

Adaptation Problem Types

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Abstract

This paper develops a typology of problems associated with the concepts of vulnerability and adaptation to global environmental change. The typology is meant to serve as an intermediate level of analysis situated between the general vulnerability and adaptation frameworks on one hand and idiosyncratic descriptions of cases on the other hand. Such an intermediate level is seen to be necessary, because scholars, while using the same terminology, implicitly address *very* different types of problems. In one case, assessing vulnerability might serve to optimise an existing management policy, in another case to raise awareness that global environmental change is producing new threats and yet in another case to negotiate an agreement between conflicting parties. The typology is build up by taking the concept of action situation as focal point of analysis and distinguishing between (*i*) problems that pertain to different cognitive phases in the process of adaptation, and (*ii*) problems formulated from the perspective of a vulnerable actor and those formulated from a facilitator's perspective, (*iii*) problems of individual and collective action. The typology aims at alleviating conceptual confusion by explicating the different types of problems addressed in assessments and supporting the choice of adequate concepts and methods for solving these. Research questions associated with the different problem types are highlighted.

1 Introduction

While it is undisputed that humans have to adapt to global environmental change it is disputed how effective adaptation shall look like or how to investigate it. To date, there is no accepted conceptualisation of, or methodology for, assessing vulnerability and adaptation; a great diversity of approaches can be found. In related scientific fields other concepts such as disaster risk reduction, adaptive management and resilience express similar ideas and cause similar confusion.

The conceptual and methodical difficulties have led to numerous attempts to provide guidance for assessing vulnerability and adaptation, either by developing collections of concepts and methods, or by proposing general frameworks. Prominent examples of such collections are the community level risk assessment toolkit maintained by the Provention Consortium [6] and the “compendium on methods and tools to evaluate impacts of, vulnerability and adaptation to, global environmental change” of the United Nations Framework Convention on Climate Change (UNFCCC) [26]. Two ongoing efforts to collect methodologies of vulnerability assessments are the “Nairobi work programme on impacts, vulnerability and adaptation to climate change” carried out by the UNFCCC secretariat [29] and the BASIC project [22]. Conceptual frameworks have been proposed, for example, by [28, 3, 15, 9, 8, 11, 16] and methodological frameworks by [5, 12, 30, 25, 14]. Recent efforts to develop methodological frameworks for assessing adaptation can be found in form of the policy appraisal framework of the ADAM project [21] and the framework for adaptive water resource management of the NEWATER project [23].

These numerous efforts have, however, not resolved the conceptual and methodical confusion. While the collections provide useful overviews of the existing approaches, they provide little practical help for choosing the right approach for a newly given problem. Methodological frameworks often only describe the common sense way of solving difficult problems; in essence: identify problem, do s.th. about it, observe, learn and do better. Conceptual frameworks either over-generalise or end up enumerating many system components and factors to be taken into account, without however helping to decide which ones are relevant in the problem to be solved. A huge gap between cases and frameworks remains and further developing methods and concepts stays a high priority on the research agendas ([2, 1], EU Framework Program 7).

This paper claims that the major obstacle that has prevented the development of practically useful frameworks and method collections is that so far the purposes of the vulnerability and adaptation assessments have not been taken sufficiently into account. Conceptual and methodical confusion is, to a great extent, a result of the fact that different scholars, while using the same terminology, address very different types of problems. For example, in one case, adaptation might mean to optimise an existing management regime, in another case to raise awareness that global environmental change is producing new threats and yet in another case it might mean to find a normative agreement between conflicting parties. In the case study literature these different purposes are hardly ever stated explicitly. In the conceptual literature the different purposes are distinguished (*e.g.*, [4, 9, 16, 27, 20]), however only on a very basic level and without relating them to the cases. A systematic analysis of the different types of problems addressed under the labels of vulnerability and adaption is so far lacking.

This paper tries to fill the gap between the general frameworks and the idiosyncratic treatment of cases with an intermediate level of analysis in form of a typology of adaptation problems. It seeks to identify the different types of problems addressed under the labels of vulnerability and adaptation. Preliminary findings of work carried out within the FAVAIA project, a joint research project between the Potsdam Institute of Climate Impact Research and the Stockholm Environmental Institute [7]. FAVAIA develops a formal framework for vulnerability and adaptation assessment [11] and applies it for the meta-analysis of cases studies.

Note that the types suggested are archetypes, which means that they generally can not be found purely in the “real world”; rather the “real world” problems are composed of several problem types. Furthermore, at the beginning of an assessment it is often not clear what exactly the problem to be solved is. Usually, a sequence of problems needs to be considered: A preliminary problem is identified, a method applied, and the results produced pose a new problem of a different type.

2 Problem Types

Since adaptation is human action, the concept of action situation is taken as the principle unit of analysis. Action situations consist of one or several actors situated within a common environment and can be described by properties such as the role of the actors, the set of allowable actions, the linkages between actions and outcomes and the information available to the actors about actions, outcomes and their linkages [17]. By environment both the physical and the institutional environment is meant. The problems types are build up by making the following three basic distinctions and combining these.

A first distinction is made between three cognitive phases that an actor goes through in the process of (consciously) adapting to global environmental change (*c.f.* [10]). The first phase is becoming aware of being in a problematic situation, that is of being vulnerable to global environmental change. The second phase is identifying the properties of the action situation.

For example, the actor assesses the severity of the hazard and which actions are available to mitigate possible adverse consequences. This, however, does not mean that the actor necessarily has full knowledge - uncertainty can and in most cases will be a property of the action situation. The third phase is choosing an action that is effective for getting her out of the problematic situation.

A second distinction is made between problems that are formulated from the perspective of the vulnerable actor and those formulated from the perspective of someone observing and wanting to facilitate the adaptation of the vulnerable actor. The former will be called single perspective problems, the latter facilitation problems. Facilitators can be the scholars that carry out an assessment or policy makers.

A third distinction is made between problems of individual action and those of collective action. Problems of collective action are those in which the outcome of an individual's action also depends upon the actions taken by other individuals.

In the following I present a couple of preliminary problem types that are attained by combining these three distinctions in different ways.

2.1 Single Perspective Problems

The first class of problems are posed and solved from the perspective of the vulnerable actor. These will be labelled *single perspective* problems. Three types follow directly from the three phases of adaptation distinguished above.

Vulnerability Identification

The actor does not know whether she is vulnerable.

Solving this problem means identifying vulnerabilities.

An example of this problem type would be a national government that does not know which regions, sectors or groups of people are threatened by global environmental change. Most of the "classical" top-down climate impact/vulnerability assessments address this type of problem. For example, the ATEAM project assessed the vulnerability of European regions that depend on ecosystem services to global change [24]. Vulnerabilities associated with this problem type have been labelled earlier "end point vulnerabilities" by [13] and "outcome vulnerabilities" by [16]. These two labels are motivated by the fact that whether or to what extent the actor is vulnerable is the result of the assessment.

Action Situation Identification

The actor is vulnerable, but cannot describe the action situation comprehensively.

Solving this problem means identifying the properties of the action situation.

An example of this type would be a farmer who is facing an increasing occurrence of droughts not knowing whether or what kind of adaptation actions could alleviate the problem. Most of the so called community based assessments (*e.g.*, participatory rural appraisal, vulnerability and capacity assessments) address this kind of problem. Vulnerabilities associated with this problem type have also been labelled "starting point vulnerabilities" by [13] or "context vulnerabilities" by [16]. These two labels are motivated by the fact that at the beginning of the assessment it is clear that the actor is vulnerable and solving the problem means exploring the context that makes the actor vulnerable.

Effective choice

The actor is vulnerable, has a comprehensive description of the action situation, but does not know which actions are effective.

Solving this problem means finding out which actions are effective.

A special case of effective choice is optimisation, that is to find not only effective actions, but the most effective one. However, only in few cases the available knowledge about the action situation allows for optimisation. Another special case is the spatial or temporal allocation of resources. An example would be a water administration allocating runoff to different riparian of a river basin.

Effective choice problems are addressed by formal methods and theories, such as decision theory, optimal control, economic theories and risk management approaches. A precondition for applying these is coming up with an adequate formal (*e.g.*, mathematical) description of the action situation.

Remarks

The three problem types frequently occur in succession and sometimes it is difficult to establish a clear cut between them. First, the problem is to find out which regions, groups or sectors are vulnerable to global environmental change. Next, available knowledge on the adaptation action situation needs to be gathered. Last, given the description of the action situation, effective actions need to be identified. In many cases it is also necessary to iterate between action situation identification and effective choice.

However, not necessarily all three problem types are transversed in each case. In some cases, it might be sufficient to identify vulnerabilities, because this then means that the action situation is fully described and choosing an effective action is trivial. For example, a farmer that realises to be vulnerable to increasing river floods might simply move away. In other cases, identifying the action situation will suffice, because knowledge about the action situation is limited such that the application of formal methods (*e.g.*, models) is not feasible.

2.2 Facilitation Problems

In the second class of problems, a distinction is made between the vulnerable actor and the facilitator that wants to support the vulnerable actor's adaptation. These will be called *split perspective* or *facilitation problems*. The problem is posed and solved from the perspective of the facilitator.

There are two different ways of solving split perspective problems. The facilitator can either interact with the vulnerable actor or act upon the vulnerable actor's environment. The former will be called *communication* and the latter *environment design* problems.

2.2.1 Communication

In the same manner as for the single perspective problems, three types follow from the three phases of adaptation.

Awareness Raising

The actor is assessed to be vulnerable by the facilitator, but does not feel vulnerable and therefore does not (consciously) adapt.

Solving this type of problem means raising awareness, that is, making the vulnerable actor feel vulnerable.

An example of this problem type would be a government that launches a campaign to raise the awareness of people settling in high risk areas such as flood-plains or steep hills prone to land-slides.

Facilitation of Action Situation Identification

The actor is assessed to be vulnerable by the facilitator, and also feels vulnerable. However, the actor does not understand the action situation comprehensively. The facilitator has a more comprehensive understanding of the situation or knows a way to elaborate one.

Solving this problems means either communicating the facilitator's understanding of the action situation or elaborating one together with the vulnerable actor.

Numerous examples of this problem type can be found in the community based vulnerability and capacity assessments that are carried out within disaster risk reduction domain. Other terms used to refer to this kind of problem are "mobilising actions" or "capacity building".

Facilitation of Effective Choice

The actor is assessed to be vulnerable by the facilitator, and also feels vulnerable. The actor has full knowledge of the action situation, but does not know which actions are effective. The facilitator does.

Solving this problem means communicating effective actions.

An example of this kind of problems is the communication of seasonal climate forecast to farmers in order to facilitate their choice of crops that are adequate for the forecasted amount of seasonal rainfall (see, *e.g.*, [19]).

As it is the case in the the single perspective effective choice problems, models are frequently used here. Note however that the role of the model is quite different. The primary problem here is communication. Models might or might not be useful in this communication process.

2.2.2 Environment Design

Instead of interacting with the actors, the facilitator can also act upon the vulnerable actor's environment.

Environnement Design

Adaptation is constrained or not promoted physically or institutionally.

Solving this problem means changing the physical or institutional environment the actor is situated in.

An example of this problem type is a government that aims at designing an incentive scheme to prevent farmers from overusing the ground water resources that are becoming scarcer due to global environmental change. For the institutional design problems, it is not necessarily important in which cognitive phase the vulnerable actor is in. For example, given the right economic incentives, an actor might adapt no matter whether she is aware of having a problem or not.

2.3 Collective Action Problems

The collective action problems are characterised by the fact that the effectiveness of individual actions depends upon the actions of others. These problems have a long history of being studied in several scientific disciplines, such as economics, sociology and political sciences. This paper does not aim at giving an overview. The aim here is to suggest that solutions to collective action adaptation problems are attained in different ways, such as coordinating actions, negotiating normative agreements and designing institutions.

Collective action situations could be sub-typed according to the involved actors being in different cognitive phases of adaptation. However, it seems that the most important class of problems is the effective choice one, that is all actors are aware that they are vulnerable, know their possible actions and which of them are effective given the actions of the others.

The major criterion applied here for sub-typing collective action situations is the way in which the actions and outcomes are linked. Depending on these linkages three different types of problems are attained.

Coordination

The action situation is such that there is a collective action that is optimal for all actors involved.

Solving this type of problem means coordinating actions between the actors.

An example of this problem type is two neighbouring communities that are threatened by global environmental change through increasing river floods. Collectively, the communities could build a dike to protect themselves; individual dikes are less effective. In a game theoretical context, this problem type is sometimes called coordination game without distribution conflict.

Negotiation

The action situation is such that there is no collective action that is optimal for all actors. However, un-coordinated individual action is less effective for all actors.

Solving this type of problem means negotiating a solution amongst the actors.

This type of problem is commonly associated with the usage of common pool resources [18]. It subsumes what is sometimes called coordination game with distribution conflict (battle of the sexes) and dilemma game in a game theoretical context.

Environment Design

The action situation is such that there is no collective action that is equally effective for all. For some actors their individual action is effective independent from the ones chosen by the others.

Solving this type of problem means changing the physical or institutional environment of the actors.

These kind of problem is frequently found in river basins between upstream and downstream riparian and in form of pollution conflicts. For example, in a river basin in which water is becoming scarcer due to global environmental change, the upstream riparian does not (necessarily) have an incentive to harmonise its water use policy with the downstream riparian. Outside intervention is necessary to solve the problem.

3 Conclusions and Outlook

A preliminary typology of adaptation problems was presented. The typology is a result of the analysis of cases carried out within the FAVAIA project at the Potsdam Institute of Climate Impact Research and the Stockholm Environmental Institute. In order to test the usefulness of these types, more cases need to be considered. To this end, a meta-analysis of European vulnerability and adaptation cases studies is currently conducted within the EU-funded ADAM project [21].

Within the typology, various scientific research questions are apparent. In the effective choice problems, an important research question is how knowledge about the hazard can be represented adequately. Risk management approaches assume that the hazard can be represented probabilistically. However, regional climate modelling can in many cases at best offer non-deterministic representations in form of a set of regional climate scenarios.

In the communication problems, an important research question is which form of interaction between the facilitator and the vulnerable actor(s) is appropriate. Prescribing that an actor is vulnerable even though she does not feel vulnerable is, of course, a delicate issue. Risk communication research addresses this question. Successful interaction also depends on the facilitator's ability to judge in which cognitive phase the vulnerable actor is in.

In the institutional design problems, an important research question is what kind of incentives are effective. Are political, economic, legal or other social incentives more effective? For example, in a case study carried out in the Guardiana Basin in Spain, legal incentives to prevent the over exploitation of scarce ground water resources have failed. It is now investigated whether and what kind of economic incentives could be more effective.

Another important role of scientific research in addressing adaptation problems is to find out which type of problem is given. Are vulnerable actors that do not adapt constrained cognitively or institutionally? For example, Grothmann and Patt [10] suggest that in many cases in which institutional constraints are said to hinder adaptation, cognitive constraints are equally if not even more constraining. Furthermore, a tendency of science to overemphasise effective choice problems has been observed in a couple of cases; analytical methods (*e.g.*, models) are applied before the action situation is sufficiently identified and adequately described.

A longer-term aim is to further develop the adaptation problem typology into a tool that supports the process of identifying the problem to be solved and choosing an appropriate method for it. The choice of a method for vulnerability and adaptation assessment is not trivial due to the great diversity of methods that exist. However, while it is clear that there is no single appropriate method for a given problem, it is also clear that not all methods are adequate for addressing all problems. Trying to fit the adaptation problem to be solved into the typology helps to narrow down the set of methods and concepts that are applicable.

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