Heterogeneous preferences and forest recreational value

The value of the global forest environment using the auction method

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Due to differences in terms of income, age, family status and household residential area, household preferences for housing are heterogeneous

- In the case of multi-sites amenity (forests) with heterogeneous recreational quality levels and accessibility
  $\implies$ diversity of preferences ?

- Objective of better understanding household demand for urban planning strategies and local public policies

This paper aims at assessing how the socio-economic profile of households affects their preferences for the global forest environment in terms of recreational services through the study of the location choice

Definition

Recreational (more generally "cultural") ecosystem services are defined as an ecosystem's contributions to the non-material benefits that people derive from human-ecosystem relations [Chan et al., 2011]

Household preferences for recreational areas :

- Differ with the characteristics of the sites and the users' profiles [Brey *et al.*, 2007 ; Christie *et al.*, 2007]

- Differ with the socio-economic profile of individuals : income, age, gender and education level [Baerenklau *et al.*, 2010]

- Using the two-step hedonic pricing method, few studies on heterogeneous household preferences [Parsons, 1986 ; Palmquist, 1984 ; Bilbao, 2001 ; Baudry *et al.*, 2009 ; Garcia, 2010]

- Using the auction method, few studies on heterogeneous preferences concerning transport network, public infrastructures or parks [Jayet and Kazmierczack-Cousin, 2001 ; Flachaire *et al.*, 2007].

  $\Longrightarrow$Chattopadhyay (1998) : Impact of air quality on households' WTP comparing hedonic and auction method

The auction method is used as an alternative of the two-step Rosen's estimation :

- Less complex and more direct for estimating household preferences in terms of socio-economic profile

- Conceptually and Econometrically more relevant for the study of an amenity that could have a positive value for some households but a negative value for others [Rouwendal, 1992 ; Yinger, 2015]

1. Housing specification database : BIEN (Notarial Base for Paris region)

39 354 geolocalized observations (sales) for the period 2001 to 2008 on the Seine-et-Marne *département* (Paris East : 514 cities & 762 IRIS)
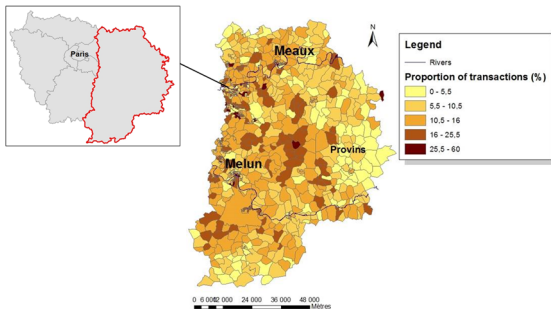
2. Districts and neighborhood indicators

INSEE (National Institute of Statistics and Economic Studies) databases to define the neighborhood of the dwellings at city and IRIS level.

Databases

Household income database (2010), Population census survey (2008), Infra-communal census database (2008), etc.

3. Recreational characteristics of forest environment

Forest areas : land-use databases (MOS & ECOMOS, 2008), National Forest Office
ES : Crédoc Survey (2000) and Recreational services typology

| What kind of activities do you practice in forest?		Ecosystem services linked to the pratices (MEA, 2005)	Variables
Walking and Hiking	75,50%	Leisure :	"Hiking path"
Observing plants and animals	24,10%	- support for the sport in nature - support for tourism and recreational activities 1. Landscape quality and aesthetics 2. Leisure : - support for tourism and recreational activities - support for research and development of educational knowledge	"Protection index" "Pools of biodiversity"
Biking and Mountain biking	17,40%	Leisure : - support for the sport in nature	"Biking path"
Jogging and Fitness trail	11,40%	Leisure : - support for the sport in nature	"Leisure areas"

To measure the accessibility to the forest environment :

$$N_i = \exp(-T) * n_i, i = 1, ..., n \qquad (1)$$

- T is the traveling time between each dwelling and each forest area
- $n_i, i = 1, ..., n$ is the set of recreational services : surface, biodiversity richness, leisure areas, hiking and biking paths.
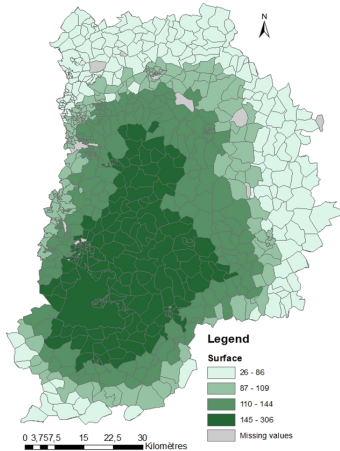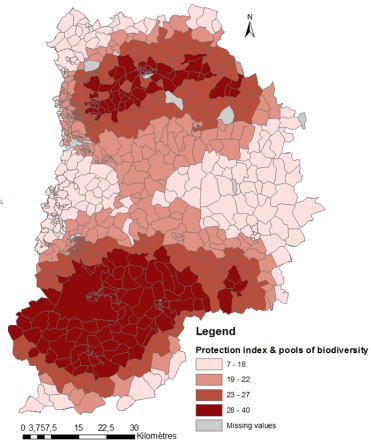
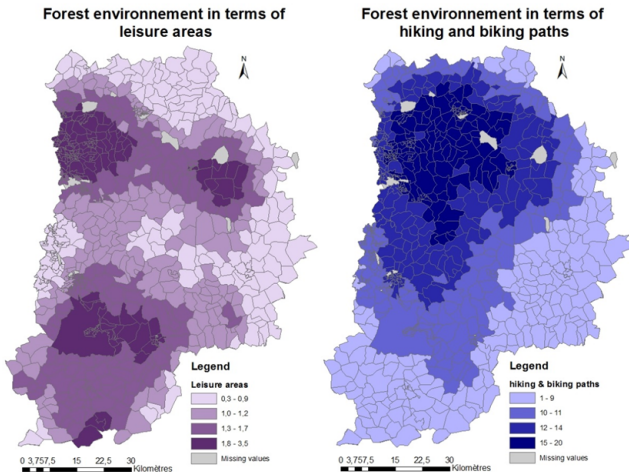FIGURE: Global forest environment with recreational services

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Buyers' group constructed from two variables of the BIEN
database : the socio-professional category (SPC) and the age of
the reference person of the household

SPC	Age	Frequency	%
Managers and intellectual professions	< 30 years	1126	3%
	30-45 years	2994	8%
	> 45 years	3283	8%
Intermediate professions	< 30 years	3869	10%
	30-45 years	6229	16%
	> 45 years	5039	13%
Employees	< 30 years	3039	8%
	30-45 years	4143	11%
	> 45 years	3507	9%
Workers	< 30 years	1672	4%
	30-45 years	2388	6%
	> 45 years	2065	5%
Total		39354	100%

A WTP function is specified for every type of buyer : each auction function must represent homogeneous sub-groups of agents, in terms of preferences and WTP for a home $i = 1, ..., I$, with a set of characteristics X.

Thus, at equilibrium, the observed price is the upper envelope of the auction function, or the highest bid :

$$p_i = max_k E_i^k$$

with E_i^k, the auction of the buyer included in the category $k = 1, ..., K$ for a dwelling $i = 1, ..., I$.

The specification of the model is the following :

$$lnE_i^k = \beta_k x_i + \sigma_k \epsilon_i^k$$

- x_i is a row vector of specifications for the housing i
- β_k is the vector of parameters associated with each attribute
- σ_k is a parameter which defines the standard deviation of the error term, ϵ_i^k is the independent and identically distributed error terms for the category of buyers k

Variables	Managers and intellectual prof.			Intermediate prof.		
	< 30 years	30-45 years	> 45 years	< 30 years	30-45 years	> 45 years
Surface of forest environment						
Coeff	**0,0008***	**0,0015****	**0,0023****	-0,0001	**0,0005***	**0,0010****
Std error	0,000	0,000	0,000	0,000	0,000	0,000
Biodiversity pools*Protection index						
Coeff	0,001	**0,005***	0,003	**-0,006****	-0,002	-0,001
Std error	0,004	0,003	0,003	0,003	0,002	0,002
Leisure areas						
Coeff	0,033	**0,049****	**0,085****	-0,006	0,008	**0,049****
Std error	0,031	0,023	0,022	0,021	0,018	0,019
Hiking*Biking paths						
Coeff	0,009	0,006	**-0,010****	**0,021****	**0,020****	**0,006***
Std error	0,006	0,004	0,004	0,004	0,003	0,004
Variables	Employees			Workers		
	< 30 years	30-45 years	> 45 years	< 30 years	30-45 years	> 45 years
Surface of forest environment						
Coeff	-0,0008	**-0,0007****	0,0004	**-0,0007***	-0,0004	**-0,0007***
Std error	0,000	0,000	0,000	0,000	0,000	0,000
Biodiversity pools*Protection index						
Coeff	**-0,005***	-0,002	-0,003	**-0,013****	**-0,015****	**-0,009****
Std error	0,003	0,002	0,002	0,003	0,003	0,003
Leisure areas						
Coeff	**-0,039***	0,001	0,026	0,022	0,013	**0,062****
Std error	0,023	0,020	0,021	0,028	0,024	0,025
Hiking*Biking paths						
Coeff	**0,022****	**0,025****	**0,009****	**0,019****	**0,016****	**0,011****
Std error	0,004	0,004	0,004	0,005	0,005	0,005

Our conclusion is centered on the following three major findings :

- Taken as amenities area in general, global forest environment value is higher for the upper classes and people over 45 years.

- Taken as protected areas for biodiversity, global forest environment negatively affects the demand of the least affluent classes but is positively valued by the managers and intellectual professions, aged between 30-45.

- Recreational areas for hiking and biking paths are valued by all and especially the less affluent and younger households.