

A conceptual framework to assess vulnerability. Application to global change stressors on South Indian farmers.

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Introduction

Objectives

- Our objectives are
 - ① to apply Füssel's (2007) conceptual framework of vulnerability to a concrete ongoing research
 - ② and to discuss on the resulting choice of an adequate vulnerability approach.
- Füssel's conceptual framework of vulnerability is a trans-disciplinary framework, allowing researchers and developers sharing a same knowledge and a common vocabulary on vulnerability.
- We apply it to a multi-disciplinary research aiming at assessing the vulnerability of South Indian farmers to global change (SHIVA ANR project).

Füssel's framework

- Vulnerability concept described through 6 dimensions
- of which emerge relevant concepts to use for vulnerability definition and assessment.
- Dimensions are given by analyzing 2 aspects of vulnerability: the vulnerable situations and the factors of vulnerability.
- 6 dimensions are now presented through SHIVA project example.

Füssel's framework I

The 6 dimensions of vulnerability concept

- Nomenclature of vulnerable situations:
 - 1 The system of analysis: South Indian farmers.
 - 2 The attributes of concern: farmers' livelihood sustainability.
 - 3 The hazards: global change. Continuous climate and economic changes.
 - 4 The temporal reference: period of interest from now to end of century. But only able to give snapshots of vulnerability state at 3 points in time: current, 2020-2030 and 2045-2065.

Füssel's framework II

The 6 dimensions of vulnerability concept

- A matrix of vulnerability factors:
 - 5 The sphere or scale of factors:
 - internal: properties of the system described through the 5 capital assets of Sustainable Livelihood Approach (SLA, Scoones, 1998).
 - external: influential factors from the outside of the system described thanks to Portal's Diamonds framework adapted to farming systems (Vandermeulen *et al.*, 2009).
 - 6 The knowledge of domain of factors:
 - socioeconomic: sources of income, market prices, government policies, *etc.*.
 - biophysical: drought, pest attacks, landholding area, *etc.*.

Füssel's framework

A terminology for vulnerable concepts

According to the combination of vulnerability factors, most of vulnerability approaches can be identified:

Figure: From Füssels paper, p. 160

Table 2

Correspondence between the conceptualization of vulnerability according to several major approaches to vulnerability research (left-most column), the vulnerability factors included (central columns), and the denotation according to the terminology presented in Section 2.3 (right-most column)

Approach	Vulnerability factors				Denotation
	IS	IB	ES	EB	
Risk-hazard	-	X	-	-	Internal biophysical vulnerability
Political economy	X	-	?	-	Cross-scale socioeconomic vulnerability
Pressure-and-release	X	X	-	-	Internal integrated vulnerability
Integrated (e.g., hazard-of-place)	X	X	X	X	Cross-scale integrated vulnerability
Resilience	X	X	?	?	Cross-scale (?) integrated vulnerability

A question mark indicates that it is not clear whether a particular vulnerability factor is included in the respective conceptualization of vulnerability. Abbreviations: IS, internal socioeconomic; IB, internal biophysical; ES, external socioeconomic; EB, external biophysical.

Füssel's framework

The choice of relevant vulnerability concepts

- From the description we made of vulnerability factors in SHIVA, it appears that the relevant approach must be cross-scale and integrated.
- Thus IPCC vulnerability definition can be used:
 - ① it accounts for future risks
 - ② and for changes in all vulnerability factors over time (Füssel, 2007).
 - ③ This dynamic approach of vulnerability is particularly adapted to the vulnerable situation we want to assess.
- The point is: how to integrate elements of dynamics into vulnerability concept.

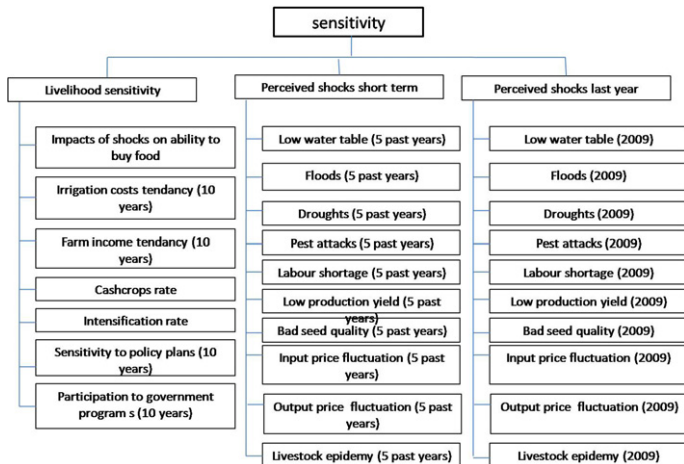
SHIVA dynamic vulnerability assessment

Methodology

- A function of exposure, sensitivity and adaptive capacity of farmers to global change (Eakin *et al.*, 2008).
- At households or individuals level, exposure and sensitivity components are merged: farmers rather vulnerable to stresses' local expression (Smit *et al.*, 2006; Belliveau *et al.*, 2006; Eakin *et al.*, 2008).
- Hazards dynamics: integrated thanks to prospective vision of climate and economic changes (regional downscaling of IPCC and SRES scenarios).
- System dynamics: integrated thanks to identification of internal and external forces of the system (SLA and Portal's Diamond). Prospective vision of major driving forces.

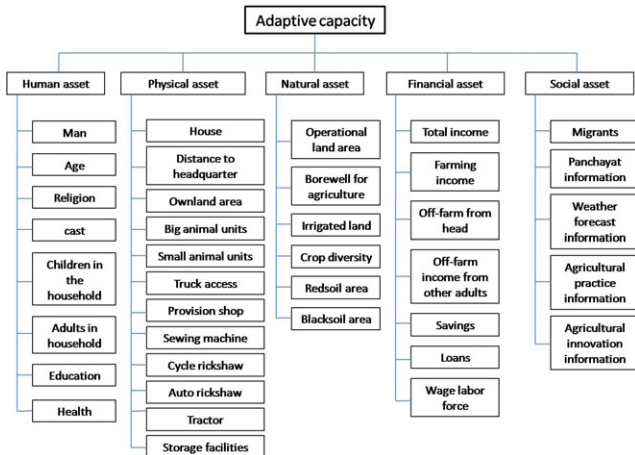
SHIVA dynamic vulnerability assessment

Sensitivity matrix



SHIVA dynamic vulnerability assessment

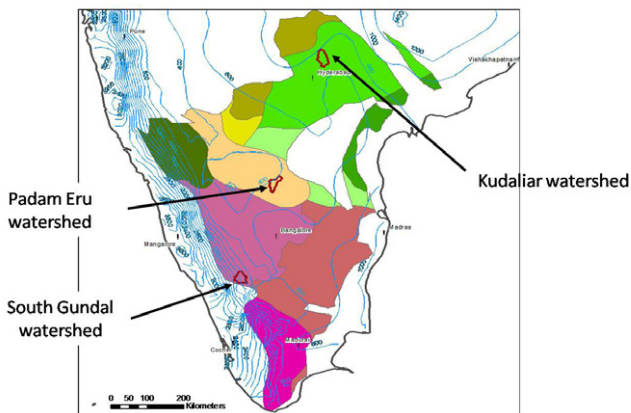
Adaptive capacity matrix



Results and discussion

Case study: Gajwel watershed

Semi-arid hard rock area of South India



Results and discussion

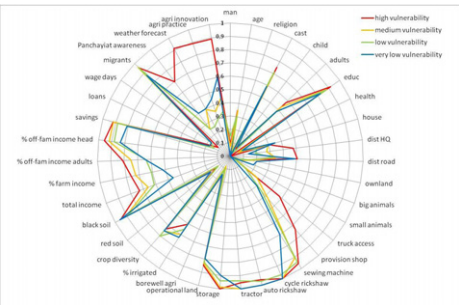
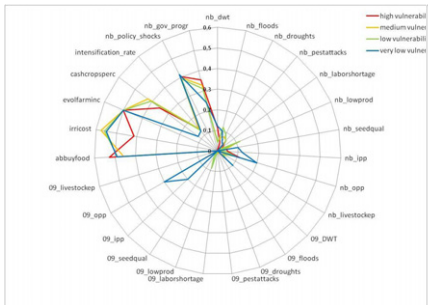
Are farmers vulnerable?

We surveyed 153 individual and representative farmers of Gajwel watershed and applied the above framework to assess their current and future vulnerability to global change.

Vulnerability class	Average score	Percentage of farmers sampled
High vulnerability	0.652	15%
Medium vulnerability	0.484	56%
Low vulnerability	0.306	22%
Very low vulnerability	0.126	7%

Results and discussion

Why are farmers vulnerable? Sensitivity and adaptive capacity contributions.



Conclusion I

- Our conceptual framework of vulnerability is "cross-scale integrated" in the terms of Füssel, and thus vulnerability is dynamic.
- As farmers are decision makers, GC hazards can't be the unique source of the dynamics of vulnerability: decisions are taken in a wider environment with also variable time scales.
- Vulnerability defined in the line of IPCC as a function of exposure, sensitivity and adaptive capacity offers the possibility to account for hazards plus system dynamics.
- Though, dynamic vulnerability assessment is constrained to the dynamics of hazards of concern (snapshots of vulnerability at 2 periods of time).

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