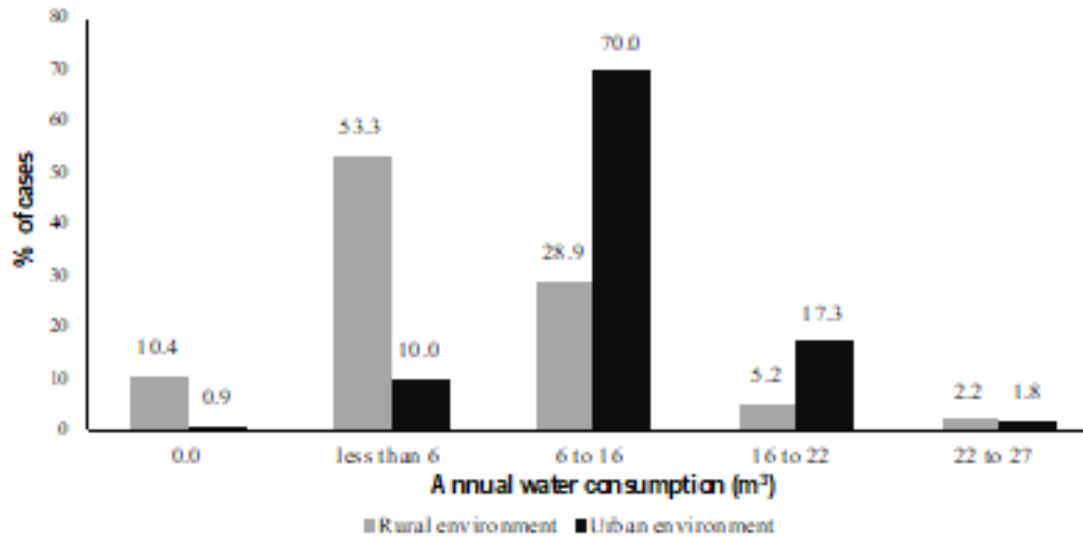
Methods

- Several statistical analyses were performed to analyze and present the data. The statistical package IBM SPSS23.0 was used for data entry and analysis.
- Special emphasis was given to the exploratory data analysis.
- Descriptive statistics (absolute and relative frequency, mean, mode, range, and standard deviation) of the variables across rural and urban environments were used to summarize the survey results and to characterize water and energy consumption in rural and urban households.
- Considering the nature of the dataset, non-parametric hypothesis tests were applied in order to compare the variables collected in rural and urban households, and to distinguish both environments.

Key questions

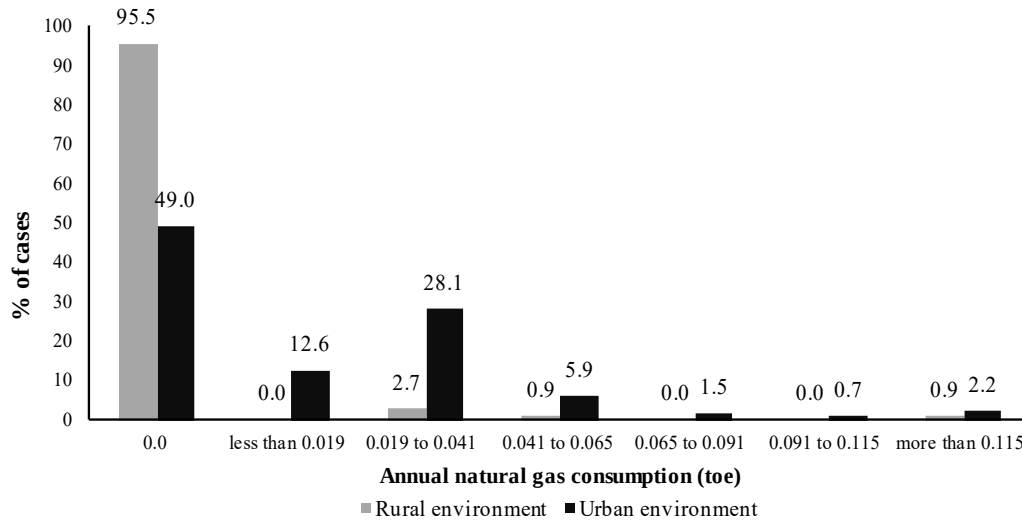
- Which are the differences between rural and urban consumptions, in terms of water and energy?
- Lets find the factors that in rural and urban environments may justify the differences found in water and energy consumptions.
- Finding among all the studied factors the ones that differ between environments will show what factors should influence water and energy consumption differences.

Results



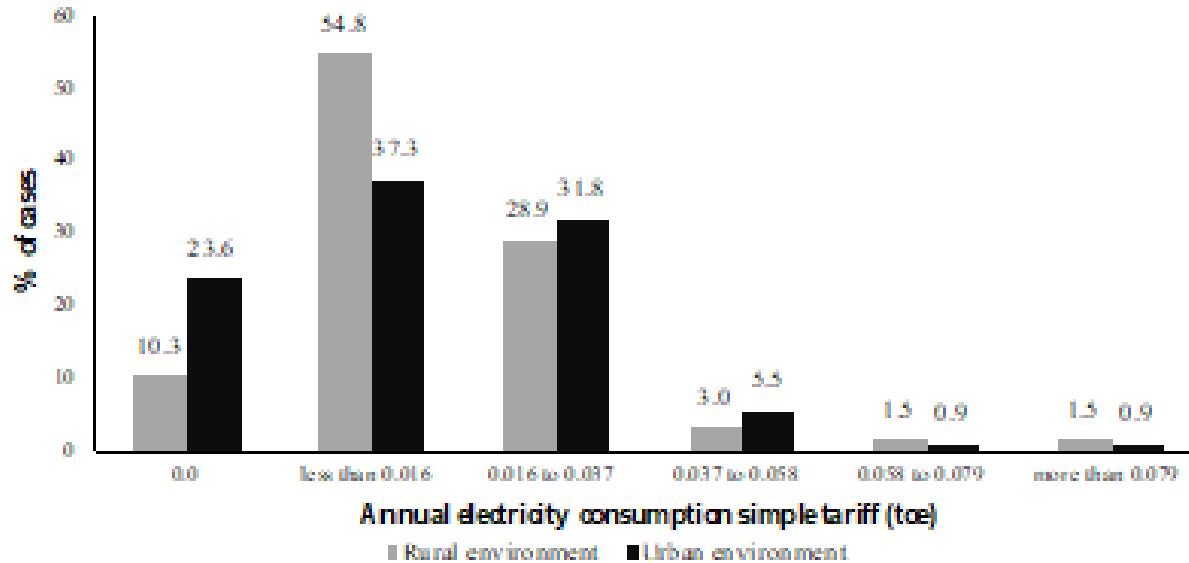
- The 10.4% of rural dwellings that did not present any type of water consumption from the public network only use water from a well or a hole, while in urban areas this situation happens in only 0.9% cases.
- More than half of the rural households (53.3%) consumes lower than 6 m³ of water from a public supply network; in contrast, the majority of urban households (70%) consumes between 6 and 16 m³.

Results



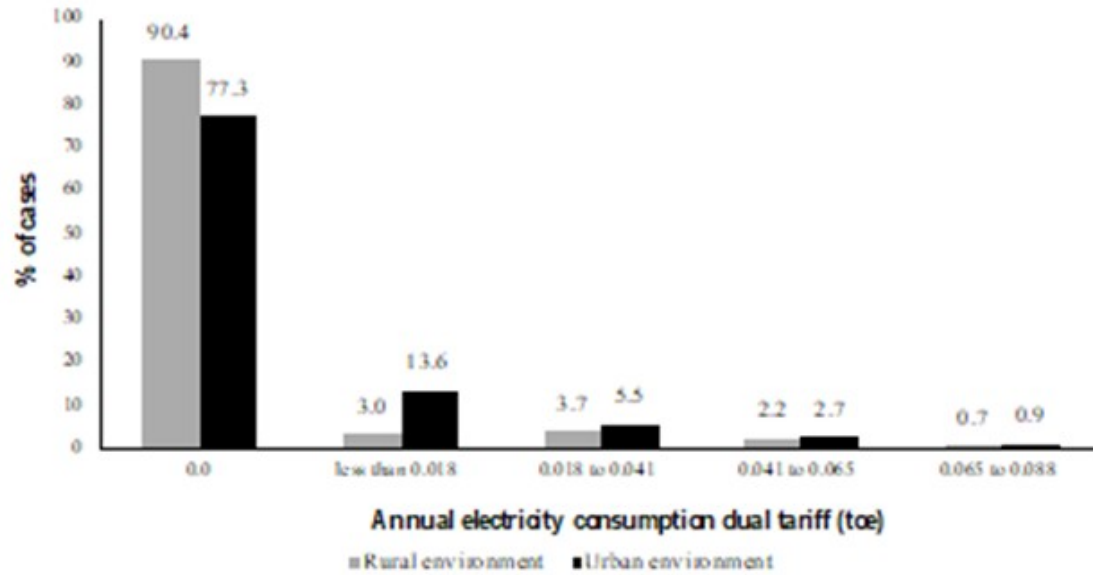
- 95.5% of the cases in the rural area does not use this energy source, using other sources of energy such as firewood, coal, pellets, gas oil, LPG and others.
- In urban areas, this energy source is not used in 49% of the cases, possibly due to the fact that some homes are not yet served with natural gas.
- In urban areas, the highest percentage (28.1%) of households spend between 0.019 and 0.041 toe natural gas per year.

Results



- It is verified that the majority of them spend less than 0.016 toe of electricity (54.8% rural and 37.3% urban).

Results



- In rural areas, the highest percentage (3.7%) of households spend between 0.018 and 0.041 toe of electricity; in contrast, in urban areas (13.6%) spend <0.018 toe of electricity.

Results

- Besides the collection of water and energy consumption data, this survey analyzed 80 variables (socio-demographic, economic, household characterization, among others), that were chosen among the bibliography as possible factors that should influence water and energy consumptions;
- After the data statistical treatment, 42 variables remained as truly differentiating factors of rural and urban environments and so as possible determinants of water and energy consumptions (Mann-Whitney-Wilcoxon test and the Chi-square test of homogeneity).
- All the 42 differentiating variables that result from this study may be able to justify the differences of consumptions found .



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Which are the factors that may explain the differences in water and energy consumptions in urban and rural environments?



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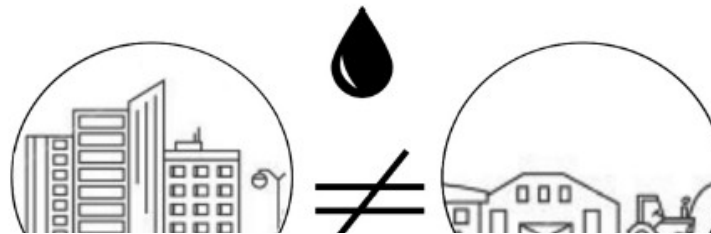
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HIGHLIGHTS

- Factors that may support differences in water and energy consumptions in rural and urban areas
- Where found significant differences between rural and urban environments
- Descriptive data analysis and statistical inference (ST) are performed.
- Started with 80 variables after ST only 42 remained as differentiating factors

GRAPHICAL ABSTRACT



Results

Descriptive statistics of the variables for quantitative and qualitative variables, respectively, in rural and urban regions

Table 3
Description of household characteristics using quantitative (continuous and discrete) variables.

Variable definition	N		Range
	R	U	R
Average number of inhabitants per day during the week	135	110	1-6
Average number of inhabitants per day during the weekend	135	110	1-7
Number of inhabitants with no education	135	110	0-2
Number of inhabitants with basic education	135	110	0-6
Number of inhabitants with high school and higher education	135	110	0-4
Number of inhabitants with active professional life	135	110	0-5
Number of inhabitants without active professional life	135	110	0-4
Number of meals per week	135	110	2-24
Number of showers per week	135	110	1-50
Number of baths per week	135	110	0-10
Duration of washing machine uses (min)	121	102	15-24
Duration of manual washing (min)	58	22	5-60
Temperature of dishwasher uses (°C)	50	60	30-80
Duration of dishwasher uses (min)	56	70	30-18
Duration of manual dishwashing (min)	120	89	5-30

Table 4
Description of household characteristics using qualitative (categorical and ordinal) variables.

Variable definition	Categories	Frequency		N	
		R	U	R	U
Housekeeper	1 = yes	8 (5.9%)	23 (20.9%)	135	110
	2 = no	127 (94.1%)	87 (79.1%)		
Professional activity	1 = with agricultural, domestic and vineyard activities	39 (28.9%)	3 (2.7%)	135	110
	2 = no agricultural, domestic and vineyard activities	96 (71.1%)	107 (97.3%)		
Income (€)	1 = less than €500	22 (16.3%)	2 (1.8%)	135	110
	2 = between €500 and €999	60 (44.4%)	26 (23.6%)		
	3 = between €1000 and €1999	37 (27.4%)	51 (46.4%)		
	4 = between €2000 and €3000	13 (9.6%)	19 (17.3%)		
	5 = more than 3000 €	3 (2.2%)	12 (10.9%)		
Type of housing	1 = multi-family housing	5 (3.7%)	77 (70.0%)	135	110
	2 = single family dwelling, isolated	94 (69.6%)	16 (14.5%)		
	3 = single family dwelling, twinned	36 (26.7%)	17 (15.5%)		
Year of construction	1 = until 1950	86 (64.7%)	39 (35.2%)	133	102
	2 = between 1950 and 2006	40 (30.1%)	49 (48.0%)		
	3 = between 2006 and 2013	7 (5.3%)	14 (13.7%)		
House area (m ²)	1 = less than 100 m ²	27 (22.1%)	28 (26.2%)	122	96
	2 = between 100 m ² and 200 m ²	48 (39.3%)	47 (48.0%)		
	3 = between 200 m ² and 300 m ²	27 (22.1%)	13 (13.5%)		
	4 = more than 300 m ²	20 (16.4%)	9 (8.3%)		
Building typology	1 = house	130 (96.3%)	32 (29.1%)	135	110
	2 = apartment	5 (3.7%)	78 (70.9%)		
Garden	1 = yes	77 (57.0%)	29 (26.4%)	135	110
	2 = no	58 (43.0%)	81 (73.6%)		
Terrace	1 = yes	86 (63.7%)	57 (51.8%)	135	110
	2 = no	49 (36.3%)	53 (48.2%)		
Backyard	1 = yes	68 (50.4%)	13 (11.8%)	135	110
	2 = no	67 (49.6%)	97 (88.2%)		
Terrace area (m ²)	1 = less than 10 m ²	27 (23.0%)	28 (68.1%)	87	57
	2 = between 10 and 20 m ²	40 (46.0%)	18 (31.6%)		
	3 = more than 20 m ²	20 (23.0%)	11 (19.3%)		
Number of car washings per month	0	38 (39.2%)	62 (79.5%)	97	78
	1	46 (47.4%)	8 (10.3%)		
	2 or more	13 (13.4%)	8 (10.3%)		
Tariff	1 = simple tariff	121 (89.6%)	84 (76.4%)	135	110
	2 = dual tariff	14 (10.4%)	26 (23.6%)		
Public supply network	1 = yes	121 (89.6%)	110 (100%)	135	110
	2 = no	14 (10.4%)	0 (0.0%)		
Water hole or well	1 = yes	42 (31.1%)	8 (7.3%)	135	110
	2 = no	93 (68.9%)	102 (92.7%)		
Domestic consumption	1 = public supply network	118 (88.7%)	110 (100%)	133	110
	2 = hole or well	15 (11.3%)	0 (0.0%)		
Garden irrigation	1 = public supply network	23 (40.4%)	17 (68.0%)	57	25
	2 = hole or well	34 (59.6%)	8 (32.0%)		
Terrace washing	1 = public supply network	24 (44.4%)	35 (79.5%)	54	44
	2 = hole or well	30 (55.6%)	9 (20.5%)		
Manual washing	1 = yes	59 (43.7%)	22 (20.2%)	135	109
	2 = no	76 (56.3%)	87 (79.8%)		
Clothes manual washing	1 = yes	36 (26.7%)	18 (16.4%)	135	110
	2 = no	99 (73.3%)	92 (83.6%)		
Efficiency class washing machine	1 = A+++	6 (5.0%)	16 (16.0%)	119	100
	2 = A++	12 (10.1%)	40 (40.0%)		
	3 = A+	64 (53.8%)	31 (31.0%)		
	4 = A	31 (26.1%)	10 (10.0%)		
Timetable of washing machine uses	1 = 08:00 am - 11:59 pm	6 (5.0%)	3 (3.0%)	122	104
	2 = 12:00 am - 07:59 pm	7 (5.7%)	8 (7.7%)		
	3 = 08:00 pm - 07:59 am	6 (4.9%)	8 (6.4%)		
	4 = random	15 (12.3%)	32 (30.8%)		
	5 = cold water	56 (47.0%)	56 (53.8%)		
Water for manual washing	1 = cold water	49 (83.1%)	5 (23.8%)	59	21
	2 = cold and warm water	10 (16.9%)	16 (76.2%)		
Dishwasher	1 = yes	59 (43.7%)	70 (63.6%)	135	110
	2 = no	76 (56.3%)	40 (36.4%)		
Manual dishwashing	1 = yes	122 (90.4%)	90 (81.8%)	135	110
	2 = no	13 (9.6%)	20 (18.2%)		
Number of manual dishwashings	1 = 0	2 (1.7%)	0 (0.0%)	121	89
	2 = 1 to 3	14 (11.6%)	12 (13.5%)		
	3 = 4 to 6	9 (7.4%)	16 (18.0%)		
	4 = 7 to 10	65 (53.7%)	28 (31.5%)		
	5 = more than 10	31 (25.6%)	33 (37.1%)		
Manual washing use of water	1 = cold water	50 (41.7%)	24 (27.0%)	120	89
	2 = cold and warm water	70 (58.3%)	65 (73.0%)		

- These variables/factors were statistically significant in the differentiation of the behavior of their distributions in the rural (Group I (R)) and urban (Group II (U)) environments analyzed, as a result of the application of non-parametric hypothesis tests.

Results of the performed non-parametric tests, where the differences between the two environments are highlighted

An example of the results found:

- The majority of professional activity of the household head is associated to “No agricultural, domestic and vineyard activities” in both environments (rural and urban), with 71.1% in Group I (Rural) and 97.3% in Group II (Urban).
- It would be expected that in rural areas the main professional activity would be the “agriculture or domestic activity” and, as this region is located in Douro region, the activity “vineyard” would have a great percentages of responses.
- The obtained results can be explained by the geographical proximity to Vila Real urban area and so, the main activities of the households are not linked to the primary sector. Although there is a slight difference between rural and urban in this variable and the main number of responses as “with agricultural...” belongs to the rural environment

- One of the main aims of the project was to settle the main differences between water and energy consumptions in urban and rural households and to evaluate the factors that contribute to these differences...Ordinal regression technique

We hope to find...

- Energy and water relation in urban and rural areas...It is not linear...how then?

Questões

