

Article

Resilience for Whom? The Problem Structuring Process of the Resilience Analysis

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Abstract: Resilience is a flexible concept open to many different interpretations. The openness of resilience implies that while talking about resilience, stakeholders risk talking past each other. The plurality of the interpretations has practical implications in the analysis and planning of resilience. This paper reflects on these implications that have so far not explicitly been addressed in the literature, by discussing the problem structuring process (PSP) of a modelling-based resilience analysis. The discussion is based on the analysis of food security resilience to climate change in Huehuetenango, Guatemala, jointly undertaken by the author, governmental authorities, small-scale farmers and academics of the national university. The aim of this discussion is to highlight the underestimated challenges and practical implications of the resilience concept ambiguity and potential avenues to address them. The contributions of the results presented in this paper are twofold. First, they show that, in practice, the resilience concept is constructed and subjective. Second, there remains a need for a participatory and contested framework for the PSP of resilience.

Keywords: food security; resilience; power; system dynamics; problem structuring process

1. Introduction

Climate change effects start to be recognised as threats to food system sustainability and food security [1]. Sustainability involves maintaining the functionality of the system without compromising its capacity to do so in the future [2]. However, undergoing effects of climate change compromises food system functionality by contributing to water scarcity and pest exacerbation [3]. Resilience is understood as the system adaptive ability of maintaining its functionality even when the system is being affected by a disturbance [4–6]. For this reason, resilience is a compelling framework for researchers and policymakers seeking to understand how socio-ecological systems (SESs) adapt and transform to withstand changes in the environment. In practice, resilience is often used as a measure of a SES's capability to respond and adapt to new conditions (e.g., climate change). Like Tendall et al. [2] (p. 18) describe, “sustainability is the measure of system performance, whereas resilience can be seen as a means to achieve it”. Resilience has the potential to contribute to food security by enhancing farmers, and other stakeholders, capacity “for foreseeing and adapting to possible changes” [5] (p. 270). For instance, in the food systems literature, a number of studies have used resilience as framework for understanding how systems can adapt and transform in the presence of disturbances in the environment while still providing required amounts and quality of food [2,7].

Applications of resilience can be found in numerous disciplines, ranging from engineering to psychology to disaster risk management [8]. The increased popularity of resilience is due, at least partially, to the flexible meaning of the concept [8,9]. Resilience definitions have often been characterised as vague and unprecise in practical terms [2,9]. While the flexibility of resilience has moved it to the category of mainstream concepts and buzzwords, the same ambiguity represents

a challenge to its application in prescriptive and normative settings. These challenges manifest when practitioners need to operationalise the concepts described in the literature to the context in which resilience will be applied. Unsurprisingly, different stakeholders of the analysed system have different and sometimes conflicting interpretations of what resilience means in practical terms.

Since each stakeholder interprets resilience differently, the scope of the analysis to be undertaken is not a given but is constructed through a problem structuring process (PSP). The term PSP is used in this paper to describe the “process by which a presented set of conditions is translated into a set of problems, issues sufficiently well-defined to allow specific research action” [10]. During the PSP, stakeholders interpret the available information in light of their values and knowledge and negotiate what is the purpose and the boundaries of the study to commence (referred to from now on as the “scope of the resilience analysis”) [11,12]. The cognitive, social and political components, involved in the construction of the scope of analysis, condition its development and outcomes. The social and political nature of the PSP make it impossible to separate the conclusions and recommendations produced from the context in which they were produced. When talking about resilience, we cannot avoid the question: resilience for whom?

Literature has recently started to recognise some of the practical challenges of resilience ambiguity [2,9,13]; however, it still lags behind on recognising the political implications of resilience ambiguity in the analysis and its outcomes [8,14]. While some progress has been made by operationalising the definition of resilience (see for example [2,13]), resilience frequently continues to be presented as a “politically neutral approach” [9] (p. 134). The influence of stakeholders’ agendas and power relationships are often overseen by practitioners [8,14]. Although these dimensions of the PSP have been discussed for a long time in the literature regarding problem structuring methods (PSMs), their implications for the resilience analysis are still unexplored.

This paper contributes to closing these gaps by discussing the political and social implications of resilience ambiguity in the PSP. To this purpose, this paper looks at the PSP of a modelling-based analysis of food security resilience to climate change. This case is used to discuss some of the cognitive and political challenges of resilience. This discussion is informed by the personal construct theory [15] and enriched by a post-normal science epistemology [16] for managing a wide range of perspectives. The aim of this discussion is to reflect on (a) the implications of having a diversity of resilience interpretations in the PSP and (b) the potential avenues to mediate stakeholder engagement and mitigate the challenges this diversity entails.

2. Case Study: Analysing the Resilience of Food Security to Climate Change in Guatemala

This research was conducted within the qualitative paradigm of case study research [17,18] and is part of an independent modelling-based discussion for the analysis of and planning for food security resilience to climate change in Guatemala. Specifically, this case study describes the PSP followed to define the scope of the resilience analysis undertaken in the district of Huehuetenango. As part of this PSP, the author conducted a series of semi-structured interviews among relevant stakeholders in the local maize production system.

2.1. Background

Guatemala, similar to other developing countries, faces food security challenges that will only increase as climate change affects small-scale farmers’ capabilities to produce food. Guatemala’s chronic malnutrition, an accepted measure of food insecurity, is one of the highest in the world [19], reaching 55% in rural areas [20]. Climate change effects, such as severe droughts and increased average temperatures, already compromise the food production in Guatemala, especially among small-scale farmers [21].

Recognising this as problematic, some studies that explore potential means to mitigate climate change effects have been commenced separately by academics, nongovernmental organisations (NGOs) and the local and central government in Guatemala. This research is part of these initiatives,

independently conducted by the author with the cooperation of numerous stakeholders in the district of Huehuetenango.

Huehuetenango is located in the Northwest region of Guatemala, on the border with the South of Mexico. Huehuetenango is one of the poorest, most vulnerable districts in Guatemala. In 2014, its population was estimated at 1,150,000 people, with 67.6% of these people under the line of poverty [22]. Huehuetenango's main economic activities are the mining industry of silver and gold and the production of coffee [23]. Nevertheless, the production of maize is an important activity for self-consumption. The majority of the population is indigenous, from the ethnics of Mam and Quechi, with a cultural dependence on maize as the main source of calories. Among indigenous groups, maize represents a 71.2% of share in basic grains consumption).

2.2. Methodology

The intention of the study was to discuss potential policies to enhance food security resilience and to explore in an operational manner the impacts of these policies on different parts of the system. The author, with the support of two academics from the Universidad de San Carlos de Guatemala (national university in Guatemala), started by identifying (mapping) and engaging relevant stakeholders as early as possible and throughout the PSP. The following stakeholder groups accepted the invitation to participate in the PSP: (i) the central government; (ii) NGOs; (iii) farmers from Huehuetenango and (iv) academics and agronomists from the University. The number of delegates from each group and their backgrounds are presented in Table 1.

Table 1. Stakeholders' group representatives.

Stakeholder Group	Number of Delegates Participating	Background
Central Government (CG)	4	Agronomists Policymakers
Non-Governmental Organization (NGO)	3	Agronomist Project Managers
Farmers (F)	6	Maize Farmers
Academics (AC)	2	Agronomist Professor Researcher

During the PSP, the author conducted semi-structured interviews to gather stakeholders' perspectives about the food security resilience of the small-scale maize production system of the region. In the first part of the interviews, the author asked the delegates of the different stakeholder groups about the agendas they have for the local food system. Subsequently, causal loop diagrams (CLDs) were used to capture stakeholders' broad understanding of the underlying causes of system vulnerability (the extent to which the system will be affected by) climate change. Finally, the delegates were also asked to rank the stakeholders in the system in terms of influence on and interest in the local food system.

The elicitation of stakeholders' agendas for the local food system was done by discussing the following general questions with the delegates of each stakeholder group:

- What would you like to get from the small-scale maize production system?
- In this context, what does resilience of food security to climate change mean?
- What are the critical success factors of policies enhancing food security?

After the interviews, the author compiled and summarised the different answers. Similar answers were grouped in the same variable or short statement to simplify further analysis. The resulting statements were discussed in further interviews with each delegate to ensure they reflected their own perspectives. When needed, changes were made and again discussed with the specific delegate requesting the change.

Beside the narratives provided by the delegates, this paper uses CLDs as a means for capturing stakeholders' assumptions. CLDs are diagrams representing, in a simple manner, a possible set of causal relationships between different variables of the systems [24,25]. CLDs are particularly useful

for identifying circular relationships known in the systems' literature as feedback loops. The rigor of diagramming forces the participants to "carefully and consistently" make their assumptions explicit and to "put their problem definition to test" [26] (p. 384). Thus, CLDs are a suitable way to represent and compare different interpretations of the problem and the causal explanations held by the stakeholder groups participating in the PSP.

CLDs might be employed in the PSP (also known as the conceptualisation stage of the modelling process) [27,28] to elicit participants' understanding of the problem. During the conceptualisation, the modeller focuses on "a verbal description of the feedback loops that are assumed to have caused the reference mode" [19] (p. 119). Namely, in this paper, the CLDs were used to diagrammatically represent the causal explanations for the lack of resilience of food security in the region. This elicitation might be done, as it was in the case of this paper, during one to one interviews with experts in the field, in our case an agronomist from the university, and stakeholders of the problem at hand.

During the semi-structured interviews, the author drafted CLDs representing what the delegates were describing. The author started by asking the delegates what were the main causes of the decrease and fluctuations of the affordability of maize (as a measure of food security [29]) experienced in the past 10 years in the region of Huehuetenango (see Figure 1). The causes stated by the delegates were summarized by the author in relevant variables while transcribing them to the diagram. Then, the author asked delegates to explain how those variables influenced each other. These causal links between different variables were represented in the diagram by arrows connecting the cause with its effects. When needed, new variables were added to the diagram.

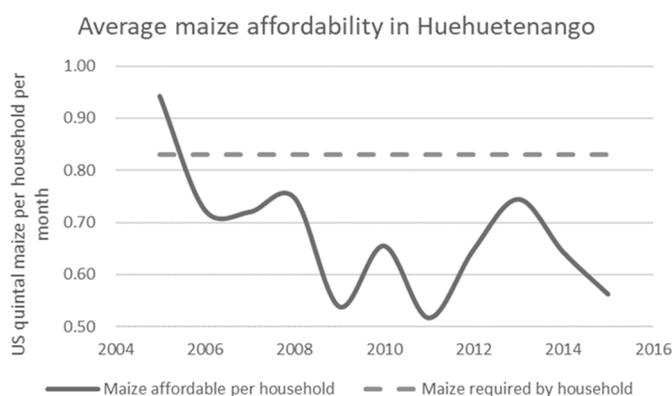


Figure 1. Maize affordability in Huehuetenango.

At the end of the interview, the delegates were asked to complete the CLDs drafted by the author by adding variables, causal relationships or any elements missing in the diagram. Later, the author worked on his own by summarising all the CLDs produced by each delegate into a single CLD per stakeholder group. The single CLDs were validated and discussed with the delegates of each stakeholder group in separate interviews to ensure all of their views were appropriately captured in the diagrams. If participants found important issues missing in the diagram, those issues were added to the final version.

Finally, delegates were asked to characterise the different stakeholders in the system. To be precise, participants were asked to rank from 1 (low) to 5 (high) the level of influence each stakeholder group has on the local food system. During this characterisation, participants were invited to consider in their assessment what resources each stakeholder can allocate for this purpose and the level of organisation and the reputation of each. Similarly, participants were asked to rank the stakeholders from 1 (low) to 5 (high) according to their interest in the problem (i.e., resilience of food security). The author tabulated the results into a single chart showing the average level of influence of each stakeholder group.

Analytical Framework

The results were analysed in light of personal construct theory (PCT) [15]. PCT is based on the assumption that a person needs to make sense of the problem to address it: “a person’s processes are psychologically channelized by the ways in which he anticipates events” [30] (p. 7). Thus, to analyse resilience, stakeholders need first to make sense of what resilience means. To illustrate how this cognitive process unfolds, this paper adapts the simplified model proposed by Eden [31] to examine how stakeholders construct their own interpretations of resilience (see Figure 2). According to Eden’s [31] model, stakeholders make sense of the concept of resilience by selecting particular elements that are applicable to the problem at hand and its context. This perception is then filtered through the individual system of values and beliefs to articulate its own interpretation of what resilience means in practical terms. This separation of selective perception and construal follows the personal construct theory of Kelly [15].

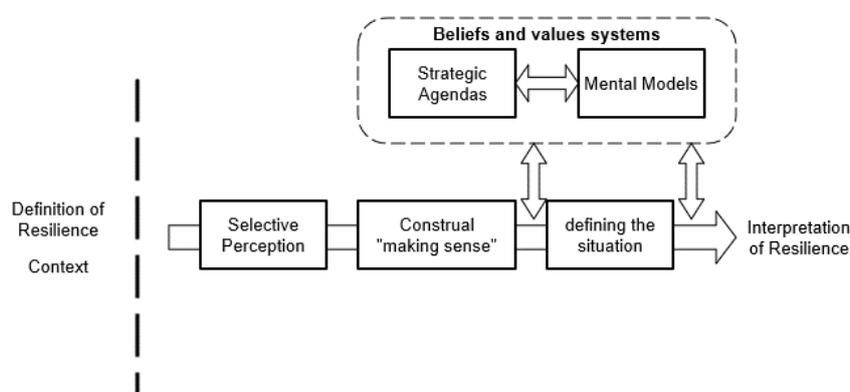


Figure 2. Construction of stakeholders’ interpretation of resilience. Note: Adapted from Eden [31].

There is no clear distinction between values and beliefs, as they are closely interconnected [31]. However, for analysis purposes, this paper explores two separate interconnected aspects of the beliefs and values systems: strategic agendas and mental models. The term strategic agenda is used here to describe the set of goals each stakeholder has for the system. Similarly, the term mental model is used to describe the conceptual representations each stakeholder has about how the system works [32]. Strategic agendas and mental models are not separate entities. They support each other, and together, they are supported by wider individual value systems [31].

In policymaking settings, closely linked to the understanding of what resilience means in practical terms, is the concept of adaptability or the “the capacity of actors in the system to influence resilience” [33] (p. 5). Stakeholders’ adaptive actions depend on how they perceive the disturbance is changing the conditions of their system. Since timing, magnitude and origin of the disturbance are, at least to some extent, unpredictable, the nature of the change that the disturbance produces deviates from the normal system-near-equilibrium analysis [34]. In these conditions of high uncertainty, identifying the mechanisms driving adaptation is not straight forward but depends on the stakeholder’s mental models about how the system works.

To analyse how stakeholders’ understand the system, this paper uses the reflections of Mayumi and Giampietro [35] about self-modifying systems and the theories of Funtowicz and Ravetz [36] on emergent systems. According to the aforementioned sources, the explanations each stakeholder group gave to the system behaviour were classified into:

- (a) endogenously driven: the observed effects of disturbances affecting the system are the result of the functional links between its different elements. Adaptation emerges from the mechanisms the system has to regulate itself and can only be enhanced by strengthening them [35]. The solution to the problem is within the system boundaries.

- (b) exogenously driven: the disturbance affecting the system comes from outside the system and, to adapt to the new conditions introduced, the system needs of external interventions that “push” it back to its equilibrium state. The solution is outside the system boundaries.
- (c) chaos: the uncertainty about the disturbance affecting the system and complexity of the system itself are perceived so high that it is impossible to identify links between actions (outside or within the system) and their consequences. The solution is unknown.

This classification offers a helpful analytical framework to explain how delegates from different stakeholder groups understand the system and the differences in the policies they will propose in further stages.

Nonetheless, the agendas and mental models used by stakeholders to construct their own interpretation of resilience are only some of the ingredients for the scope of the resilience analysis. The manifestation of power in the PSP is indeed critical analytical lens to understand complications of resilience ambiguity. In fact, power effect on resilience is one of the most unexplored but most contested characteristics of resilience [14].

Case study research shows that in prescriptive settings, the PSP of resilience is predominantly a negotiation endeavour. For instance, Lebel et al. [37] describe that in many case studies undertaken by the Resilience Alliance, the scope of resilience analysis reflects, to a large extent, the interest of powerful stakeholders, undermining perspectives of ethnic minorities and small-villages (powerless stakeholders). Similarly, Larsen et al. [38] highlight the tensions regarding roles, control and ownerships between powerful stakeholders during the process of building resilience in Thailand tourism-dependent communities.

These cases studied in the literature show that during the PSP of resilience, stakeholders will try to persuade the others to join or accept their own interpretation of resilience and to articulate the scope of the resilience analysis accordingly. As illustrated in Figure 3, the scope of analysis is a negotiated outcome of the PSP that reflects not only the interpretations of each stakeholder in the system but also the power relationships between them.

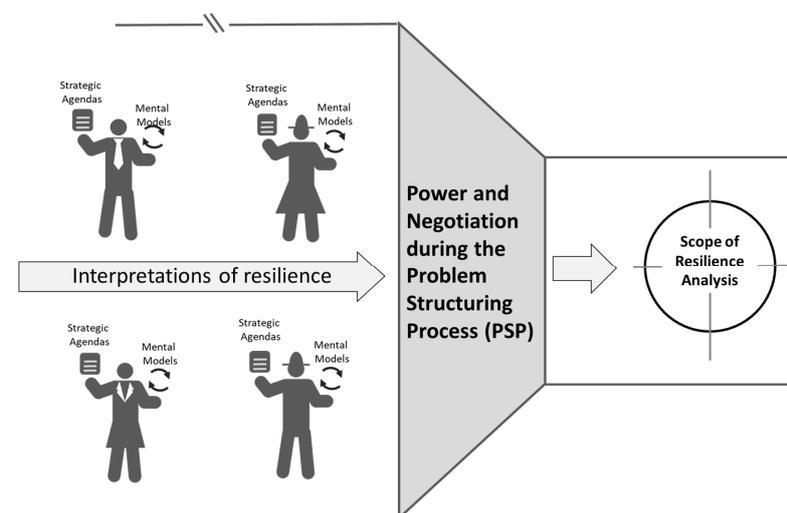


Figure 3. Simplified representation of the problem structuring process (PSP) of resilience analysis.

2.3. Results

2.3.1. Strategic Agendas

Tabulated results from the interview show that delegates from the same group coincide to a large extent in the answers they provided about their agendas. Table 2 summarizes these tabulated answers. In Table 2, it is noticeable that most of the delegates of the same group agreed on a similar answer.

Table 2. Summarized answers to the semistructured interviews.

	Delegate Code	CG1	CG2	CG3	CG4	NGO1	NGO2	NGO3	AC1	AC2	F1	F2	F3	F4	F5	F6
What would you like to get out from the small-scale maize production system?	Increase households' wealth	X	X		X											X
	Produce revenues			X		X	X	X		X			X			
	Produce food								X		X				X	
	Produce food for locals						X			X		X	X	X		X
In this context, what resilience of food security to climate change means?	Being able to afford food even when droughts	X	X	X				X								
	Produce food constantly in despite of the droughts	X			X	X	X		X	X		X			X	
	Don't starve during the bad years								X							
	Have always enough food										X	X	X	X	X	X
What are the critical success factors of policies enhancing food security?	Money available for purchasing food	X	X	X												
	Crop productivity		X		X	X		X								
	Maize Yield				X		X		X	X			X			
	Maize reserve										X	X	X	X	X	X

Note: CG: Central Government; NGO: Non-Governmental Organization; AC: Academics, F: Farmers.

Based on the interviews results, the strategic agenda held by each stakeholder group can be summarized as follow:

Central Government (CG): The purpose of the analysis is to identify how to increase the household’s wealth and particularly the money available to buy food so that households can afford enough food even when droughts reduce the yields of maize in the region.

Non-Governmental Organization (NGO): The purpose of the analysis is to identify how to enhance crop productivity so that households can produce food and revenues constantly despite the droughts. Note that in the words of the NGO delegates, crop productivity is understood as the amount of crop (not exclusively maize) produced from each Guatemalan Quetzal invested by the farmers.

Academics (AC): The purpose of the analysis is to identify how to increase maize yields and reserves as a mean to prevent starvation by increasing farmers revenues and food supply to the region.

Farmers (F): The purpose of the analysis is to identify how to increase food production (not limited to maize or crops in general) and maize reserves to have food year round.

2.3.2. Causal Loop Diagrams

Figure 4 presents the CLD’s prepared jointly by the author and delegates of each group. In general, diagrams are relatively simple and focused (with the exception of diagram in Figure 4c) on one or two main causal explanations of the problem to address (decrease and fluctuations of maize affordability in the region).

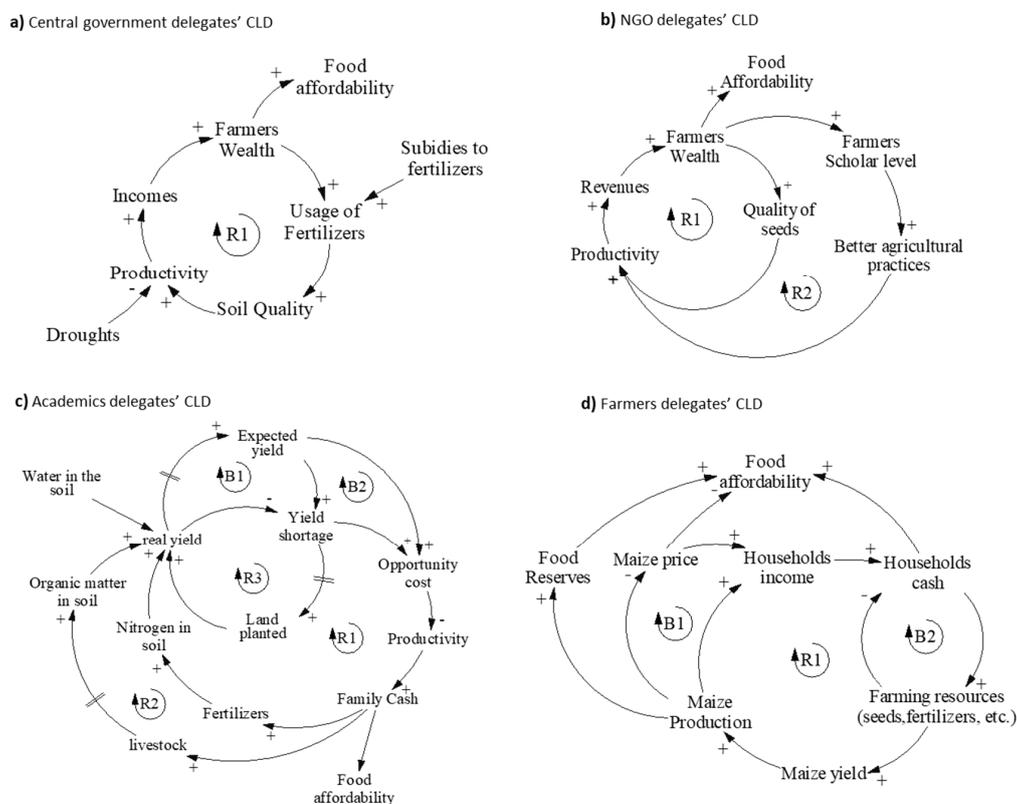


Figure 4. Causal loop diagrams (CLDs) explaining the decrease and fluctuations of maize affordability in Huehuetenango. CLDs were produced by (a) central government delegates; (b) NGO delegates; (c) academics delegates and (d) farmers delegates; during one-to-one semi structured interviews.

Next, there is a brief explanation of each diagram.

Central Government (CG): Farmers productivity increases the incomes and, therefore, the wealth of the farmers. Higher wealth increases farmers' capacity to use fertilizers (fertilizers are more affordable). Usage of fertilizers is directly related to the productivity and, therefore, the more fertilizers the farmers use the more productive they become in a virtuous cycle represented by the R1 feedback loop in Figure 4a. This loop, however, is perturbed by droughts (disturbances of the system) that reduce farmers productivity, reducing their overall wealth and hence their capacity to acquire food (food affordability).

Non-Governmental Organization (NGO): Farmers productivity increases the incomes and therefore the wealth of the farmers. Higher wealth increases farmers' capacity to access better seeds and formal education. Seeds of improved varieties, the ones that require less water, are assumed to increase crop productivities, especially during drought seasons, compared to seeds coming from informal sources (on farm save seeds for example). Better seeds increase wealth in the virtuous cycle represented by R1 in Figure 4b. Access to formal education is assumed to be linked to better agriculture practices (e.g., appropriate usage of fertilizers and land planning). Better agriculture practices increase revenues and wealth in the virtuous cycle represented by R2 in Figure 4b.

Academics (AC): The causal explanation represented in Figure 4c focuses on the variation of the real yield against the expected one (yield shortage in the diagram). Yield shortage results into lower productivities and opportunity costs that reduce families' cash and their capacity to invest in fertilizers and livestock (see feedback loops R1 and R2 in Figure 4c). Higher yield shortage also translates into a reduction of the land planted each season (see R3 in Figure 4c), because farmers need to spend more time on other activities (e.g., working on coffee plantations) and less time farming. The expected yield eventually gets adjusted, decreasing the yield shortage and opportunity costs (see loops B1 and B2 in Figure 4c). The increase in droughts occurrence increases yield shortage by affecting the maize system and its real yield, reducing at the same time the land planted and the cash available for the next season's harvest.

Farmers (F): Maize production increases incomes and households' cash, allowing farmers to acquire more resources needed in farming activities (seeds, fertilizers, etc.). This eventually increases the maize production. Higher production results in a) higher food reserves and b) higher incomes (see feedback loop R1 in Figure 4d). However, there are two drawbacks from the feedback loop R1. First, the acquisition of resources decreases households' cash (see feedback loop B1 in Figure 4d) thereby reducing the food affordability. Second, higher production will eventually translate into lower maize prices, reducing farmers' income and profit margins (see feedback loop B2 in Figure 4d).

2.3.3. Influence-Interest Grid

Figure 4 presents the stakeholders' grid produced by the delegates. The four stakeholder groups participating in this case study were consistently identified by all the delegates as those with the highest interest in the problem (see Figure 5). The central government and NGO working in the area were described as being the stakeholders in a better position to solve the problem or those with higher influence on the problem (see quadrant I in Figure 5). Other stakeholders, like the large-scale farmers producing food in the region and traders, were also recognised as highly influential. However, there was an agreement among delegates of all the stakeholder groups participating that, unfortunately, large-scale farmers and maize traders have no interest in enhancing food security in the region (quadrant IV in Figure 5). While recognized as those with higher interest in the problem, small-scale farmers were portrayed as the group with the lowest influence on it (see quadrant II in Figure 5). Academics and stakeholders not participating in the PSP (local government) were also portrayed as interested parties with low influence.

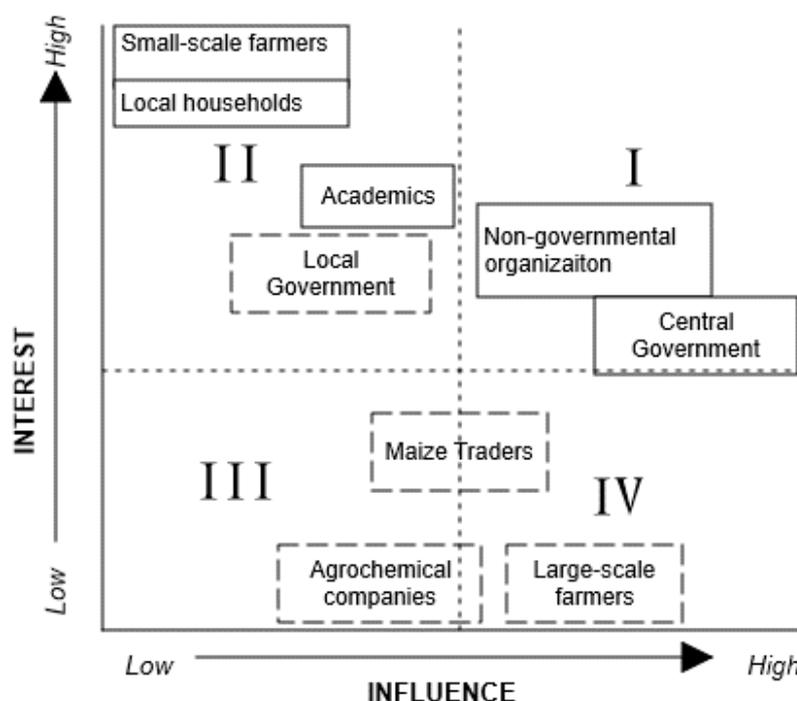


Figure 5. Influence/interest diagram summarizing stakeholders rank in the small-scale maize production system in Huehuetenango. Note: stakeholders in dotted lines did not take part in this research.

3. Complications of the PSP in the Analysis of Resilience

The results presented in Section 2 offer relevant evidence to discuss the ambiguity of resilience and its complications. The ambiguity of resilience, in this case, does not arise from the differences between many definitions of resilience [13], but from the way in which stakeholders interpret it for their specific context and problem. The differences that emerged during the PSP might already be noticeable for the reader, but the analytical lenses proposed in this paper offer a perspective of the deeper and more conflicting differences in the agendas and mental models held by each stakeholder group.

These cognitive differences set the scene for analysing the conflict that could unfold during the negotiation of a single scope of resilience. The more mutually exclusive agendas and mental models are, the harder it is to reach a scope of resilience that satisfies all the stakeholders. As Eriksen et al. [39] pointed out, adaptation will change social, political and economic relationships between stakeholders, “yet not all these changes are desirable for everybody”.

This section concludes by discussing the practical implications of resilience ambiguity in the policymaking process. These implications are not only political but also methodological and require thoughtful planning of the PSP. While it might be possible to mitigate some drawbacks, more research is needed before outlining a comprehensive framework for addressing the political challenges that resilience entails.

3.1. Constructing an Interpretation of Resilience

The experience in the district of Huehuetenango in Guatemala shows that different stakeholders have different interpretations of resilience. These interpretations of resilience are context specific [40,41] and reflect the values and beliefs of the stakeholders involved. In other words, stakeholders make sense of what resilience means in their particular context and frame the analysis process accordingly. In this case study, different interpretations of resilience are reflected in (a) the different goals and desired outcomes (strategic agenda) stated during the interviews (see Table 2) and (b) the different descriptions of the causes of the problem (mental models) captured in the CLDs (see Figure 1).

When looking at the strategic agenda, stakeholders see the maize production system at different levels of aggregation (household level vs. regional level). As presented in the results section, delegates from the same stakeholder group share similar perspectives about the purpose of the system (see Table 2). With the exception of the farmers, the groups also share some alignment among themselves. The answers in Table 2 and summarized strategic agendas in the Results section show that most of the delegates have local/regional goals for the system, namely to promote local economic development. Alternatively, farmers focus on their current urgent problem of living in insecure food conditions.

In other words, there are two main strategic agendas for the system. One agenda (shared by many stakeholders) is seeking to use the system as a tool for local and/or regional economic development. The other agenda, held by the farmers, is to have food all year round. While there might be different arguments in favour of one agenda over the other one, it is unlikely that regional solutions will have any impact unless urgent issues challenging the farmers' own subsistence are addressed. Similarly, small-scale solutions, addressing farmers immediate needs, might prove to be unsustainable in the mid-term if the wider problem is not tackled.

Wider differences are found when looking at stakeholders' mental models reflected in the CLDs developed. Academics and NGO delegates describe the system in endogenous terms. This endogenous perspective is reflected in the feedback loops identified in the CLD they drafted (see Figure 4b,c). They look at the problem in a systemic way and try to find solutions within the system boundaries. They have, however, a different understanding of the vicious circles constraining food security. On the one hand, academics focus on the management of the water resources and reservoirs as a potential leverage point.

"The obvious cause of the problem is the deficiencies the communities face to access water This is why that, now that droughts are becoming more common, farmers face more problems."
(Academic delegate 1)

On the other hand, NGO delegates blame farmers' lack of technical skills and training as the cause of their poor productivity and, hence, food insecurity. The solution they propose is to increase training and to provide farmers with better seeds to increase their productivity in a sustainable way.

"You see, there are several complications in the situation of these poor people because their culture doesn't let them move forward. They use the same techniques they have been using since pre-colonial times. They have no formal education. You know that most of them cannot read. It is really difficult to teach them and change their minds. We need to make an effort to provide them with the right seeds and the proper instruction to use them well." (NGO delegate 2)

The government delegates describe the system as exogenous driven. These delegates think the way to influence the system is through the artificial enhancement of farmers' productivity (see Figure 4a). Even though they identified a feedback loop in the system, their proposed solution focuses on ways to quickly boost the system performance, namely by using more fertilizers to increase productivity.

"The government is committed to provide a sustainable and plausible solution by providing the fertilizers they (farmers) need to increase their productivity and become more competitive Once they (farmers) level up with the market, the food affordability should be a natural condition."
(Central government delegate 2)

Farmers perceive the problem in a very different way. In their perspective, the increasing uncertainty about rainfall is transforming the system into a chaotic one. From their perspective, using more expensive seeds or more fertilisers will be useless if the weather conditions are not good. Farmers do not feel in control of the system. They feel they are victims of the uncertainty of the yields that they will get at the end of the season.

“The problem is you don’t know if the yield is going to be good or not Now you never know If the yield goes bad, we lost the money we spent on seeds and fertilizers.” (Farmer delegate 4)

“The weather now cannot be predicted You gamble every time you plant.” (Farmer delegate 1)

Furthermore, the farmers do not see higher production as a means to increase their revenues but only as a means to increase their food reserves (see Figure 4d). In their view, the region is isolated, and they do not have access to other markets to trade. The benefit they perceive from higher production is in having more maize to build food reserves for the future.

Understanding and acknowledging different goals and mental models about the system will lead to a wider scope of analysis and might result in a more balanced decision-making process [34]. Short-term solutions and systemic interventions could provide a balanced view between achieving short-term outcomes and their long-term consequences. Farmers’ chaotic view of the world challenges the mechanistic understanding other stakeholders might have and balances their deterministic view by the acknowledgement of uncertainty. The system cannot be assumed mechanistically following economic rules since human behaviour under stressful situations adapts in sometimes unexpected ways [7]. An oversimplified understanding about how different groups will react during a crisis might lead to policy failure [42]. For instance, while most of the stakeholders expect farmers to use a potential production surplus to increase their revenues, farmers will use it to increase their food reserves, affecting the policy’s effectiveness.

3.2. Negotiating the Scope of Analysis

The power to influence the final outcome is not symmetrical among stakeholders, with those holding key resources being in an advantageous position to impose their own interpretations in the final scope. System adaptation will “influence social relations, governance and distribution of resources in any given population or place” [39] (p. 2). However, as shown in this case, there is not always agreement about the changes and the scale at which those changes should be made. Those with higher level of influence in the scope of analysis might not be those directly affected by its outcomes. For instance, the small-scale farmers in Huehuetenango are the stakeholders directly affected by potential decisions about how to enhance resilience, but they are also those with the least influence on the decision-making process (see Figure 5).

Power differences have contentious repercussions considering that those with a higher level of influence have different strategic agendas than those suffering the larger impacts of the policies implemented. This is particularly relevant since there is a clear difference between the farmers’ interpretations and those held by the rest of the stakeholders. Considering the different interpretations of resilience, the power to set agendas about what issues are to be addressed needs to be an important consideration during the PSP.

Competitive agendas and mental models set the scenario for a game of power where different stakeholders seek to impose their own agendas on the scope of the analysis that will follow. The allocation and distribution of the access to natural resources have been, historically, an expression of power tension between different groups [14,39]. While building the resilience of the system outcomes, the resilience of the institutions and relationships defining those outcomes are also enhanced [43]. Many stakeholders perceive the resilience analysis as an opportunity to gain power or to influence the system towards their own interests [14]. This power might be exercised in many ways. For instance, stakeholders might scope the problem in isolation, ensuring their interpretations are the only ones represented. Alternatively, some groups could try to undermine those with competitive or opposite views by diminishing their credibility as shown in this case. For instance, note the comment above from NGO delegate 2 in which the delegate undermines farmers’ practices because they have no formal education. Any analysis that does not account for these tensions would result in an incomplete understanding of the scope of potential responses [14,44].

In short, recognising that there might be different interpretations of resilience implies accepting the PSP as a negotiation and political process. Seeing the PSP as a negotiation forum means that practitioners need to acknowledge the social and political factors (e.g., inequality and legitimacy) shaping the scope of analysis and need to be transparent about the implications of these factors on their recommendations. Otherwise, the resilience analysis risks being used, possibly inadvertently, as a way to legitimise the power of particular groups and to impose particular means to manage natural resources [43].

3.3. What Are the Potential Implications?

There are at least two implications resulting from the flexibility of resilience to interpretation. First, it seems unlikely that a proper analysis would result in a PSP that does not account for the many different interpretations of resilience in each particular context. If the scope of analysis has been defined by only a few groups, it risks being too narrow, excluding important elements from the analysis and reducing the range of solutions explored. For instance, the analysis might focus on short-term solutions, ignoring important feedback loop mechanisms of the system. Alternatively, a pure systemic view of the problem might fail to recognise uncertainty and might oversimplify decision rules and human behaviours.

Second, stakeholders who have a different understanding of the problem will rarely support or get actively engaged in the implementation of a solution that is not addressing their initial understanding of the problem [45]. The contribution of any solution is null if those ultimately responsible for implementing them are not willing to do so [46]. For instance, stakeholders might sabotage the policies proposed at the end of the analysis by refusing to participate in the implementation (e.g., training and the introduction of new practices) or, even worse, by explicitly opposing them (e.g., demonstrations against the introduction of new seeds).

3.4. Potential Avenues for Mitigation

Recommendations are not conclusive, but it is possible to outline avenues for further development with the aim of reducing the potential drawback of power in the PSP. A possible avenue is to advocate for more participatory settings. So far, the SES literature has extensively discussed stakeholders' participation as a requirement for the enhancement of resilience in the SES. However, very little has been elaborated on the role of participation in the formulation of the problem as such. Facilitated modelling approaches, such as Group Model Building [47] or Cognitive Mapping [48], might contribute to mediating this process (e.g., by introducing the CLD as a transitional object that helps to leverage power differences) [49,50]. These methods contribute in leveraging the power between groups by forcing participants to make their assumptions explicit in a diagram that is challenged by the group [47,51,52]. In this case, the diagram is used to jointly represent the problem definition shared by and agreed upon by different stakeholders through a process of negotiation and dialogue [49].

Alternatively, another option is to aim for a broader perspective in the analysis of resilience and to consider possible trade-offs and asymmetries in resilience between different groups and communities within the system. A broader perspective might be particularly useful when there is a conflict between long-term and short-term goals or when the boundaries of the system are not clear [53]. By using computer simulations, for example, it is possible to uncover long-term unintended consequences that might result from short-term perspectives. Uncovering unintended effects is possible because computer simulations are especially useful when the delays between the policies and their results are too large to allow for assessment by simple intuition. Simulations might also uncover unexpected and unintended consequences of policies that are beneficial to one group but negative for others.

The latter is particularly important when analysing climate change problems because there are time lags or delays between policy measures (or non-action), and effects often extend beyond the normal period of analysis [54,55]. When important consequences of current policies materialise several years later (in some cases decades later), significant future stakeholders will not be present to voice their

concerns and weigh in when preferences are aggregated into policy decisions. Present stakeholders might be willing to compromise the overall future detriment of the system for short-term benefits. Namely, in the resilience analysis, present stakeholders might favour policies that yield more efficiency in the short term but diminish the capability of the system to continue providing the desired outputs in the long term. The benefits for the few who are defining the problem now might be preferred over the benefits for the many tomorrow.

4. Conclusions

The ambiguity of resilience is a challenge for practitioners that want to implement it as an analytical and policymaking framework in real life problems. This paper addresses the ambiguity of resilience from a cognitive and political perspective by focusing on how resilience is interpreted in practice instead of its theoretical definition. This paper argues that the interpretation of what resilience means in a specific context (resilience of what?) and the ways to achieve it are results of the values and beliefs of those with a stake in the system. In this light, the case study presented methods to identify and highlight some of the challenges and practical implications of resilience ambiguity. Specifically, this paper focuses on strategic agendas and mental models as observable expressions of stakeholders' values, beliefs and knowledge about the system. The results discussed in this paper show that, in practice, different agendas and mental models compete during the PSP to be part of the scope of resilience analysis. The question of what outcome of the system needs to be resilient has many answers (revenues, yield, food supply).

The results presented in this paper show that stakeholders have different understandings of how the system works. For instance, while academics and delegates from the NGO participating in the study focused on enhancing virtuous cycles within the system, the central government delegates proposed solutions outside the system's boundaries. All of these solutions, however, ignored the bounded rationality of the farmers and the premises of their decision-making process. Including only a few stakeholders in the process risks leaving many important aspects out of the scope of the analysis and therefore undermining its results.

It is also necessary to acknowledge the role of power shaping and filtering different interpretations of resilience into a formal scope of analysis. It is expected that those with more power will attempt to influence the PSP to reflect their views and agendas. In the case presented in this paper, farmers have little influence in the PSP and their agendas might, intentionally or accidentally, be bypassed by experts (e.g., academics and researchers) and policymakers. For instance, as discussed in this paper, farmers bounded rationality and socioeconomic position might be used as an argument for disregarding their knowledge and their claims.

In short, results show that the practical meaning of resilience is socially constructed by those participating in the PSP and the way this process is conducted will affect the result of the analysis. There are at least two practical implications of underestimating resilience ambiguity while structuring the scope of the resilience analysis. First, including only a few stakeholders in the process risks leaving many important aspects of the system out of the scope of the analysis to be undertaken. Second, poor stakeholder management also risks obstructing the implementation of proposed policies and, in the worst case, unintentionally harming those in more vulnerable positions. While literature starts to acknowledge the challenges and contentious implications of power in the resilience analysis (see for instance [7,14,39]), more research is needed toward defining a framework of how to facilitate negotiation during the PSP.

If resilience is to play a significant role in climate change adaptation, policymakers should be careful when structuring the scope of the resilience analysis and should seek for broader participation. Such broadening is not a simple case of bringing more perspectives. Instead, it is a "fundamental shift in how knowledge is understood to operate and consequences of this for the kinds of questions we formulate prior to our analyses" [14] (p. 484). Increasing participation is not a normatively uncontroversial route either, but at least it acknowledges that resilience-based policy solutions and

institutions will have distributional and, thereby, moral consequences (as most other forms of public policy do).

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