Fuel poverty in tropical territories: a latent class model

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Introduction

- Fuel poverty in Europe :
  - France : 12,9% spend more than 10% of their income in energy, 8,7% suffer from cold (2020)
  - Italy : around 8% between 2004 and 2015 have low incomes and high costs (Faiella & Lavecchia, 2015)
  - UK : 10,4% with low incomes and high costs (gov.uk, 2019)
- « One who encounters a social, economic, environmental vulnerability which prevents him from heating himself appropriately and/or paying his energy bills » (Devalière, 2007)
- But in a tropical territory, the question of heating appears much less relevant !

Introduction

Reunion Island

French Guyana

Guadeloupe & Martinique

Guadeloupe, wordpress

French Guyana, La voix du Nord

Introduction

- 2018 cyclone season in Reunion Island (in the Indian Ocean):
  - 2 intense tropical cyclones, 3 tropical cyclones, 3 severe tropical storms, 1 moderate tropical storm, 1 tropical depression
- Consequences on :
  - Electric networks, water networks, sanitation of housing units

Introduction

- Developped countries:
  - Climatic issue : cold winter
  - Housing energy efficciency

- Developping countries:
  - Climatic issue less pronounced
  - Network development

- Tropical areas (French overseas territories):
  - Tropical Climate
  - Housing energy efficiency
  - Networks exposed to natural hazards

Introduction

- Fuel Poverty
  - Northern and colder countries (Bouzarosvski and Petrova, 2015)
  - Low incomes, low energy efficient housing and high energy prices (EPEE, 2006; Devalière, 2007; Palmer et al., 2008)

- Energy Poverty
  - Less developped countries (Bouzarosvski and Petrova, 2015)
  - Inadequate access to modern energy sources (infrastructure, electrification) (Nussbauer *et al.*, 2011)
  - Global development issues (UNDP, 2000; IAEA, 2005, Pachauri *et al.*, 2004; Pachauri and Spreng, 2004, 2011).

Introduction

- Characteristics of French overseas territories (Guadeloupe, Martinique, Reunion Island, Guyana)?
  - Mild or hot temperatures and humidity,
  - Low housing energy efficiency,
  - Low standards of Living, high prices for basic necessities, up to 35% for fuels compared to mainland France
- Poverty rate with local poverty tresholds : 19% in Guadeloupe, 23% in Guyana, 19% in Martinique, 15% in Reunion Island
- Poverty rate with national poverty tresholds : 34% in Guadeloupe, 50% in Guyana, 29% in Martinique, 39% in Reunion Island

Introduction

- Fuel poverty in tropical territories cannot be defined and measured with traditionnal indicators:
  - Energy effort rate approach, Low Income High Cost, Feeling of cold
  - Complex and multidimensional issues around fuel poverty in tropical territories

Introduction

How to characterize fuel poverty in tropical areas?

→ Methodological issue : how to analyze and quantify a phenomenon for which there is no definition or measurement method?

→ Identification and measure of the phenomenon in French overseas territories

Introduction

- Energy consumption, access to energy → services for utility (Sovacool, 2011; Bouzarovski and Petrova, 2015):
  - Cooking, lighting, cooling
  - Freedom offered by the consumption of energy services

- Energy poverty and Fuel poverty from a capabilities approach (Sen, 1979, 1999, 2012; Nussbaum, 2003; Nussbaumer et al., 2012)

- « An inability to realize essential capabilities as a direct or indirect result of insufficient access to affordable, reliable and safe energy services, and taking into account available reasonable means of realizing these capabilities » (Day et al., 2016)

Introduction

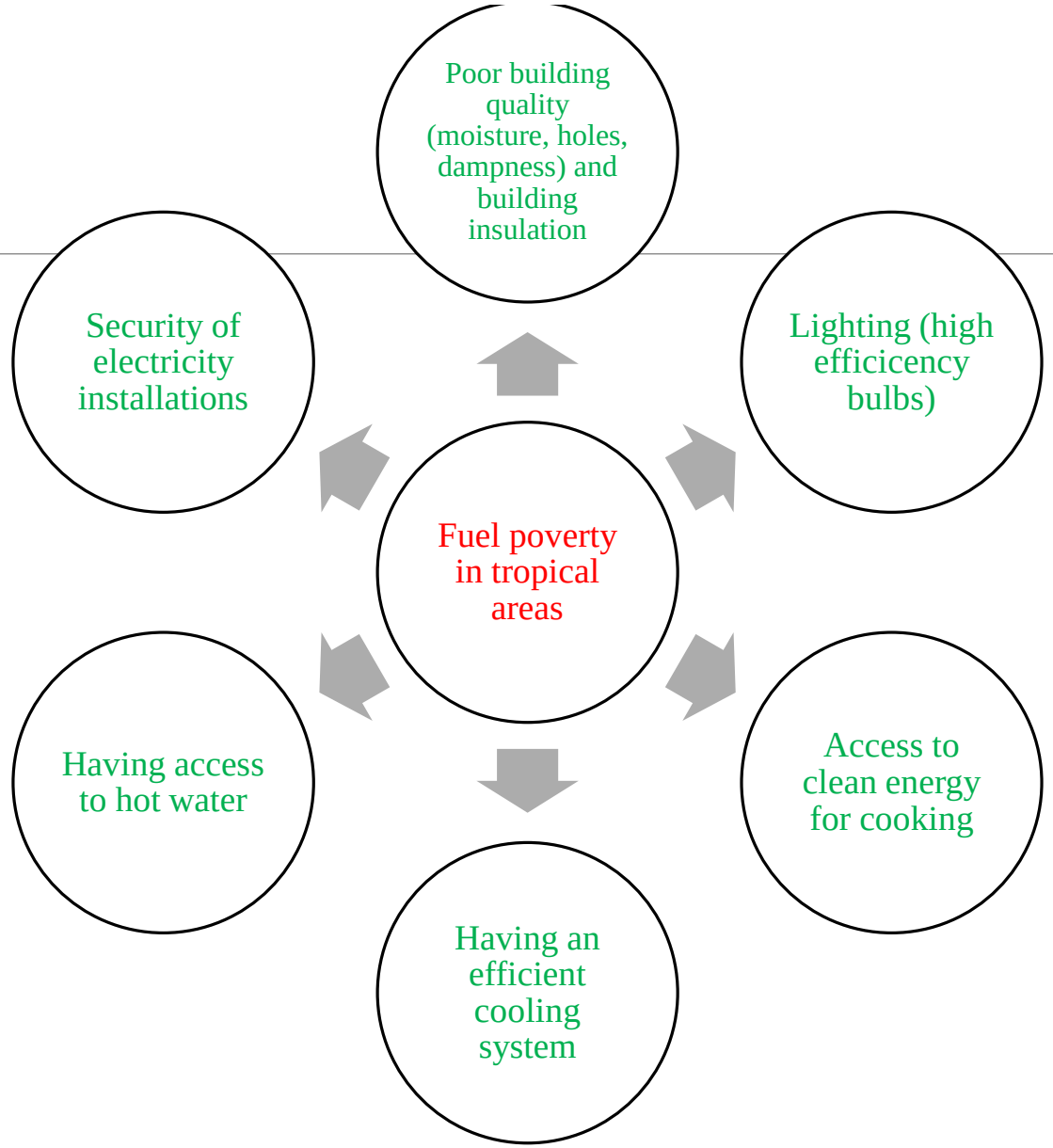
- Energy, energy services, secondary and basic capabilities (Day et al., 2016):
  - Daily actions
  - Being in good health, having social respect

- Unobservable phenomenon = latent phenomenon → latent class model

- We don't have a definition of fuel poverty in tropical territories, but we do know characteristics preventing from realizing capabilities → Observable characteristics of exposition to fuel poverty in tropical areas

Latent/unobservable

Observable



Introduction

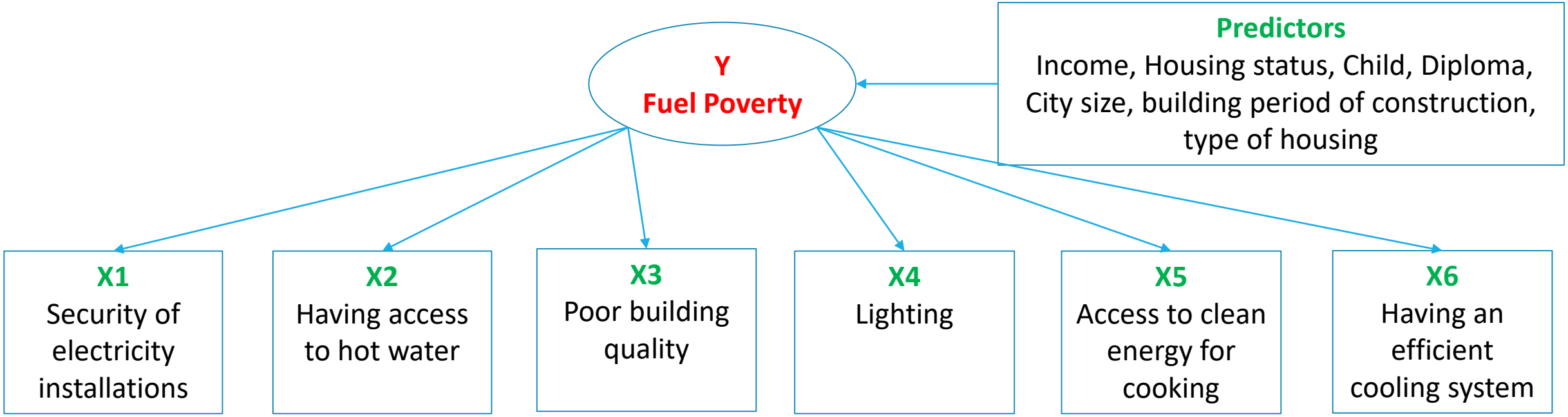
Outile of the presentation:

1. Methdological approach : the latent class model
2. Data: 2013 French Housing Survey
3. Results and policy implications

Model

- A latent class analysis: observation categorized into latent classes (Goodman, 2002)
- Latent classes : class 1 = fuel poor, class 2 = not fuel poor
- Is there a third class of vulnerable people?
- The latent variable is discrete and unobservable ➔ latent heterogeneity varies with observed factors
- Determinants of fuel poverty: observable characteristics of decent, safe and healthy dwelling ➔ observable attributes that contribute to determining class membership.

Model


Y
Fuel Poverty
Predictors
Income, Housing status, Child, Diploma, City size, building period of construction, type of housing
X1
Security of electricity installations
X2
Having access to hot water
X3
Poor building quality
X4
Lighting
X5
Access to clean energy for cooking
X6
Having an efficient cooling system

Model

- Observable attributes that contribute to determining class membership
- Covariates (predictors) directly affect the probability of belonging to a given class
- Number of classes?
  - LL test
  - Bayesian information criterion

Data

2013 French housing survey

- Housing stock physical characteristics (size, sanitary comfort, heating);

-Housing quality: housing and building quality, noise, exposure, location, environment, neighbourhood, safety, quality of existing equipment (heating system), use of clean energy;

- Housing expenditures (rent, rental or co-ownership expenses, price and financing of recently purchased housing, loan repayments for first-time buyers, work) and the assistance received by the occupants;

- Characteristics of household members (income, level of education, individual occupation status, etc.);

- Residential mobility, household members' opinions concerning their house and their eventual desire to change it.

Data

2013 French housing survey

- Water heating: information about water access is available. It is possible to know if households have hot water or cold water only and if there is no access at all.

- Quality of building insulation: components of building quality, moisture and holes in the roof.

- Cooling: having a cooling system

- Lighting: no direct information about the number of lights available in the dwelling but information of brightness in the house ➔ A good level of brightness leads to less energy consumed per day in terms of lighting.

- Electricity: information available on the quality of the installation (protected or not)

- Cooking: main fuel used for cooking (fossil fuels or solid fuels).

Descriptive statistics

46% with no roof problem and 30% with a cooling system

24%

46.3%

34.2%

20%

Descriptive statistics

26% with only cold water

35.3%

27.1%

47.8%

10%

Descriptive statistics

8% with wood for cooking (and 0.6% with no cooking system) – Mostly Butane/Propane

9.3%

2.4%

3.4%

14%

Descriptive statistics

85% Protected electrical installation (and 92% good brightness)

84.1%

84.5%

78.1%

88.9%

Comparison of models

		AIC	BIC	LL	df
Model 1	2 classes	44203.67	44393.87	-22073.84	28
Model 2	3 classes	43471.39	43783.85	-21689.69	46

Results for predictive variables – base outcome: Class 1- fuel poor

	Class 1: fuel-poor households (12%)	Class 2: vulnerable households (56%)	Class 3: not fuel poor (32%)
Observable	Problem with roof holes or moisture No cooling system wood cooking or no cooking system Cold water supply or no water Unprotected electrical installation Low level of brightness in the house	Problem with roof holes or moisture No cooling system Propane used for cooking Electricity used for cooking Hot water or cold water supply Protected electrical installation Good brightness level in the house	No problem with roof holes or moisture Cooling system Propane used for cooking Hot water supply Protected electrical installation Good brightness level in the house
Socio-demographic characteristics	Low income Tenant No education No children Lives in rural areas Old building Individual housing unit	Medium income Homeowner High education level No children Lives in large city Recently built house Collective building	High income Homeowner High education level Family with children Lives in large city Recently built house Collective building

Conclusion

- Contribution to growing literature by exploring the energy deprivation in tropical overseas areas ➔ usual distinction between energy poverty and fuel poverty no longer relevant.
- Fuel poverty cannot be defined in a binary dimension ➔multi-dimensional phenomenon
- Fuel poors: 12% of the population
- This methodology:

- Let to construct a categorization of fuel poor and non-fuel poor rather than applying an existing definition

- can enable policy makers to clearly identify fuel poverty in tropical areas
- can aid in the development of policy actions to alleviate the problem.