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INRA SCIENCE & IMPACT

Nudging acceptability for wood-ash recycling in forests: a choice experiment

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Context and motivations

- Public policies on renewable energies:
  - Wind energy, solar panels, biofuels, biomass and wood energy
  - CC issues, new technologies
  - public acceptability should receive more attention to go further (van Rijnsoever et al. 2015; Wüstenhagen et al. 2007).
- French targets for renewable energy production:
  - significant increase in wood harvest
  - to fertilize forests to compensate for the loss of nutrients (Paillet et al. 2013)

50% of the biological growth harvested (2005-2012), Source: Inventaire Forestier

25% of the standing timber volume of the French production forest between 2008 and 2012 corresponds to large or very large timber , Source: Inventaire Forestier,
http://inventaire-forestier.ign.fr/spip/IMG/pdf/IGD_2015_FR.pdf

Context and motivations

- Increasing use of wood for energy may have some adverse effects (Jong et al 2017), e.g.
  - Increased harvest – Less forest undisturbed by human activities
  - Removal of nutrients and reducing long-term soil fertility
  - This is in particular a problem with the new harvest systems with whole-tree harvesting, i.e. exploitation of branches, needles, stumps.

From thinnings

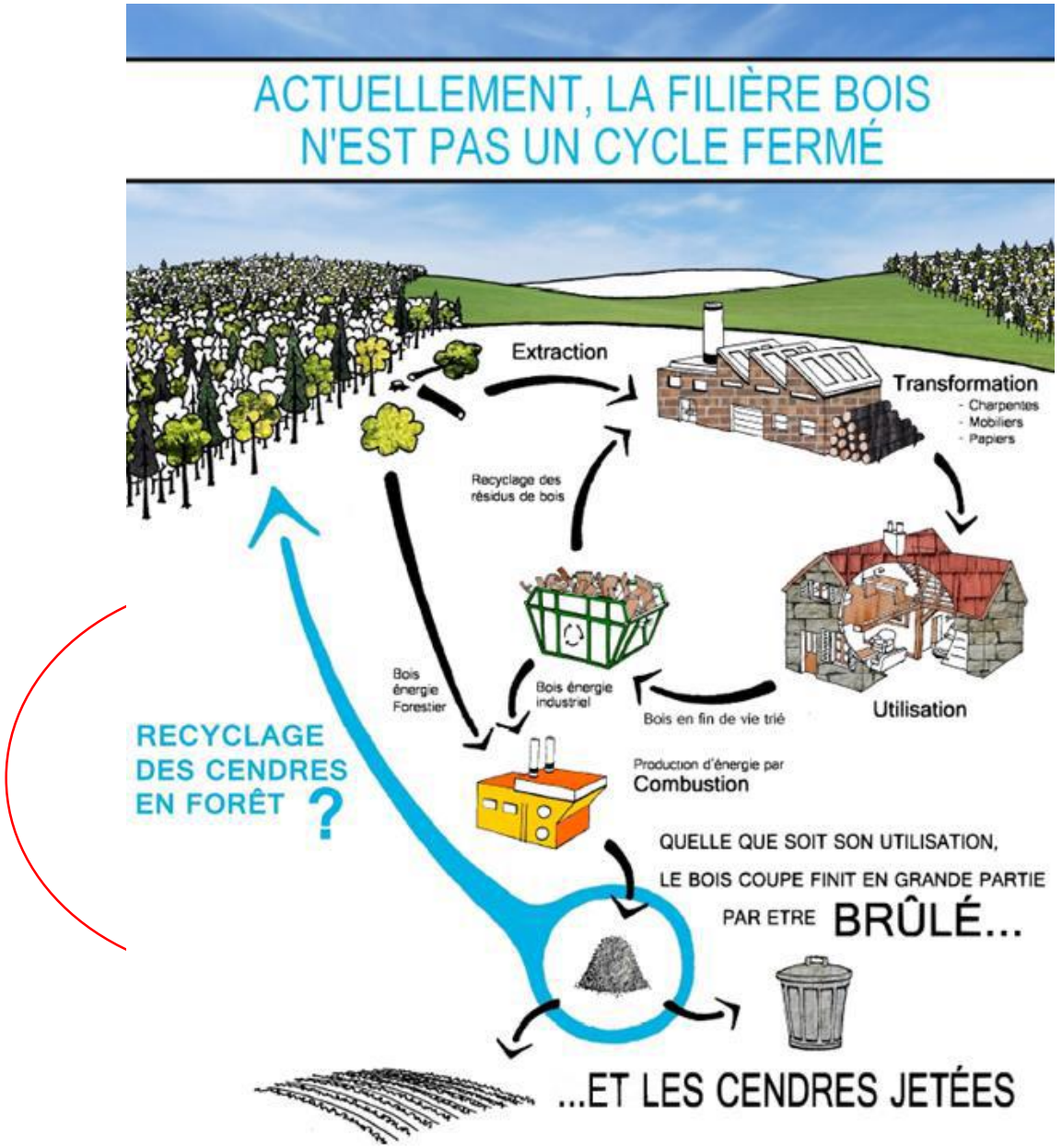
Residues from timber harvest

Chipping trees

Context and motivations

One solution:

- recycling of ash to reduce the negative impact of biomass harvesting



Motivation and Objectives

- survey carried out in France in 2017 using a CE technique
  - to assess the general population's acceptability of ash recycling in forests (Choice experiment and WTP)
  - Acceptability
    - Kallbekken et al. (2011),
    - Dreyer and Walker (2013), Dreyer et al. (2015)
      - Acceptance
      - Support
      - Perceived equity
      - Perceived effectiveness

- CE and nudges: effect on implementation (on the social acceptability of a public policy).
  - Kuhfuss et al. (2016), Nudging participation and spatial agglomeration in payment for environmental service schemes
  - a framing (*i.e.*, a specific presentation of the alternatives) *and*
  - a wording approach (*i.e.*, the use of a specific word)
    - to influence the respondents' choices.
    - to assess whether it is possible to improve the respondents' social acceptability of the new environmental measure

Study design

- a discrete choice experiment to estimate the French population's willingness to pay for wood-ash implementation
  - four attributes
  - 12 choice tasks
- A control group

Table 1 Attributes and their levels of the discrete choice experiment

Attribute	Levels
Period of implementation	At any time of the year Outside picking periods
Increase in fertility	+5% +15%
Setting up of a sign	Yes No
Cost	0 € +4€ +8€ +15€ +30€ +50€

Study design

Figure 1 – Example of a choice task in the control group

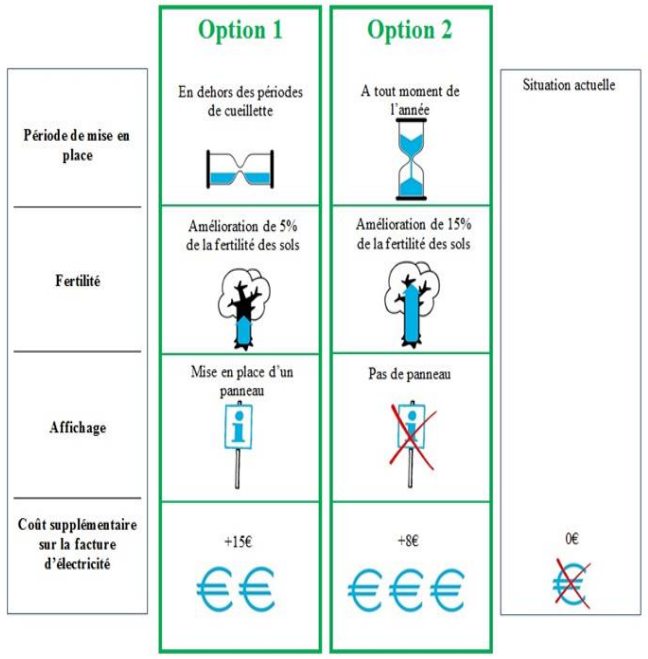
	Option 1	Option 2	Situation actuelle
Période de mise en place	En dehors des périodes de cueillette 	A tout moment de l'année 	
Fertilité	Amélioration de 5% de la fertilité des sols 	Amélioration de 15% de la fertilité des sols 	
Affichage	Mise en place d'un panneau 	Pas de panneau 	
Coût supplémentaire sur la facture d'électricité	+15€ 	+8€ 	0€ 

Study design

- A control group and 3 Nudge treatments:

  - ***positive framing: "***Option 1" and "Option 2" were displayed in large and in green
  - ***recycling wording:*** "Ash recycling 1" and "Ash recycling 2", instead of "Option 1" and "Option 2"
  - ***productive wording:*** "Option to insure the soil's productivity 1" and "Option to insure the soil's productivity 2"

Study design



Positive framing treatment

	Recyclage des cendres 1	Recyclage des cendres 2	Situation actuelle
Période de mise en place	En dehors des périodes de cueillette	A tout moment de l'année	
Fertilité	Amélioration de 5% de la fertilité des sols	Amélioration de 15% de la fertilité des sols	
Affichage	Mise en place d'un panneau	Pas de panneau	
Coût supplémentaire sur la facture d'électricité	+15€	+8€	0€

Recycling wording treatment

	Option pour assurer la productivité des sols 1	Option pour assurer la productivité des sols 2	Situation actuelle
Période de mise en place	En dehors des périodes de cueillette	A tout moment de l'année	
Fertilité	Amélioration de 5% de la fertilité des sols	Amélioration de 15% de la fertilité des sols	
Affichage	Mise en place d'un panneau	Pas de panneau	
Coût supplémentaire sur la facture d'électricité	+15€	+8€	0€

Productive wording treatment

Study design: 3 steps

- *Step 1: Choice experiment*

- *Step 2: Environmental sensitivity questionnaire*

  - a series of ten question to measure individual's interest in the conservation of the environment (*Milfont and Duckitt, 2010*) .

  - affirmations describing five pro-environmental behaviors and five anti-environmental behaviors (level of agreement according to a 5-likert scale)
    - *I make sure that during the winter the heating system in my room is not switched on too high.*
    - *In my daily life I'm just not interested in trying to conserve water and/or power.*
      - *This behavior does not describe me at all (a little, neutral, describes me, totally describes me)*

Study design: 3 steps

- *Step 3: Social acceptability questionnaire*
  - four dimensions:
    - Acceptance (To what extent are you in favor for/against wood-ash recycling in forests?)
    - Support (How willing are you to take action to voice a positive opinion about wood-ash recycling, such as writing a letter or calling a representative?)
    - Perceived equity (How fair do you think it is that all French households pay the same for wood-ash implementation in forests?)
    - Perceived effectiveness (How effective do you think wood-ash recycling will be to improve the quality of the soils in forests and avoid the soils depletion in the future)?

Behavioral hypotheses

- **Hypothesis 1 (H1):** the use of the (positive) framing and of the recycling and productive wordings increases a respondent's willingness-to-pay for a scenario with ash recycling.

- **Hypothesis 2 (H2):** the social acceptability of wood-ash implementation is higher in the different treatments than in the control group.

- **Hypothesis 3 (H3):** the social acceptability of wood-ash implementation is higher in the wording treatment than in the positive framing treatment.

Survey implementation

- online survey platform- November 2017
- the most representative sample as possible of the French general population.
- 1010 respondents
- 77% of the sample went at least once in a forest during the 12 last months

Results

Mean total scores of the social acceptability questionnaire per dimension and treatment (standard deviation into parentheses)

	Control	Positive framing	Recycling wording	Productive wording
Acceptability	7.143 (1.781)	7.230 (1.695)	**7.120** (1.628)	*7.237* (1.668)
Support	*21.857* (5.288)	**21.296** (5.680)	21.657 (5.722)	21.720 (5.352)
Equity	5.894 (2.036)	**5.498** (2.162)	5.932 (1.998)	*5.996* (2.066)
Efficiency	6.996 (1.717)	**6.895** (1.818)	6.932 (1.649)	*7.082* (1.610)

P-values of the Mann-Whitney mean comparison tests (Equity dimension)

	Control	Positive framing	Recycling wording
Positive framing	**0.044**	-	-
Recycling wording	0.820	**0.023**	-
Productive wording	0.681	**0.014**	0.861

The positive framing induces a the smallest score
The productive wording treatment, the highest scores -

Significant differences between treatments only for equity
the positive treatment: a smaller score for equity

So H3 is partially validated (H3: the social acceptability is higher in the wording treatment than in the positive one)
And H2 is not validated (the acceptability is higher in all treaments)

Results

- Preferences for wood-ash implemented outside picking periods
- Preferences for high impact on fertility, the set up of a sign, but paying less
- Preferences for the status-quo
  - Preferences for the option in the framing and in the productive wording
  - The effect of nudge for SQ is less important for
    - individuals more sensitive to equity (PF and PW)
    - Individuals more sensitive to environment

Conditional logit estimation of the effect of the treatments

Variable	Control vs Positive framing Coefficient (St. Err.)	Control vs Recycling wording Coefficient (St. Err.)	Control vs Productive wording Coefficient (St. Err.)
Period	0.063* (0.033)	0.078** (0.033)	0.052 (0.032)
Fertility	0.560*** (0.034)	0.616*** (0.034)	0.581*** (0.033)
Signal	0.134*** (0.033)	0.082** (0.033)	0.149*** (0.033)
Cost	-0.041*** (0.001)	-0.041*** (0.001)	-0.037*** (0.001)
SQ	3.536*** (0.299)	3.550*** (0.300)	3.567*** (0.298)
SQ*sensitivity	-0.059*** (0.007)	-0.059*** (0.007)	-0.059*** (0.007)
SQ*equity	-0.378*** (0.025)	-0.379*** (0.025)	-0.375*** (0.025)
Treat*SQ	-1.094** (0.426)	-0.170 (0.418)	-2.172*** (0.411)
Treat* SQ*sensitivity	0.014 (0.010)	-0.002 (0.998)	0.048*** (0.010)
Treat* SQ*equity	0.089* (0.033)	0.046 (0.035)	0.085** (0.033)
Log-Likelihood	-5511.934	-5389.827	-5619.943
Adjusted R^2	0.167	0.176	0.151
Likelihood Ratio Test	0.006	0.599	<0.001
N	502 (6024 choices)	496 (5952 choices)	502 (6024 choices)

Significant levels: * p < 0.10, ** p < 0.05, *** p < 0.01

Results

Environmental sensitivity has no effect on the decision to depart from SQ in the productive treatment

Results are confirmed in a latent-class model: environmental sensitivity is not significant in productive wording treatment

Conditional logit estimation per treatment

	Control	Positive framing	Recycling wording	Productive wording
Variable	Coefficient (St. Err.)	Coefficient (St. Err.)	Coefficient (St. Err.)	Coefficient (St. Err.)
Period	0.072 (0.047)	0.056 (0.046)	0.084* (0.047)	0.033 (0.045)
Fertility	0.604*** (0.048)	0.517*** (0.047)	0.628*** (0.048)	0.559*** (0.047)
Signal	0.115** (0.047)	0.153*** (0.046)	0.049 (0.047)	0.181*** (0.045)
Cost	-0.037*** (0.002)	-0.044*** (0.002)	-0.045*** (0.002)	-0.037*** (0.002)
SQ	3.574*** (0.300)	2.405*** (0.308)	3.362*** (0.297)	1.391*** (0.287)
SQ*sensitivity	-0.059*** (0.007)	-0.046*** (0.007)	-0.062*** (0.940)	-0.011 (0.007)
SQ*equity	-0.376*** (0.025)	-0.292*** (0.023)	-0.337*** (0.025)	-0.290*** (0.023)
Log-Likelihood	-2693.7	-2812.1	-2690	-2925.3
Adjusted R^2	0.166	0.170	0.187	0.137
N	245 (2940 choices)	257 (3084 choices)	251 (3012 choices)	257 (3084 choices)

Significant levels: * p < 0.10, ** p < 0.05, *** p < 0.01

Results

-preference for the status quo alternative

-WTP for SQ: the highest ones in the 'control' and in the 'recycling wording'

-the WTP is sensitive to ES and to equity

Table 7 – Estimation in the willingness-to-pay space per treatment (in euro)

Variable	Control	Positive framing	Recycling wording	wording
	Coefficient (St. Err.)	Coefficient (St. Err.)	Coefficient (St. Err.)	Coefficient (St. Err.)
Period	0.802	-0.289	0.126	-0.374
	(0.652)	(0.343)	(0.381)	(0.591)
Fertility	13.795***	7.163***	9.869***	11.819***
	(1.028)	(0.390)	(0.516)	(0.823)
Signal	2.023***	1.353***	0.640*	4.501***
	(0.618)	(0.311)	(0.362)	(0.720)
SQ	85.512***	44.527***	94.377***	20.745***
	(12.075)	(3.024)	(4.524)	(4.041)
SQ*sensitivity	-1.661***	-1.036***	-1.716***	-0.432***
	(0.231)	(0.065)	(0.094)	(0.091)
SQ*equity	-10.341***	-8.370***	-11.018***	-7.244***
	(1.492)	(0.529)	(0.407)	(0.463)
Het. constant	-1.521***	-0.597**	-0.691***	-1.564***
	(0.184)	(0.289)	(0.258)	(0.193)
SD				
Period	2.243***	0.365	0.528	1.087
	(0.793)	(0.428)	(0.519)	(0.882)
Fertility	18.204***	9.756***	14.747***	15.793***
	(0.934)	(0.332)	(0.557)	(0.836)
Signal	3.723***	0.967**	1.241***	11.291***
	(1.079)	(0.450)	(0.393)	(0.659)
SQ	22.644***	23.478***	28.073***	19.135***
	(3.011)	(1.525)	(1.169)	(1.146)
SQ*sensitivity	0.908***	0.649***	0.791***	0.719***
	(0.124)	(0.040)	(0.032)	(0.044)
SQ*equity	0.395***	2.959***	3.144***	3.933***
	(0.102)	(0.177)	(0.102)	(0.222)
Tau	1.614***	2.063***	1.943***	1.564***

Public policy

Simulations of willingness-to-pay for wood-ash implementation for a 5% increase in soils' productivity (WTP expressed in terms of the WTP computed with the median scores into parentheses)

	Median score for ES and equity	Score of the 10% lowest ES score and median for equity	Score of the 10% highest ES score and median for equity	Median score for ES and score of the 10% lowest score for equity	Median score for ES and score of the 10% highest score for equity
Control	48.57€	33.62€ (69.22%)	**61.86€** (127.36%)	17.55€ (36.13%)	**69.25€** (142.58%)
Positive framing	**50.00€**	40.67€ (81.34%)	58.28€ (116.56%)	24.89€ (49.78%)	66.74€ (133.48%)
Recycling wording	*42.51€*	*27.07€* (63.68%)	56.24€ (132.30%)	*9.46€* (22.25%)	64.55€ (151.85%)
Productive wording	49.55€	**45.66€** (92.15%)	*53.00€* (106.96%)	**27.81€** (56.13%)	*64.03€* (129.22%)

- ✓ Simulations on the general WTP based on the WTP-space taking
  - ✓ all the significant attributes
  - ✓ Varying ES & equity

- ✓ Recycling wording: the lowest WTP
- ✓ Median score: the highest WTP in positive framing
- ✓ In the highest decile: control
- ✓ In the lowest deciles: productive wording

Public policy and conclusions

- The productive wording is the best option
- H1 (partially) validated: the effect of the treatment on the WTP depends on the type of individuals a regulator wants to nudge
- Nudges do not necessarily help to increase the social acceptability of a new measure (H2 rejected)
- To increase efficiency of nudge and acceptability of a measure: Need to better know the individuals before nudging them

THANK YOU!

Results

Table 1 - Mean scores and standard deviation of the social acceptability questionnaire

Dimension measured	Mean total score	Standard deviation
Acceptability (2 questions)	7.18	1.19
Support (7 questions)	21.63	5.51
Perceived equity (2 questions)	5.83	2.07
Perceived efficiency (2 questions)	6.98	1.70