Risk aversion hinders foresters to adapt to climate change

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Climate change (CC) and adaptation

CC

- Impact on ecosystems : ↑ in temperature and modification of the precipitation regime.
- Main concern : CC increases frequency and intensity of natural events.
- Consequence in forest : reduction in growth and productivity, defoliation, mortality, etc.

Adaptation

- **Forest adaptation strategies** are recommended : better-adapted tree species, ↓ of the rotation length, ↓ of the tree density, change in the thinning regime, species mix, etc.
  ↪ Adaptation is not sufficiently implemented by foresters (Andersson and Keskitalo, 2018).
- Adaptation is associated to **many unknowns** : management changes, adoption of new practices, costs/benefits and efficiency to fight against CC are unknown, etc.
  ↪ Foresters take decision not only in a risky environment but in an uncertain one.

↓

Do foresters' preferences towards risk and uncertainty affect the adaptation decisions ?

Positioning in the existing literature

Preferences

- Lottery choices from experimental economics like MPL (Holt and Laury, 2002) or OLS (Eckel and Grossman, 2008).
- Musshof and Maart-Noelck (2014), Sauter et al. (2016a, 2016b), Brunette et al. (2017a), Sauter et al. (2018).
- Results : forest owners are risk averse + impact on decisions (probability to harvest (+), WTP for insurance (0)).
- Some recent research on uncertainty aversion (Brunette et al. 2017b) but no measurement.

Adaptation

- Cost-benefit analysis for different adaptation strategies :
  - Better-adapted tree species : Hanewinkel et al. (2010), Brunette et al. (2014)
  - Species mix : Yousefpour and Hanewinkel (2014)
  - ↓ rotation length : Bréda and Brunette (2019)
  - Comparison of strategies : Brèteau-Amores et al. (2019)
- Questionnaires about :
  - Perception of CC : Blennow et al. (2012), Yousefpour and Hanewinkel (2015)
  - Potential adaptation options : Ogden and Innes (2009), Lidskog and Sjödin (2014)
  - Both : Sousa-Silva et al. (2018).
- Results : main role of risk perception, some brakes for adaptation (lack of information).

Research question

Observations

- Foresters' risk preferences are never analysed as a potential driver for adaptation decision.
- Uncertainty preferences of foresters were not studied and never quantified.
- Adaptation decisions were analysed as a whole (willingness and intensity together).
- German and French are the main samples in this literature with no comparison between them.

Objective

To analyse the role of the preferences towards risk and uncertainty of French and German foresters on their willingness and intensity of adaptation.

Methodology

- Computerized questionnaire send to 1000 private and public foresters in Grand-Est in France and Baden-Württemberg in Germany in Sept. 2018 $\rightarrow$ 88 fully completed (39 G, 49 F).
- Questionnaire in three parts :
  - Part 1 : Lottery choices to quantify risk and uncertainty preferences.
  - Part 2 : Questions about adaptation choices.
  - Part 3 : Questions about the foresters and their forests.

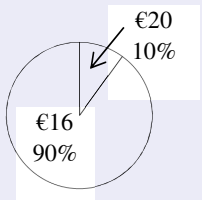
Part 1 : Elicitation of preferences

Method

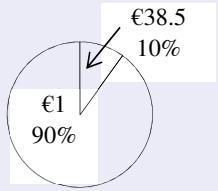
- Multiple Price List (Holt and Laury, 2002) : 10 lottery choices between two options.
- Measure of the preferences : number of left choices (the higher the number, the higher the aversion).

Risk

Question 1. Which option do you prefer?



Option 1 ☐



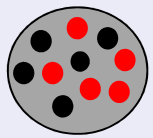
Option 2 ☐

Questions 1 to 10 were presented in the same way.

- 10 decisions presented sequentially using pie charts.
- Option 1 = safe ; Option 2 = risky.

Uncertainty

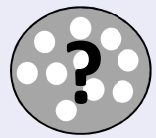
Question 1. Which option do you prefer?



Urn A: 5 red balls and 5 black balls.

- Chosen color obtained: €35
- Chosen color not obtained: €0

Option A ☐



Urn B: 10 balls, we don't know the number of black balls and red balls.

- Chosen color obtained: €25
- Chosen color not obtained: €0

Option B ☐

- 10 decisions presented sequentially using urns composed with colored balls.
- Option A = risky ; Option B = uncertain.

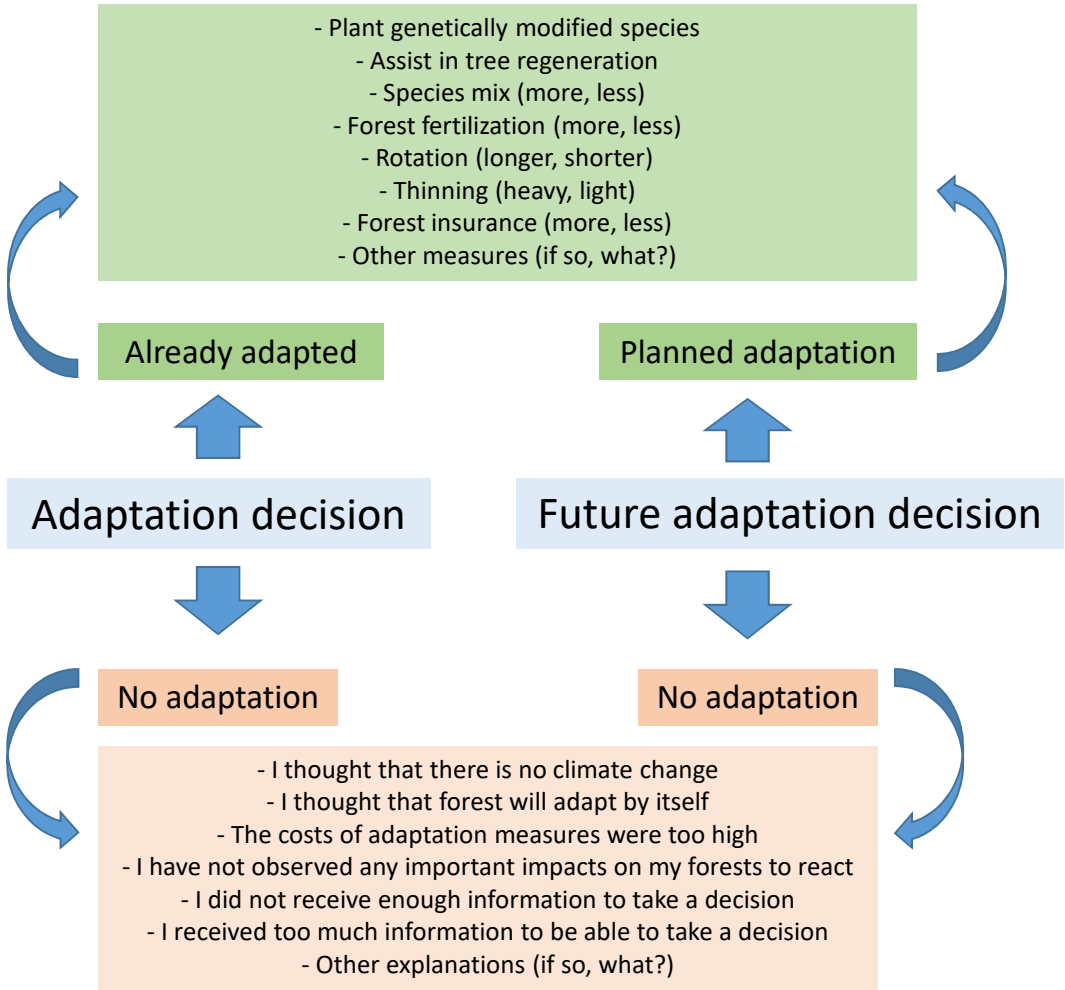
Parts 2 and 3 : Questions about adaptation choices and characteristics

Part 2 : Adaptation

- Question 1 : perception of CC
- Questions 2 and 3 : already modified the practices and/or planned to modify their practices

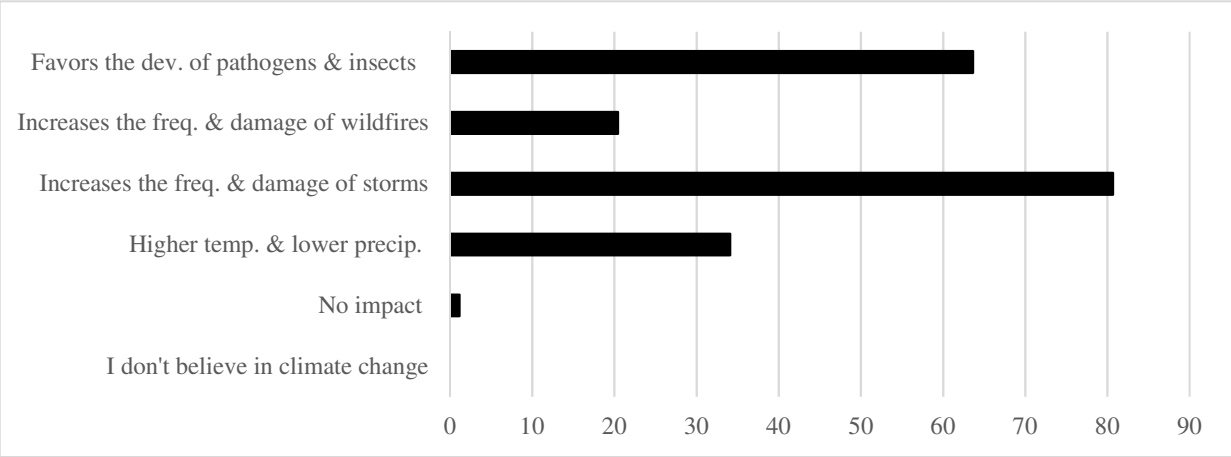
Part 3 : Characteristics

- Forest : private/public, area, composition, dominant tree species, management objectives.
- Forester : gender, age, income.



Result : Perception of CC

Question : among the six proposed, please select the two truest answers from your own opinion.



- None of the forester don't believe in CC.
- Very few think that CC will have no impact $\rightarrow$ in line with Yousefpour and Hanewinkel (2015).
- For 80% of our sample, CC is associated to an increase in the frequency and damage of storms.
- More than 60% think that CC favors the development of pathogens and insects.

Result : Elicitation of preferences

TABLE – Risk and uncertainty preferences

	Risk		**Uncertainty**	
	Average coef.	Nb of safe choices	Average coef.	Nb of risky choices
French (N = 49)	0.595	5.98	0.729	6.51
German (N = 39)	0.273	5.08	0.841	6.26
Total (N = 88)	0.453	5.58	0.779	6.40
Neutrality	*-0.15 < r < 0.15*	*4*	*0.9771 ≤ s < 1*	*5*

Risk

- Foresters are risk averse.
- French foresters are on average more risk averse than the German ones.

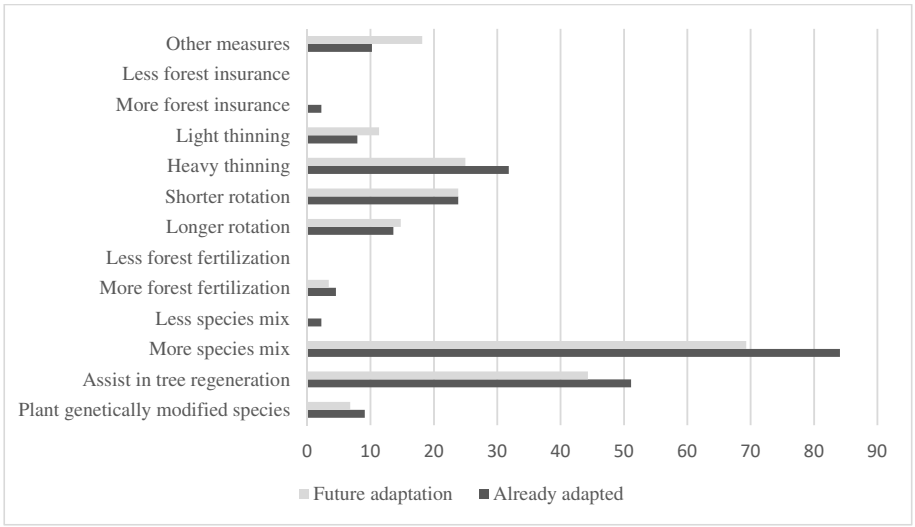
Uncertainty

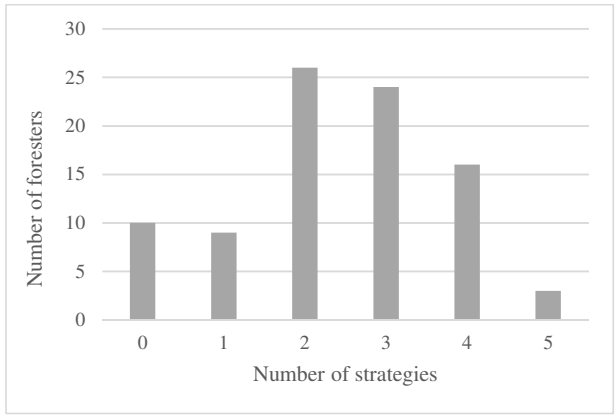
- Foresters are uncertainty averse.
- No significant difference between French and German foresters.

Result : Willingness and intensity

Adaptation

- 88.6% of the foresters had already modified their practices in order to adapt to CC.
- 87.5% of them planned to modify their forestry practices in the near future.





No Adaptation

Among the 11.4% of foresters indicating that they have not adapted yet, and those indicating that they did not plan to adapt in a near future (12.5%), the main reason invoked is : "*I did not receive enough information to take a decision*".

Determinants of the willingness to adapt : logit regression

TABLE – Significant variables of the logit

	Parameter	Stand. error	Sig.
Constant	19.432	6.615	0.003***
Nb of safe choices	-0.104	0.047	0.027**
Income	0.249	0.136	0.066**
Age	-0.023	0.011	0.041**
French	-0.448	0.259	0.084*
Pseudo R^2 Mc Fadden	0.329		

- The higher the risk aversion, the lower the probability to adapt.
- Being French reduces the probability to adapt.
- Older foresters are more reluctant to adapt.
- The wealthier the forester is, the higher the probability to adapt will be.

Determinants of the intensity of adaptation : Poisson count model

TABLE – Estimation of the parameters of the Poisson count model

	Parameter	Stand. error	Sig.
Nb of safe choices	-0.056	0.0332	0.091*
Nb of risky choices	0.016	0.0315	0.611
Age	-0.005	0.0062	0.417
French	-0.306	0.1467	0.037**
Private	0.175	0.2153	0.416

- The higher the forester's risk aversion, the lower the intensity of adaptation.
- Being French (as compared to German) has a significant and negative impact on the number of adaptation strategies selected.

Discussion and conclusion

Main results

- The forester with the higher willingness to adapt is young, rich, with a low degree of risk aversion, and is German.
- The forester with the higher intensity of adaptation is German and with a low degree of risk aversion.

↪ "Reluctance to change" : the risk of any change in the BAU is higher than the risk of CC impact in forestry.

Another results

- Income is significant on the willingness to adapt : interesting vector for public help.
- Uncertainty aversion never significant : strategy-dependent ? uncertainty on the damage (not on the probability) ?
- Being a French forester reduces both the willingness and the intensity of adaptation as compared to German : socio-economic and political contexts (Sousa-Silva et al., 2018).
- The lack of information hinders forester's adaptation : in line with previous studies (Yousefpour and Hanewinkel, 2015 ; Sousa-Silva et al., 2018).

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