Project LANDSURF

Users' interaction protocol to identify specific climate indicators and end-user needs for the development of a decision support system (DSS)

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Introduction

Providing tailor-made climate information to end-users and developing appropriate tools to clearly communicate this information are challenging and require the involvement of end-users in the development process from the beginning. In the project called "Land surface processes as a determinant of climate change in Africa – scenarios, high-resolution modeling and development of a stakeholder data portal (LANDSURF)", a decision support system (DSS) that delivers climate information relevant to priority sectors (mainly agriculture), is being designed and developed for and with end-users. The different actions carried out to involve end-users in this process are described in the following interaction protocol. This protocol can be used, with some modifications, for other projects where end-user participation is needed/desired. It also gives examples of online tools that have been used in this project, which were helpful in overcoming barriers posed by the COVID-19 pandemic.

Interaction protocol

To ensure end-user participation in a project and to identify end-user information needs that will make the DSS useful to end-users, a protocol consisting of nine actions was developed (Fig. 1). At the beginning of the process, the aims of the DSS must be defined (1.). This is followed by the selection of potential end-users who will use the DSS (2.) and the development of an online form to contact the end-users (3.). After distribution of the online form and an appropriate waiting period (e.g., two weeks), the received end-user contacts are analysed (4.). In action (5.), potential indicators that the DSS should provide are collected from the literature. The most challenging action is to plan

and conduct a virtual workshop to evaluate end-user needs (6.). After obtaining additional indicators and end-user needs during the workshop, both must be prioritised using a survey (7.). During the development of the DSS, it is worthwhile to keep in touch with the end-users by keeping them informed about the status of the DSS development (8.). Finally, the DSS should be validated by end-users and their suggestions for improvement should be incorporated into further development (9.).

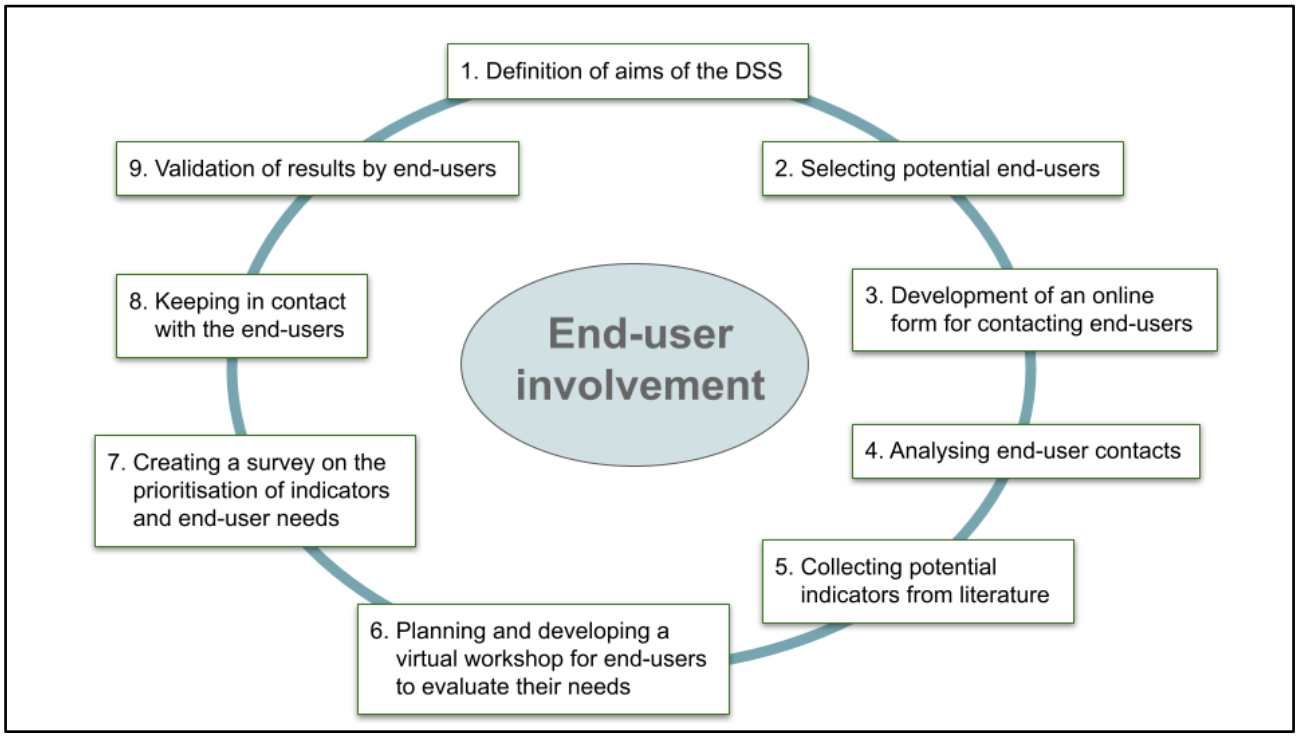

Fig. 1: Implementation process

Implementation of the LANDSURF-Protocol

1. **Definition of aims of the DSS**
   The very first action in this process is to define the purpose of the DSS. This requires answering the questions, what information should the DSS provide and what sectors should it support. Answering these questions then leads directly to action (2). Which end-users should use the DSS? In the LANDSURF project, the DSS will provide climate information, especially for the agricultural sector, to support the adaptation of this sector to climate change in West Africa.

2. **Selecting potential end-users**
   At this stage, the potential end-users of the DSS are identified by answering the following question: Who might be interested in climate information provided by the DSS? In the LANDSURF project, the DSS is focused on useful climate information to guide planning and decision-making mainly in agriculture, but also in food security, water management, and risk management sectors. Therefore, we have contacted governmental representatives, who are contact people for the National Adaptation Plans (NAP) to the United Nations Framework Convention on Climate Change (UNFCCC), National Meteorological Services, National Emergency Management Agencies, National Hydrological Agencies, Environment Protection

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Agencies, National Ministries of Environment and National Ministries of Agriculture, and universities in West Africa. These end-users can be classified as governmental and non-governmental organisations as well as universities. In addition, local farmers and communities as well as private companies should be considered although it is more difficult to make contact.

3. **Development of an online form for contacting end-users**
   After identifying the potential end-users of the DSS, a contact form was developed to collect all the necessary information about the end-users, e.g. contact person, institution/company, sector, existing climate knowledge, and first questions about their climate information/data needs. For reasons of efficiency, the questionnaire should be an online form that can be easily completed by end-users and facilitate the conduct of an end-user analysis. For this purpose, there are various tools (Tab. 1 lists the ones used in LANDSURF). Some of the online surveys already contain functions that analyse and visualise the survey results. When the contact form is distributed to the potential end-users by email, a brief project description should be included, explaining the aim of the project, the role of the end-users, and their benefits from participating.

   Special attention should be paid to local farmers and communities and how their specific needs can be captured. Especially in some rural areas, internet access may be limited. Therefore, it was originally planned to hold some workshops on-site, where local farmers and communities can participate and contribute regarding their needs. However, due to the uncertain COVID-19 pandemic situation, the first workshop was held in a virtual format (see action (6)). In order to learn about the information needs of local farmers and communities indirectly, we trusted that governmental organisations, academia, and non-governmental organisations, that are in close contact with local farmers and communities, would be able to share their information needs with us.

Table 1: Applied tools during the implementation process

Name	Purpose	Freely available
Google Forms	Collecting end-user contact information, conducting a survey on prioritisation of indicators	yes
Zoom	Conduct a virtual workshop	no (free version limited to 40 min)
Google Jamboard	Visualisation of the information needs of the end users	yes

4. **Analysing end-user contacts**
   Once a certain number of end-user contacts have been collected, the end-user contacts can be sorted by their location (country), the type of organisation, the sector they work in, their interests or expertise, and the language spoken (examples in Fig. 2,3). This information is important for communicating with end-users and/or developing end-user workshops.

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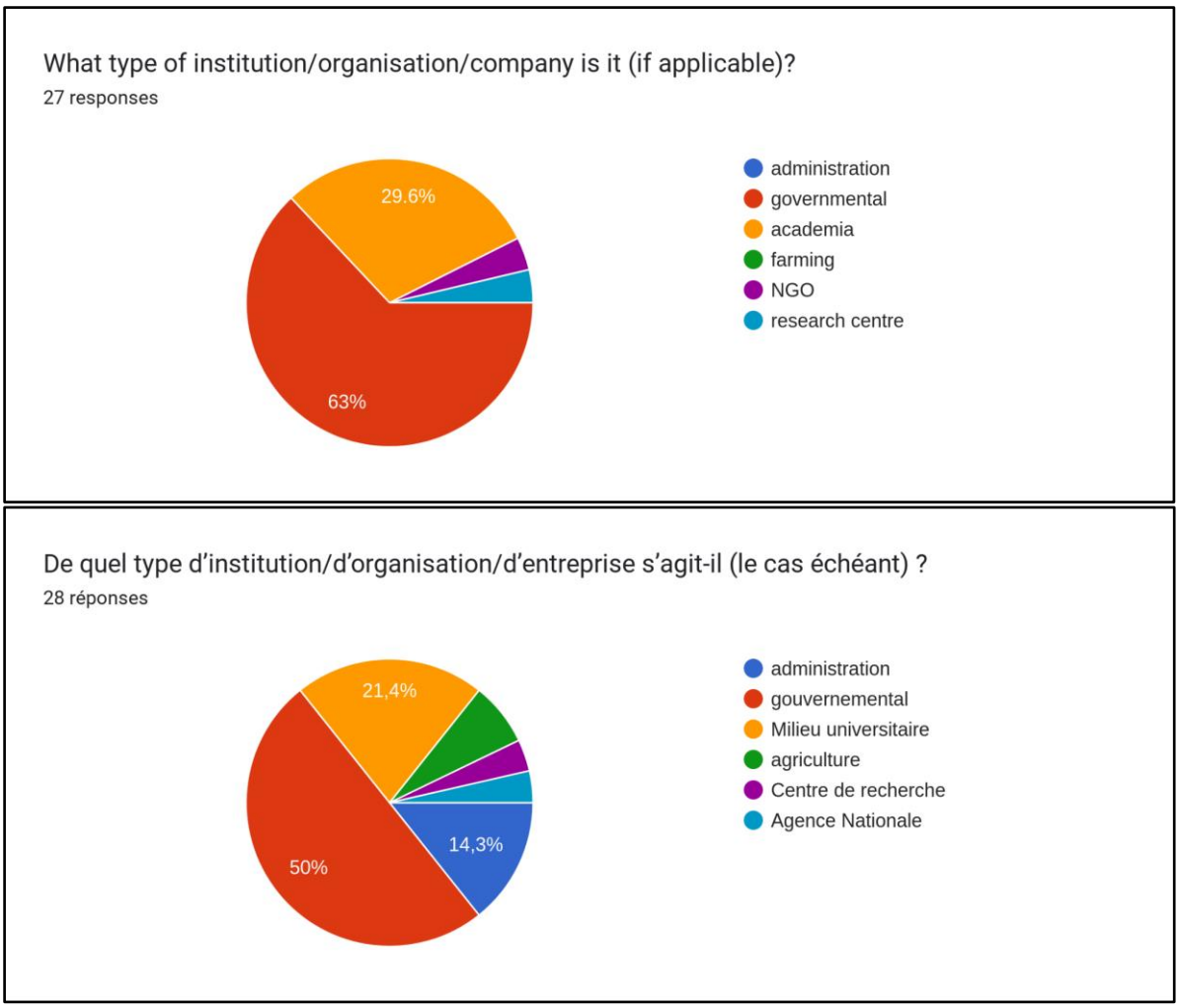
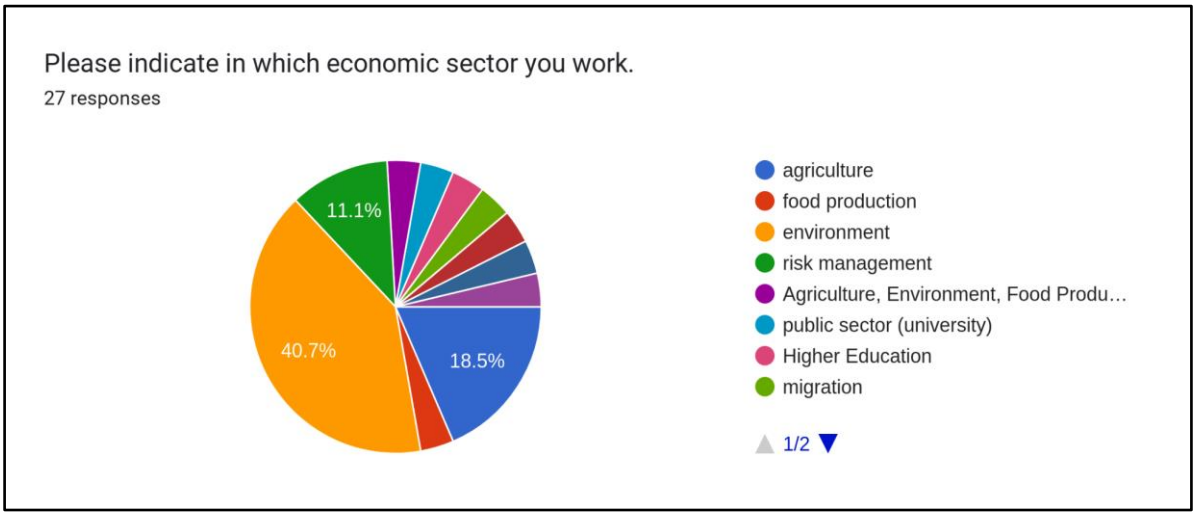


Fig. 2: Analysis of end-user contacts by organisation type, separated by spoken language



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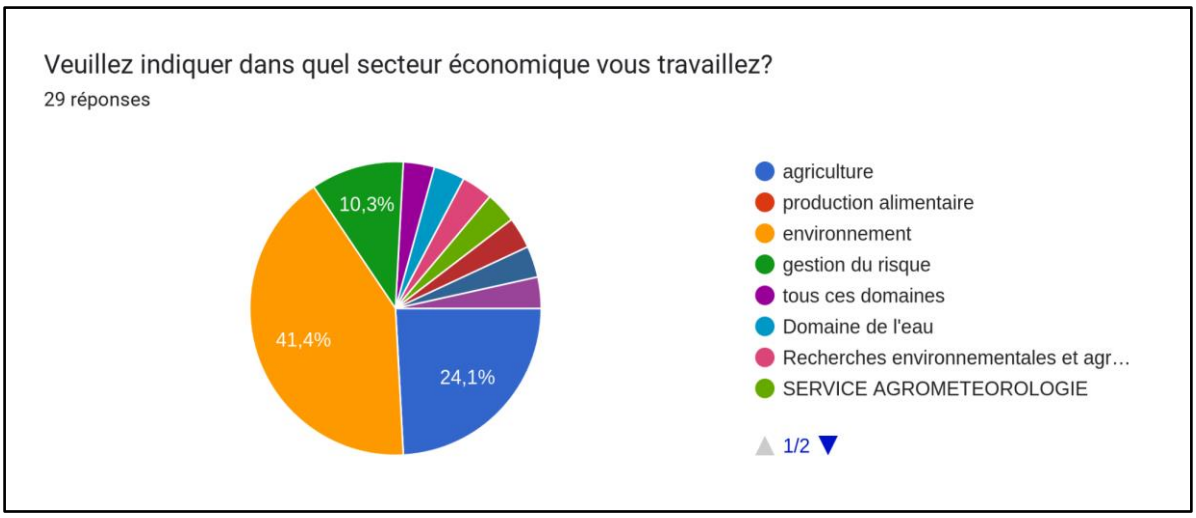

Fig. 3: Sectoral analysis of end-user contacts, separated by spoken language

5. Collecting potential indicators from literature

For the provision of tailored regional climate information to end-users, there are many different specific climate indices depending on the sector. Many end-users are active in various sectors and often have little or limited climate knowledge. Therefore, it is helpful to build up a database of different climate indices from existing literature before asking end-users for the climate information they need. A first pre-selection can be made by limiting the climate indices to the sectors in which the end-users are active or to which the DSS is aimed.

6. Planning and developing a virtual workshop for end-users to evaluate their needs

An important tool for end-user involvement is a joint workshop to identify their needs. Ideally, such a workshop should take place in different African countries, allowing for the participation of various and diverse end-users. However, due to the uncertain situation and the evolution of the COVID-19 situation in the different African WASCAL countries, it was decided to conduct a virtual workshop using the Zoom software. A virtual workshop has several advantages. It enables more end-users from different countries and more diverse backgrounds to participate without travelling. Additionally, virtual surveys can be conducted during the workshop. On the other hand, a virtual workshop may have the disadvantage of lacking face-to-face contact to get to know each other better and thus build trust between the scientists and the end-users.

The virtual workshop in the LANDSURF project had a duration of 4.5 hours (including breaks) and was structured as follows:

a) *Introduction of the project*
b) *Session on basic climate knowledge*
c) *Introduction of the DSS*
d) *Identification of indices*
e) *Concluding remarks and next steps*

At the beginning, the project and its objectives were introduced a) and basic climate knowledge was provided to bring all participants to the same level of knowledge b). This is crucial, otherwise some participants might not be able to follow the subsequent parts of the

workshop. Then the planned DSS was presented including the first examples of the DSS c). In the session where the climate indices were identified by the participants, some practical examples of the application of climate indices were shown d). A Google Jamboard was used to collect the information needs and indices from the end-users (Fig. 4). This tool enabled the active collaboration of the participants in the session and made it more interactive. At the end of the workshop, the main points of discussion were briefly summarised and the next steps of end-user participation were explained e). Finally, a detailed summary of the workshop, including the results, was distributed to all end-users by email a few weeks later.

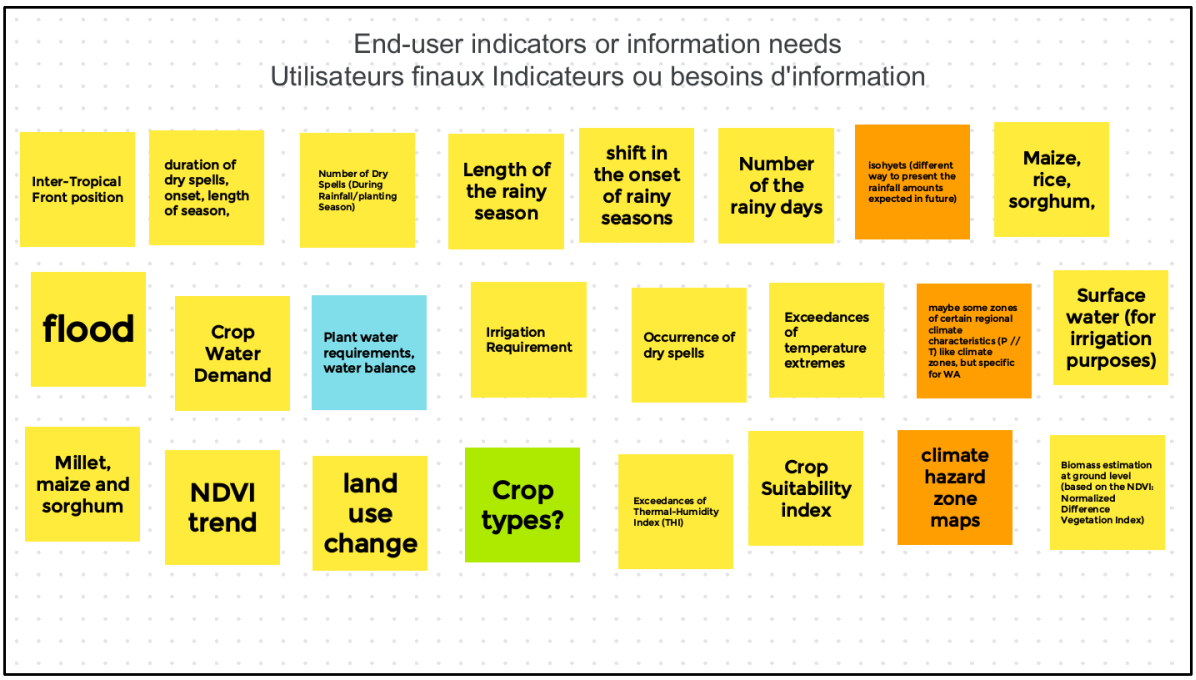

Fig. 4: Google Jamboard showing the end-users' contributions during the workshop

7. **Creating a survey on the prioritisation of indicators and end-user needs**

At this point, a prioritisation of climate indicators for the DSS was made, as the DSS has limited capacity and many different indicators have been collected from the literature and the end-user workshop. The climate indicators have been categorised into different groups such as rainfall, rainy season and drought indicators, temperature and extreme temperature indicators, irrigation and crop indicators, and miscellaneous indicators. This improves the readability of the survey and makes it possible to limit the number of choices by the end-users, e.g. if a category contains eight indicators, the end-user is asked to select four of the most important to them. Furthermore, a short definition of each of the climate indicators was included in the survey to facilitate the selection of indicators by the end-users. In addition to prioritising the indicators, the participants were also asked about the design and handling of the DSS and who would like to actively collaborate in the development of the DSS. The final survey was again created using Google Forms and distributed to the end-user contacts by email with a request to complete the survey within two weeks.

8. **Keeping in contact with the end-users**

End-user involvement is an ongoing process in the LANDSURF project. Therefore, it is helpful to keep in touch with the end-users. This can be done by providing news from the project or joint workshops that show the state of development of the DSS and get their input

on different stages of the project and their preliminary results. This ensures that the DSS is developed according to the needs of the end-users and increases the end-users' acceptance.

9. **Validation of results by end-users**
   A crucial element in the development process of climate service products is the evaluation by the end-users in order to be able to adapt the product if necessary. Therefore, as soon as the first intermediate results are available, they should be presented to and evaluated by the end-users. A typical format is an evaluation workshop, which can take place in person or virtually. During the workshop, end-users can provide verbal feedback on the usefulness of the results. Alternatively, a survey can be conducted among end-users, if appropriate.

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