# Brief communicationLessons ~~Learnt~~ Learned and ~~Experienced~~ Experiences Gained from Building Up a Global Survey on Societal Resilience to Changing Droughts

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**Abstract.** ~~Drought resilience indexes are essential tools for an evidence-based decision-making process. There are a myriad of indicators representing the different components of risk and resilience, thus requiring selecting more relevant and representative indicators to compose the index. This selection can be made by enquiring drought experts directly. For our study, we have developed a global survey focusing on eliciting the relevance, data availability, and understanding of drought resilience indicators for medium and small farms in different contexts but allowing cross-country and cross-regional comparison. The process of constructing the global survey was challenging and the most time-consuming part of the research so far. However, there are not many literature discussions on this process. Therefore, this~~ This paper presents the ~~challenges found a priori~~ experiences during the process of creating a global survey with experts in drought ~~, that can affect the significance of the results to be analyzed a posteriori~~resilience. The lessons learned ~~from the developing process of global survey~~ include five main points: (1) the heterogeneity of the conceptual background should be minimized prior the construction of the survey; (2) large number of indicators ~~to be evaluated~~ decreases the engagement of respondents through the survey; (3) it is necessary to find a ~~better format of the survey~~ good survey design to balance response rate and accuracy, (4) the survey should be clean and fluid, (5) ~~raising~~ reaching diverse experts by knowledge areas, experience and regional representations is difficult, but crucial to minimize biased results.

**Keywords:** drought resilience, indicators, expert elicitation, global survey

## 1 Introduction

~~Drought is an omnipresent natural disaster on Earth and one of the biggest threats to water security, food, and energy production. Despite our limited short time window of meteorological observations, we have witnessed an increasing tendency in frequency~~

and severity of droughts (?). Society must adopt measures to mitigate these impacts and to adapt to reduce their consequences.

The formulation of a global survey is a complex process that poses several challenges both in its preparation (a priori), and evaluation of results (a posteriori) phases. In general, studies focusing on surveys and expert elicitation address a posteriori challenges, such as the data analysis tools used for samples of different sizes and compositions. However, a priori challenges are rarely addressed and represent an important and exhaustive step in the process. For example, Baker et al. (2014) state that "while there is a rich literature on expert elicitation approaches and protocols, there is less information available on the specifics of how an elicitation is carried out".

Drought resilience indicatorsare tools that are being increasingly used to support an evidence-based decision-making process since they can Harzing et al. (2013) have reviewed the issues faced in global surveys and identified cultural and language differences, which may lead to different interpretations of questions or loss of meaning, and varying response rates between countries as significant sources of bias in global surveys. ProductLab (2023) also discusses the difficulties of global surveys and provides best practices for their formulation. They also mention the challenges due to cultural and language differences and finally recommend appropriate survey timing for all countries. However, both studies have a focus on business and product development.

Therefore, our main motivation for writing this brief communication is due to the scarcity of papers or other materials discussing the challenges of creating global surveys in complex subjects where we face conceptual divergences - such as resilience. We believe that the challenges and problems faced during the survey-building process are often not discussed by the researchers, as doing so may weaken confidence in their final results. However, it is important to face this fear and openly share difficulties encountered, as this sharing of challenges can also lead to valuable new knowledge and insights gained. In this study, we have used a global survey to elicit experts' opinions on drought resilience indicators. These indicators have been increasingly used in Decision Support Systems (DSS) to reflect different socioeconomic, ecological, and technological conditions . Although there are many (WMO and GWP, 2016; Meza et al., 2019; Blauhut, 2020). Although numerous indicators for drought resilience are available in the literature, several aspects can make them not feasible for analysis, in particular for comparison between global regions certain aspects may make them unfeasible for comparative analysis across global regions (Bachmair et al., 2016; Blauhut, 2020). The absence of spatial and temporal data, variability of measurements in different regions, and difficulty in understanding can be a hard challenge indicators can make it hard to select indicators to compose a global drought resilience index . These difficulties are reflected in the use of these indicators as a support for public policies and decision-making processes. (Blauhut, 2020). However, these aspects are usually overlooked when rating the relevance of the indicators during the surveys. For example, Meza et al. (2019) have not incorporated these aspects in their global expert survey on drought vulnerability indicators. Therefore, there is a need for a more in-depth analysis of the drought resilience indicators to ensure their suitability for cross-regional comparisons.

A model for drought resilience quantification needs several indicators to integrate the magnitude and frequency, economic and social impact, and further analyze the capacity to overcome or minimize negative consequences in social and ecosystems under extreme events. There is a lack of clear consensus on which indicators should be selected to compose an index to assess exposure, vulnerability, and resilience concerning droughts. A conceptual hybrid approach considering stakeholder views on

possible drought risk factors as well as quantitative measures of past impacts has not been implemented in a cross-country context. This encouraged us to seek the construction of an index, proposing connections between hazard, exposure, and vulnerability concepts, with an emphasis on infrastructure and institutional capacity indicators.

Our focus is on the was on the agricultural drought resilience of the food system linked to small farmers. As drought, we are referring to the agricultural drought, which usually relates to a period with declining soil moisture and consequent crop failure without any reference to surface water resources Mishra and Singh (2010). A food system is "the networks that are needed to produce and transform food and ensure it reaches consumers" (WFP, 2023). According to OECD. (2021), food systems around the world are facing a triple challenge: they have to provide food security and nutrition to a growing population; they have to provide a livelihood for millions of farmers and other people working in segments of the food supply chain; and they have to do all this using the principles of sustainability. The food system is also likely to be affected by extreme events, in particular droughts. Thus, we intend to contribute to the understanding of the risks related to drought this crucial sector can face.

By following the Sendai Framework for Disaster Risk Reduction (DRR) 2015-2030 (UNDRR, 2015), we listed and screened indicators proposed in the scientific literature for drought resilience focused on the food system. After, a global survey with experts was planned to assess the relevance, the data availability, and the shareholders' perception and understanding of these indicators in different contexts.

The process of formulating a global survey imposes several challenges a priori (in the process of preparing the survey itself) and a posteriori (in the process of evaluating the results). In general, studies with surveys and expert elicitation address a posteriori challenges , such as the data analysis tools used for samples of different sizes and compositions. However, a priori challenges are rarely addressed and represent an important and exhaustive step in the process . In this sense, in this opinion paper, we share the challenges faced in our study and the lessons learned that can help other research in global surveys.

## 2 Methods for eliciting expert views and knowledge

This methodology has been applied to global surveys (i.e., Rastandeh et al., 2018); however, the process of conducting this research requires further discussion.

Global surveys are ambitious projects that require sufficient answers to attain statistical significance. The target group of the Constructing the survey is the major determinant of the sample size and will define the amount of data to be collected to answer the research questionstook about a year due to the challenges presented in this brief communication. We believe that it is important to discuss the process of formulating the survey to prevent other researchers from passing through the same problems and improving the use and interpretation of this method. The importance of preparing the survey itself for any generic field was also discussed by Elangovan and Sundaravel (2021). Here, we would like to complement the suggestions for the resilience field.

## 2 Methods for eliciting expert views and knowledge

Mukherjee et al. (2017) identify six strategies that are best suited to the various stages of the decision-making process and for eliciting different judgments: Interviews, Focus Group Discussion (FGD), Nominal Group Technique (NGT), Q methodology (Q), Delphi technique, and Multi-criteria Decision Analysis (MCDA). An interview consists of an information exchange between two or more individuals in which one of them aims to obtain information, opinions, or beliefs from the other person. The FGD is a technique in which a researcher gathers a group of people to discuss a given issue. Aside from the FGD, which aims to draw on ~~the~~ participants' complex personal experiences and personal actions, beliefs, perceptions, and attitudes, the NGT is an interactive group decision-making process primarily focused on reaching a consensus. The Delphi technique traditionally aimed at reaching consensus, through a group-based, anonymous, and iterative technique. The Q, on the other hand, is a tool for understanding the primary viewpoints or opinions on an issue among a group of significant players, in which respondents are asked to rank a set of items. Finally, the MCDA assists decision-making ~~that considers~~ by considering the benefits and disadvantages of several possibilities for achieving a certain objective.

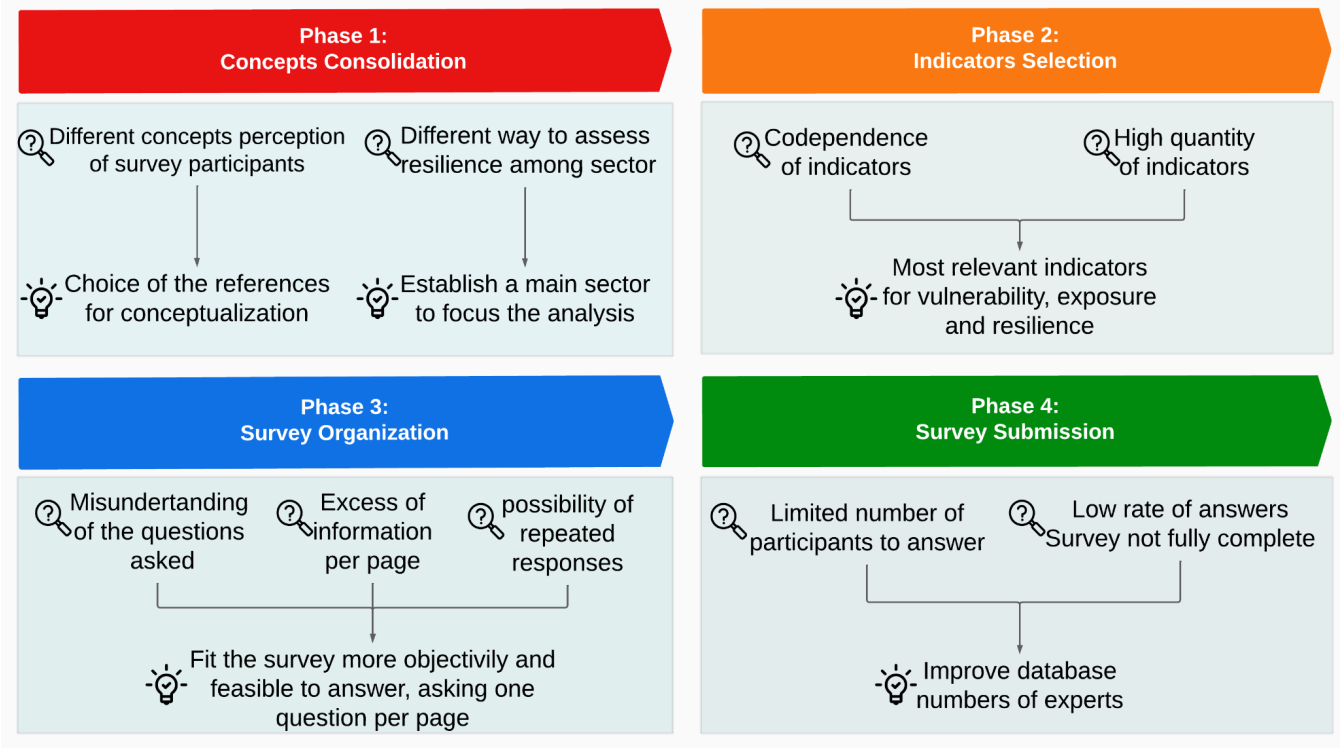
In their application, all approaches have advantages and disadvantages. The interview, for example, may be difficult to perform due to the geographical proximity to the desired sample group (Mukherjee et al., 2017). Another example of a challenge is that FGD discussions are dependent on participant engagement, giving researchers less control. Furthermore, the Q and NGT may encounter time restrictions, one because participant interpretation might be difficult and time-consuming, and the other because there may be insufficient time to reach a consensus.

We chose the Delphi technique because it is a tool that can gather and assimilate a set of experts' opinions across geographically diverse time zones on potentially complex matters. ~~We used it to create a sample of worldwide experts' opinions on the relevancy, understanding, accessibility, objectivity, and consistency of drought resilience indicators related to the food system. One of the main challenges of the Delphi technique is the low response rate, as well as the considerable planning and preparation time. In the next section, we discuss the main challenges we faced in this process~~Even though the reliance on expert opinions can pose obstacles to the use of the Delphi method in evaluating drought indices, this method has been applied to develop indices for desertification (Hai et al., 2016) and water supply (Crispim et al., 2022). Additionally, this methodology has been applied to global surveys (i.e., Rastandeh et al. (2018)); however, the process of conducting this research requires further discussion.

## 3 Challenges in the survey planning

The elaboration and consolidation process of the global survey was carried out in four main phases: ~~concepts consolidation~~conceptualization (concept consolidation), indicators selection, survey layout organization, and ~~survey submission (Figure 1). The~~ distribution/data collection (Figure 1). This section discusses the challenges encountered in each phase ~~are discussed in this section~~and how the research team addressed them using a collaborative approach. The total survey construction process, in ~~its 4~~ four phases, lasted 11 months, being the most time-consuming part of the research. Additionally, it was a crucial part since ~~depending~~ the quality

**Figure 1.** Phases of global survey elaboration and main steps




of the research outcomes depended on the questions and the engagement of the responders~~, the quality of the further steps of research is highly affected~~.

### 3.1 Phase 1: Concepts Consolidation

The first challenge was related to the consolidation of the concepts frequently associated with drought ~~risks~~resilience. We targeted experts from different fields, such as geophysics, engineering, economics, and social sciences~~that~~ , who work and live in different countries. Thus, ~~concepts such as droughts, disaster risk reduction~~the concepts used in the Sendai Framework, such as drought, DRR, resilience, vulnerability, ~~adaptation, and mitigation~~ and adaptation, can be analyzed and perceived differently among ~~the participants. Thus, since the experts have different backgrounds, it was important to define all the relevant concepts.~~ participants.

~~Phases of global survey elaboration and main steps~~

Initially, we ~~thought of asking the~~ planned to ask experts to classify the selected indicators ~~concerning~~ into vulnerability or resilience types, based on the component in which they had the ~~greatest~~ highest representation. However, due to the heterogeneity of ~~specialties~~expertise, backgrounds, and contexts, we realized that leaving the classifications open for a later consolidation would only propagate conceptual confusion, instead of solving it. ~~This challenge was perceived even in~~ These

conceptual divergences make it difficult to categorize indicators in the resilience components and may affect the perception of their relevance to the respondent. This task was difficult even for the research group itself, which ~~has people~~ included researchers from different backgrounds and countries. ~~Thus,~~ Therefore, we realized the importance of having a ~~well-defined~~ clearly defined a priori resilience model ~~was perceived, for the use of already consolidated concepts. In this sense, for this research, it was chosen~~ to reduce conceptual confusion. For this purpose, we decided to adopt the Sendai Framework ~~for Disaster Risk Reduction (UNDRR, 2015, 2022)~~(UNDRR, 2015), due to its ~~international importance in the formulation~~ global significance in the development of public policies.

~~The next step was the most difficult one, the selection of indicators to be evaluated by the experts.~~ As part of the DRR approach, it is important to first understand the evolution of disaster response and decision-making from an international perspective. Past discussions attempting to reduce the impacts of disasters had a focus on disaster management, which does not necessarily aim at averting or eliminating threats, but decreasing the negative impacts resulting from the event and recovering as fast as possible to the original (or better) state of the system (UNDRR, 2015). In recent years, there has been a shift from the approach of disaster management to disaster risk management. The latter is defined as "the application of disaster risk reduction policies and strategies to prevent new disaster risk, reduce existing disaster risk, and manage residual risk, contributing to the strengthening of resilience and reduction of disaster losses" (UNDRR, 2015), aiming at actions on different timescales and with a focus on increasing the economic, social, health and environmental resilience. This new approach to managing disasters has been incorporated in the Sendai Framework report (UNDRR, 2015), which presents the importance of pre-disaster actions, such as prevention, mitigation, development, and implementation of appropriate actions for preparing and effectively responding to disasters. To this end, it emphasizes the importance of risk assessment and dissemination of location-based information, to support risk-informed decision-making.

As previously mentioned, the goal of disaster risk management is to increase and strengthen resilience. The UNDRR (2015) defines resilience as "the ability of a system or community to anticipate, resist, prepare, respond to and recover from an event with multiple risks, with the least possible harm to social, economic, and environmental well-being". Several indices have been proposed over the years to represent the level of resilience of a given system to a disruptive event. In general, resilience assessment requires the identification of the risks in the system due to disruptive events and the adoption of risk management policies to prevent their occurrence or reduce their impacts along the system's chain.

Risk can be represented by a function that correlates the probability of the occurrence of the disruptive event (H), the vulnerability of the system's different components (V), and their exposure to risk (E), so that vulnerability and exposure represent the potential impacts on the system (Merz et al., 2014). Within the disaster risk management and risk-oriented decision-making approach, the risk analysis stage is of fundamental importance and a precursor to the decision-making process.

To evaluate the risk management stage, it is important to understand the type of the proposed action, its temporal component, and the magnitude of the impacts if the proposed action fails. According to these components, the actions can be correlated with the different system capacities that help reduce the disaster risk and further impacts, therefore, improving resilience, such as adaptive capacity, coping capacity, and transformative capacity.

### 3.2 Phase 2: Indicators selection

Droughts can have significant impacts on different economic and social sectors~~, however, the way to assess the~~ . However, assessing the drought resilience of each ~~of these sectors can differ. . We first thought of focusing~~ sector can be different. Initially, we focused on agriculture, but we realized that vulnerability and resilience to droughts can vary ~~a lot inside~~ significantly within this sector. ~~So~~Therefore, we prioritized the selection of indicators ~~of drought resilience and vulnerability related to medium and small farms. These farms respond to~~ related to small farms' drought resilience and vulnerability. Small farms produce a significant part of the world's food production ~~(Lowder et al., 2021) and~~ (Lowder et al., 2021), and they are more susceptible to climate change and ~~weather~~ extreme events than commercial farms ~~(Morton, 2007).~~ (Morton, 2007). We observed that prioritizing indicators specific to the resilience and vulnerability of small farmers to drought allows tailored insights and interventions to address their unique needs. However, such a specificity comes at the cost of broader applicability and requires more intensive data collection and analysis. These observations highlighted a trade-off between the effectiveness of the targeted application and the generalizability of a risk management index, which is overlooked in the literature.

The list of indicators to be evaluated in the global survey was ~~obtained from a compilation of indicators frequently used in the literature~~ compiled from a structured literature review. At the beginning of the process, we ~~compiled over~~ identified more than 136 indicators ~~. From this~~ that are frequently used in the literature (Supplementary Material 1). From our literature review, ~~it was noticed that there was already a consolidation of~~ we noticed that indicators related to ~~hazard, which can~~ the hazard component of the agricultural drought risk were already well established and could also be easily obtained from global open databases~~or even satellite information and geoprocessing. Therefore, we decided to reduce the survey on the exposure, vulnerability, and capacity indicators, since there is still a lot of context variation in terms of comprehension, data availability, and understanding, which still poses a challenge for constructing a global index for cross-country studies~~, or even remote sensing satellite data, through geoprocessing. For example, the Global Drought Observatory [1] already monitors hazard indicators globally. Therefore, our focus on this survey was to identify indicators related to risk impacts (vulnerability and exposure) and risk management actions to increase resilience (adaptive, coping, and transformative capacity).

There ~~are~~ is a myriad of indicators for evaluating drought and its impact on agriculture. ~~However, two~~ Two issues were raised from this ~~first~~ initial list: (1) There were too many codependent indicators (e.g., Gini index and poverty rate). Including the codependent indicators would affect the final index by unintentionally attributing a higher weight to this factor. (2) ~~The~~ Including all the 136 indicators, the survey would become too extensive and exhaustive~~to answer this number of indicators~~, which could affect the ~~number of respondents. To solve this, we defined two selection criteria to reduce the number of indicators . First, we evaluated if the indicators can be classified into the dimensions of risk of the Sendai Framework (vulnerability, capacity, and exposure of persons and assets). Then, we evaluated if the indicators are relevant in different local contexts, i.e., they should represent local risk and resilience. From a pre-selected~~ response rate.

To address the issues raised, the selection of the final list of indicators was made through three steps. The first step was to remove hazard indicators, as previously discussed. In this step, 31 indicators were removed. In the second step, we removed

[1] https://edo.jrc.ec.europa.eu/gdo/php/index.php?id=2000

the codependent indicators from the list, keeping those with greater availability and easy-to-access data. For example, from the Gini index and the poverty rate, we opted for the poverty rate, since it is a more direct measurement and easier to get in different contexts. This process of eliminating codependent indicators was made interactively in group discussion sessions with members of our research team. A total of 28 indicators were removed from consideration through this process. The third step was reducing the total number of indicators to avoid the survey from becoming too extensive and exhaustive to answer. From this part, each participant in the group independently ~~evaluated the indicators, discussed their ratings and justifications in group discussions, and finally, we had a group consensus on which indicators to include.~~ rated the relevance of the indicators, through a form available only to the group and based on the seven questions given by WMO and GWP (2016). From the answers, in a group discussion session, we selected the 33 indicators with the highest average rating.

In the next stage, we sought independent experts' opinions on the selected indicators and the overall structure of the survey. External experts recommended three additional indicators after the first pilot run of the survey. In the end, we had a list of 36 indicators (Table ~~1~~1).

Additionally, during our internal group discussion sessions, one of the concerns was that some indicators are very interesting and relevant, but they are not easy to obtain. In this sense, we identified important complementary questions on data quality that are usually not asked in surveys (where all the relevant data are assumed to be equally easy to obtain and understand). We asked experts to rate the indicators' metrics: relevancy, ease of understanding, accessibility, and objectivity (we included a definition of each at the beginning of the formulary).

The choice of these specific metrics came from Sweya et al. (2021). They presented 5 complementary attributes for social resilience indicators of the water supply systems (which are: affordability, availability, reliability, simplicity, and transparency). As a result, they have obtained that data availability, reliability, and affordability were the most limiting factors for selecting indicators in Tanzania. In this sense, and with a focus on the Global South, the group selected the three metrics before mentioned to be complementary to relevancy and adapted from Sweya et al. (2021), where understanding was used to represent simplicity, accessibility was used as a single attribute to account for affordability and availability, and objectivity was an additional attribute that we chose to evaluate how objective the final measure is (since some of our social indicators are political measurements and may be subjective).

~~III~~||

Table 1: List of indicators evaluated in the survey

| **Indicator** | **Description ~~Reference~~** |
|---|---|
| 1. Crop income dependence | Percentage of participation of crop and live<br>.production in the income of smallholder f |
| 2. Crop loss | Crop Damage & Sensitivity (Crop Loss) ~~(~~ |
| ~~(Antwi-Agyei et al., 2012),(Simelton et al., 2009),(Epule, 2021))~~3. Drought resistant crops | Cultivation of drought-resistant crops (%) |

Table 1: List of indicators evaluated in the survey (Continued)

| **Indicator** | **Description** ~~**Reference**~~ |
|---|---|
| 4. Crop varieties | Farmers use different crop varieties (%) ~~(M~~ |
| 5. Protected area | Area protected and designated for the conservation of biodiversity (%) ~~(Me~~ |
| 6. Use of agricultural inputs | Use of Insecticides and pesticides (Use of agricultural inputs) ~~(Meza e~~ |
| 7. WUE | Crop water use efficiency (WUE) ~~(Meza et~~ |
| 8. Land degradation | Degree of land degradation and desertifica |
| 9. Land rights | Land rights clearly defined (yes/no) ~~((Lind~~ |
| ~~(Leguízamo et al., 2020))~~10. Drought management policies | Existence of drought management policies |
| 11. Technical assistance | Technical assistance from local entities ~~(L~~ |
| 12. Drought insurance | Farmers with crop, livestock, or drought insurance (%) ~~(Meza et al.,~~ |
| 13. Water use rights | Water use rights are clearly defined ~~(Kamp~~ |
| 14. Prediction system | Availability of drought prediction and warn systems or climatic predictions |
| ~~(Xu et al., 2021),(Leguízamo et al., 2020))~~15. Transportation network | Transportation network ~~(Simelton et al., 20~~ |
| 16. Electricity | Access to electricity (Access to energy) ~~(M~~ |
| 17. Conflict | Prevalence of conflict/insecurity ~~(Meza et~~ |
| 18. Sanitation condition | Population without access to (improved) sanitation (%) ~~(~~ |
| 19. Gender inequality | Gender inequality (categorical) ~~(Meza et a~~ |
| 20. Rural population | Rural population (% of the total population |
| 21. Unemployment | Unemployment rate (and/or proportion of formal work) ~~(Meza et al., 2~~ |
| 22. Working-age population | Population ages 15-64 (% of the total popu |

Table 1: List of indicators evaluated in the survey (Continued)

| Indicator | Description ~~Reference~~ |
|---|---|
| 23. Displaced population | Percentage of the population displaced internally or transboundary ~~(M~~ |
| 24. Drivers of migration | Presence of drivers of migration and displa |
| 25. Poverty | Poverty Rate ~~(Epule, 2021)~~ |
| 26. Food source reliability | Food source reliability and diversity ~~(Luet~~ |
| 27. Participation in local policy | Public participation in local policy ~~(Meza~~ |
| 28. Cooperatives or associations | Participation in farming cooperatives or as |
| 29. Employment in small farms | % of the population employed in small far |
| ~~(Kampragou et al., 2015))~~30. Financing and credit | Access to financing and credit ~~(Leguízame~~ |
| 31. Water stress | Baseline water stress (ratio of withdrawals to renewable supply) ~~(Meza e~~ |
| 32. Water quality | Water quality (categorical) ~~(Meza et al., 20~~ |
| 33. Groundwater level | Groundwater level/sources ~~((Kampragou e~~ |
| ~~(Wu et al., 2013),(Alonso et al., 2019),(Murthy et al., 2015))~~34. Integrated policies | Integrated land and water management pol |
| 35. Retained renewable water | Percentage of retained renewable water ~~(M~~ |
| 36. Dam capacity | Total dam capacity ~~(Meza et al., 2019)~~ |

* The reference to each indicator is provided in Supplementary Material 1

### 3.3 Phase 3: Survey Organization

Another challenge was ~~in the way of~~ presenting the indicators ~~to be answered. The layout of the survey was a theme of discussion, aiming at establishing the best way of~~ and relevant information effectively during the survey to make viewing, understanding, and comparing ~~them. We wanted the experts to rate the attributes: relevancy, ease of understanding, accessibility, objectivity, and consistency of the indicators (we included a definition of each one at the beginning of the formulary). As a group, we tested alternative layouts, but we also asked a~~ the indicators as straightforward as possible. The survey design was made based on guidelines for operationalizing the Delphi method (Hasson et al., 2000) and the suggestions made by Elangovan and Sundaravel (2021). The last provided a template to validate the survey instrument. However, they present a generic form of document, in which we still experienced difficulties related to the resilience field study. Therefore, we have

improved our survey design based on the evaluation of different literature that used the Delphi method to access resilience indicators (e.g., Alshehri et al. (2015); Ogah et al. (2021)).

Over a year, our team worked on constructing a survey. During the process, we tested different designs within the group. We created several prototype surveys that varied in terms of question layout, types of questions (such as Likert scales versus ranking), number of scales, and how the definition of concepts was presented. To evaluate each prototype, the research team members considered the ease of understanding, cognitive load, and the time required to complete the survey. These survey prototypes were modified and combined based on the user experience. After the first consolidation of the survey design to be used, a pilot test was done with a small external group of experts ~~for their opinion on which survey format to choose. We asked them to take the survey in different formats and give us feedback, which was incorporated into the final survey . In the selected layout~~who were asked for their opinions on the final design and indicators. We used the same process to design the second stage of the survey, according to the Delphi method, which was more difficult because the results of the first stage of the survey were expected to be provided to the respondents.

In the final selected design, each page of the survey refers to one specific attribute, and rates of importance should be given to each indicator. This format was chosen because it allows a comparison between the indicators when answering, reducing the possibility of repeated responses for all indicators, and allowing a hierarchy between them and greater fluidity in conducting the survey.

Each indicator could be rated on a three-point scale: “Low”, “Medium”, and “High”. The definition of this point scale changes ~~based on how the question is formulated in the survey. For example, when evaluating the relevancy of an indicator, “Low” means that the indicator is irrelevant to the information needs of decision-makers; “Medium” means that the indicator is moderately relevant to the information needs of decision-makers. ; and “High”, meaning that the indicator is highly relevant to the information needs of decision-makers.~~ according to the metric that is being evaluated. The category “Don’t know” was included ~~as a possibility of response~~to filter pseudo-opinions. On the last page of the survey, we asked for some demographic information, like area of expertise, years of experience, region of analysis, etc. The final format of the survey (Supplementary Material 2) was consolidated after all members of the group and ~~a small external group of experts~~ the piloting phase group answered the survey and did not make any new inputs and suggestions. ~~The final format~~ For the second stage of the survey~~is presented in the Supplementary Material~~, the same format was used, but we included the percentage of responders at each level of the scale, for each indicator and each metric.

### 3.4 Phase 4: Survey Distribution/Data Collection

The last challenge was defining the experts to whom the survey should be sent. As the purpose was to obtain the ~~opinion of people~~ opinions of experts from different backgrounds and socio-economic contexts, a list of experts was ~~made~~ created from recently published papers on droughts in the Web of Science and Scopus databases. The members of the group also shared the survey in their networks.

~~Due to the greater number~~ As a result of the disproportionate amount of research conducted in countries and regions ~~of~~ in the Global North ~~, due to the economic bias of science, the use of scientific databases to list the names and contacts of experts~~

reproduces this bias , so this must be addressed and equalized. before sending the surveydue to economic factors, scientific databases have a bias toward the Global North. Therefore, after this initial gatheringit is important to address and remedy this issue in the recruitment process. After this initial data collection, a distribution analysis was carried out about continents and countries to assess whether there was a need to complement any specific region. Despite the attempt

Despite the attempts to assemble the greatest diversity of experts' background on drought risk and backgrounds on drought resilience analysis, the study had a limitation in relation to about a large concentration of responses coming from academic experts (approximately 80%). This was due to the difficulty in listing the names accessing the information of other practitioners and stakeholders, since there is no unified database, as is the case with Scopus and Web of Science for researchers. For future surveys, we recommend trying to reach out to existing policy networks around drought to reach other types of stakeholders.

The survey has been approved by the Institutional Review Board (IRB) of Penn State University for Human Subjects Protection (IRB # STUDY00021208 ) and an agreement term a consent form was provided for all the participants before starting the survey. We customized the research consent form to align with the legal and ethical standards of the participant's country as much as possible. For example, the survey presented a different consent form that accurately reflects the customized considerations of the European Union. After the survey concluded, we saw that 326 experts from 46 countries started answering and 120 finished it. The presentation and the analysis of the data obtained from the survey will be the subject of a scientific paper (?). and their a posteriori analysis are presented in Sass et al.. For the second stage of the survey, we obtained 32 respondents from 21 countries.

## 4 Lessons learned and suggestions for further surveys

Constructing global surveys to classify indicators that allow comparison between contexts is a major challenge, as the concepts related to risk components, especially vulnerability and adaptation, have significant variations between regions. This variation can be attributed to the different impacts suffered by populations according to the social, economic and cultural characteristics of each location. In this sense, in this research a

## 4 Lessons Learned and Recommendations

In this study, great effort was made on to understand how to equalize regional issues in the identification of indicators from during the construction of a global survey for the construction of aiming at identifying indicators to compose a global index to evaluate resilience to agricultural droughts , focusing on the context medium and small farms .

In papers in the context of small farms for food production. In articles on surveys and experts' expert elicitation, the challenges encountered a priori in the application of the method (e.g. construction of questions and engagement of participants in the process) are not explained and or discussed, despite being a great challenge and crucial for the quality of the data obtainedand the later stages of the research. Most of the challenges presented are related to a posteriori analysis, as presented

~~in section 2. Here we~~ . In this paper, we summarize our processes of designing such a survey, highlight the main ~~ones and~~ challenges, and present suggestions to work around them:

(1) ~~Different~~ There are different concepts related to ~~the components of risk and~~ resilience, especially ~~about~~ vulnerability and adaptation, which can be very ~~context dependent.~~ context-dependent.

To deal with this challenge in the construction of a global indicator, we suggest choosing an internationally relevant and well-consolidated resilience framework (in this case, ~~we chose~~ the Sendai Framework ~~,~~ due to its relevance in public policies), rigidly adopting the presented settings. ~~Moreover, to equalize the importance of the indicators due to the different~~ Additionally, to account for differences in local contexts, in addition to the relevance of each indicator, ~~complementary attributes were listed~~we utilized complementary attributes, such as ease of understanding, accessibility, objectivity, and temporal consistency.

(2) ~~Large number of indicators present~~ There are many indicators in the literature. Surveys containing all the indicators become tiresome to answer, decreasing ~~the engagementin the total of complete answers and the consistency~~ engagement, response rate, and quality of the answers obtained.

In our experience, ~~lists with~~ including more than 40 indicators already significantly ~~reduce~~ reduced engagement and consistency in responses. ~~Thus~~Therefore, the choice of the final and reduced list of indicators should be based on the ~~final~~ objective of the research, and the system evaluated, with only the priority ~~ones being~~ indicators chosen for representativeness in different local contexts of risks.

(3) ~~Identify better formats that clarify in~~ It is important to identify the best survey design that clarifies questions and definitions ~~,~~ to reduce misunderstanding and divergent answers ~~. Before the open it~~ across different contexts (expertise and region-wise).

Before making the survey available to the general public and experts, ~~the survey must be validated by an external and~~ it was essential to study its face validity and conceptual validity by our internal research team and externally by a smaller group of experts ~~, to reduce poorly prepared questions and poorly defined concepts .~~ during a pilot phase. Face validation refers to whether participants can interpret the survey items according to their intended meaning. The conceptual validity ensures that the survey items accurately represent the theoretical concept that they are intended to represent. These validation processes will help identify and correct poorly prepared items and ill-defined concepts to ensure the quality of the survey responses. Providing the conceptual definitions of the scales can improve the face validity of surveys.

(4) ~~Clean and fluidsurvey format~~ The survey design must be clean and fluid.

The engagement of respondents from the beginning to the end of the survey is of great importance to maintain consistent results for all questions. Therefore, the format of the applied survey is important. The survey should allow quick and explicit comparison between the main components evaluated (in our case the indicators) and questions about different attributes should be separated into different sections. ~~Response~~ The response time should preferably not exceed 15 min.

(5) ~~Difficulty in listing~~ It can be difficult to list participants from different areas of knowledge, professional experience, and regions/countries. The small number of respondents for each area affects the significance of the ~~analyzes~~ analysis a posteriori.

There is a lack of databases for practitioners and stakeholders other than academics, which makes it difficult to gather names of other actors usually involved in ~~the~~ decision-making ~~process~~processes. Suggestions to obtain a more diverse base

with more actors from the public and private sectors and international organizations include seeking alternative sources of contacts ~~,~~ and requesting the linkage of research in institutional communication to the agencies involved in dealing with ~~the risk of~~ disasters, especially droughts (e.g. IDMP, UNCCD, WMO, FAO). Moreover, even in academic databases, there is still a great bias for international research to be centered on countries of the Global North~~, so that the listing of names through these databases without prior treatment to ensure greater isonomy between regions can reproduce this bias in the results obtained by the survey~~. Since the countries of the Global South are generally the ones with the greatest difficulty in coping with the risks of droughts, studies of indicators cannot ~~fail to pay attention to such representativeness.~~

~~Lessons learned can be addressed from the own experience and sentiment of the survey itself, as well as from a global perspective around climate justice. On the one hand, by~~ ignore this representativeness. By sharing our experience in the process of ~~constructing~~ building a global survey, we expect to help other researchers by pointing out the main difficulties and presenting our solution.

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