Modelling farm vulnerability to flooding Towards the appraisal of adaptation policies

Pauline Bremond, G. Abrami, C. Blanc, F. Grelot

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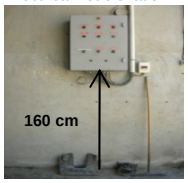
1 Case study

The Rhône river program, a contract of agreed objectives between French government and local authorities, plans to implement measures to mitigate farm vulnerability in flood prone areas of the Rhône river downstream.

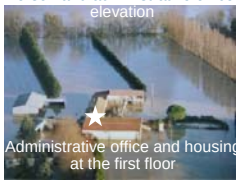
Expected advantages of farm vulnerability mitigation are:
1. to adapt farms to maintain agricultural activities in floodplains,
2. to compensate "over-flooding" impacts in case of risk transfer at basin level.

Electrical net elevation



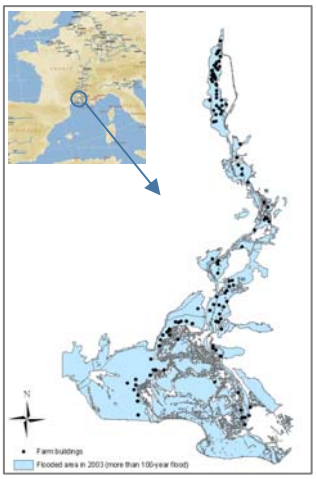
Equipment elevation

Person and administrative office elevation



Examples of mitigation measures
Those measures intend to avoid direct damages and to facilitate recovery.

Few examples of implementation of vulnerability mitigation measures exist. To help decision making, local authorities asked for an economic method to evaluate the program of farm vulnerability mitigation.



Studied area
3 000 farms are potentially exposed to flood risk.

2 Contributions of modelling vulnerability at the farm scale

Our study aims at developing a methodology to appraise this kind of policy using Cost-Benefit Analysis.

Measures to mitigate vulnerability enhance farm capacity to adapt and recover after flooding. The expected benefits of their implementation rest upon the improvement of farm management during and after flooding. Current appraisal methods are not sufficient: they rely on direct damage estimation and do not consider farm level.

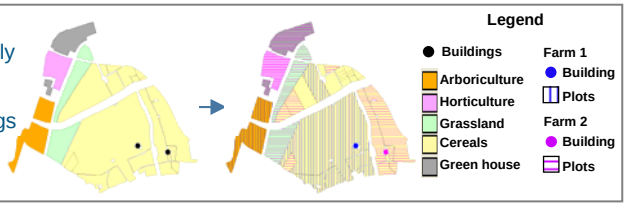
We developed a conceptual model using UML (Unified Modelling Language) at the farm scale which takes into account:

1. spatial distribution of farm buildings and land plots,

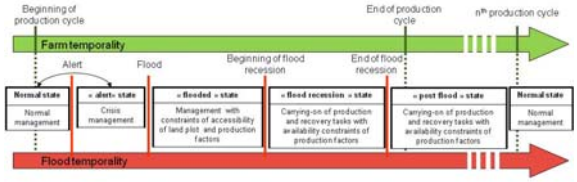
2. time scale (mid and long term effects),

3. work management to achieve production and recovery tasks.

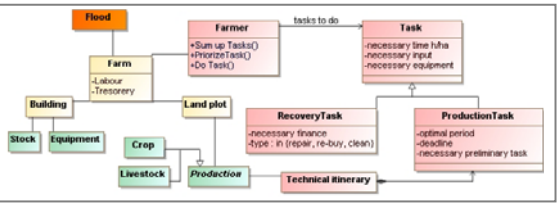
Spatial dimension
Current models (left) only take into account land use, our model (right) also links plots / buildings to farms.



Time dimension
To account for mid and long term effects, temporalities of flood events and farm activity are considered.



Organisational dimension
Our model takes into account work management after flooding (competition between production and recovery tasks).



3 Perspectives of application to the downstream area of the Rhône river

Effects of a list of measures to mitigate farm vulnerability will be evaluated using a "farm scale" vulnerability model and will be compared with the costs of implementation (Cost-Benefit Analysis) to help decision makers to prioritize funding. The modelling step highlights a need of data and help us to establish a methodology to collect it.

	Direct effects									Positive induced effects								Negative induced effects
Measures	Building	Green house	Fixed equipment	Mobile equipement	Stock of input	Stock of product	Stock of forage	Crop	Livestock	Equipement availability for production task	Input availability for production task	Availibility of forage for livestock	Limit competition between production and recovery tasks	Equipment availability to recover	Finance availability to recover	Limit customer loss	Limit label loss	
Emergency program	✓	✓		✓	✓	✓			✓	✓	✓		✓	✓	✓	✓	✓	
Recovery program										✓			✓	✓				
Store products out of flood plain						✓							✓		✓	✓	✓	Transportation costs
Look for association with farmers out of floodplain										✓	✓	✓		✓		✓	✓	
Adapt networks	✓	✓				✓		✓	✓		✓		✓			✓	✓	
Create refuge area for equipement, stock and livestock				✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			Maintenance costs
Elevate building	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			Operating costs
Grow crops less sensitive to flood								✓					✓	✓	✓			

Effects taken into account with current methods and with a farm scale approach
Current methods of damage appraisal appraise direct damage (building and crop). Focusing on the farm scale enables to take into account induced effects on farm management after flooding.

Effects that can be appraised with current methods
Effects taken into account with the farm scale method

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