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Report activities to establish co-design committee, stakeholder analysis

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Executive Summary

Flooding is a rapidly growing concern in West Africa, projected to increase with climate change. Therefore, there is a great need for reliable access to operational flood forecasts and alerts adapted to regional conditions and operated by capable West African institutions. This led to previous cooperation between FANFAR participants to identify user needs and co-developed technologies, and capacities aimed at meeting them. As a result, several ICT components of the desired system are already available and being used by key West African institutions. However, they have not yet been fully integrated or adapted to the conditions and needs in West Africa. Indeed, several factors are still limiting uptake.

The aim of the FANFAR project is to reinforce the cooperation between West African and European hydrologists, ICT experts, decision analysts, and end-user communities to provide a co-designed, co-adapted, integrated, and co-operated streamflow forecasting and alert pilot system for West Africa. For such an ambitious aim of close collaboration and partnership, the essential first step is to understand who plays which role, to understand the importance of each stakeholders' interests, the influence, or power that stakeholders hold, and how they are affected. For that purpose, we developed a participatory stakeholder analysis to better understand the interested parties. The gained insights allow to identify and select those who should be involved in the project, i.e. whom to include in the co-design committee and in co-design activities.

We carried out a thorough stakeholder analysis during the first FANFAR workshop in West Africa in Niamey, Niger (16-20.09.2018). The selection of the workshop participants was based on existing knowledge in FANFAR, and a preliminary stakeholder analysis carried out during the FANFAR kick-off-meeting, 17.-19.01.2018 in Norrköping, Sweden. In the workshop in Niamey, a systematic questionnaire survey was completed by 31 workshop participants. They listed a total of 249 stakeholders, which we first merged if they were very similar, and for which we then calculated summary statistics. This data cleaning process resulted in 68 stakeholder types, which we further analyzed. We grouped and filtered these according to their information profile (hydro-innovation stakeholders versus information end-users), decisional level, sector they belong to, and their perceived main interest. We then analyzed, the "importance" of considering their interests in the FANFAR co-design process, their "influence" (power) on a sustainable uptake of the ICT system, and how strongly "affected" every stakeholder would be by a well-functioning (or not well-functioning) forecast and flood alert system.

These analyses give a good overview of which interests and parties should potentially be included in the FANFAR co-design process. As a summary, the interests of the stakeholders that were perceived as being of "high" importance on these three dimensions were: "Resource planning" (31%), "economic service and operations planning" (25%), and "rescue aid" (18%; Figure 12). Mentioned by fewer stakeholders were other important interests, namely "technical", "civil society", "disaster management", and "environment". Nearly half of the stakeholders (46%) would use the FANFAR flood forecast and alert system for "alert information", 21% for "forecast refinement", and 16% for "water related information". Only few would use it for "meteorological data" (8%), and "forecast production" (4%).

The social science framework used during the co-design workshop in Niamey, also allowed us to build a list of entities that desire to continue their involvement in such a co-design committee. They come from 15 West African countries and already represent a wide range of different functions and interests (Table 3). The workshop also promoted the identification of further stakeholders and organizations that should be interested and willing to participate in future co-design activities (Table 4).

Finally, we were able to compile a list of the types of stakeholders that, even though they were not directly identified, could be considered as potential co-design collaborators (Table 5). This analysis was again based on a high rating in the survey on the three mentioned dimensions of considering their interests, or because they were perceived to have a high influence (power), or because they would be strongly affected (or any combination of the previous); and that were not yet identified in the above-mentioned lists (Tables 3-4). Since this is still a large list, for practicability reasons, it will not be possible to include all of these additional co-design stakeholders in the future FANFAR co-design activities. There are several ways to deal with this. Firstly, there are still some

overlaps within and among the tables. For instance, it might be possible to include one or two representatives from the agricultural sector, instead of several with different functions. The same goes for humanitarian aid organizations, and others. Secondly, it can be possible to invite some stakeholders for very specific activities only, rather than including them in the entire co-design process.

Interestingly, most additionally identified stakeholders (Table 5) are downstream stakeholders (a.k.a. information end-users), who are at the "receiving end" of the flood forecast and alert information chain. The stakeholder analysis thus illustrates that many of the important hydro-innovation stakeholders (i.e. those producing the information and the alerts) were already selected to participate in the FANFAR co-design committee. Regarding the downstream stakeholders, it is important for the co-design process in FANFAR to understand *how* (via which channels) they receive flood-related information, i.e. which distributions channels are effective in reaching them, and which are not effective. This information may be gathered, for instance, via country representatives that are already participating in the co-design committee, or by inviting some selected stakeholders to a specific FANFAR event. It would certainly not be necessary to invite all potential downstream stakeholders to all future FANFAR co-design workshops, where more-technical details of the ICT system are discussed and tested.

The results seem very promising. They allow us to acknowledge the already existing high commitment of stakeholders to participate in the FANFAR refinement process. This will ensure that the existing FANFAR ICT system will be fully integrated and adapted to West African conditions. This in turn is a necessary condition for a sustainable uptake of the FANFAR flood forecast and alert system.

1 Stakeholder analysis: Introduction

1.1 General introduction stakeholder analysis

The aim of FANFAR is to "reinforce the cooperation between West African and European hydrologists, ICT experts, decision analysts, and end-user communities to provide a co-designed, co-adapted, integrated, and co-operated streamflow forecasting and alert pilot system for West Africa" (FANFAR proposal, 2017, Abstract). To reach such an ambitious aim of close collaboration and partnership, the essential first step is to understand who plays which role in streamflow forecasts and alerts in West Africa.

One of the most widespread approaches to better understand the needs, activities, relationships, influence, interests, and goals of important parties in any participatory process is stakeholder analysis. Although popular, the definition and also methodology is actually rather unclear and somewhat disputed in academia. Important definitions are:

> *"Stakeholder analysis can be defined as a holistic approach or procedure for gaining an understanding of a system (…) by means of identifying the key actors or stakeholders and assessing their respective interests in the system" (Grimble and Wellard, 1997).*
>
> *"Stakeholder analysis aims to evaluate and understand stakeholders from the perspective of an organization, or to determine their relevance to a project or policy. In carrying out the analysis, questions are asked about the position, interest, influence, interrelations, networks and other characteristics of stakeholders, with reference to their past, present positions and future potential," (Brugha and Varvasovszky, 2000).*
>
> *"We define stakeholder analysis as a process that: i) defines aspects of a social and natural phenomenon affected by a decision or action; ii) identifies individuals, groups and organizations who are affected by or can affect those parts of the phenomenon (this may include nonhuman and non-living entities and future generations); and iii) prioritizes these individuals and groups for involvement in the decision-making process," (Reed et al., 2009).*

The main criticism of stakeholder analysis is that it is not rigorous enough from an academic point of view and often of rather poor analytic quality, and also that it is often done ad hoc (see e.g. Hermans and Thissen, 2009; Reed et al., 2009). Despite such criticism in the academic literature, we regard a relatively simple, but well-structured stakeholder analysis as an invaluable tool for better understanding those involved in any complex decision or project - and also for finding out who might be affected by a decision taken. In a project such as FANFAR, to ensure a sustainable rollout, it is absolutely essential to understand the needs and priorities of the West African stakeholders. We need to identify, who should be involved in the project; since for practical reasons it will never be possible that "everybody" participates in the workshops. The stakeholder analysis will help us to define whom to include in the co-design committee, i.e. who should be invited to join us in a cooperative working group during the course of the project.

In all our environmental decision projects at Eawag, a set of questions is developed and used as a starting point for a structured stakeholder analysis (Department of Environmental Social Sciences, Cluster Decision Analysis).[1] The method has been presented in detail in Lienert et al. (2013). We draw on this theoretical background and on our previous experience for the stakeholder analysis in the FANFAR project.

[1] https://www.eawag.ch/en/department/ess/main-focus/decision-analysis-da/

1.2 Purpose and aims of stakeholder analysis in FANFAR

The stakeholder analysis is part of the FANFAR work package 2 (WP2), with the overall objective:

> *"(…) to lead, prioritize and refine the technological adaptations, based on the needs and objectives of key hydro-innovation stakeholders and information end-users (both termed "users" in the following)"* (FANFAR proposal, 2017, page 55-56).

More specifically, the stakeholder analysis is part of WP2, Task 1:

> *"A co-design committee of key West African organizations and system developers will meet regularly with key end-users in workshops. We will co-design the system as an iterative process with several development cycles: define specific need → develop functionality → test and provide feedback → revise functionality, etc. This framework and the stepwise MCDA process (see section 1.3.6) shall ensure that the developed flood forecasting and alert system and its services meet the needs of users. WP2 is broken down into three tasks, designed to meet following objectives:*
>
> *Task 1 aims at (i) identifying key users, (ii) establishing a co-design committee of key West African organizations (co-developers and end-users), (iii) defining priorities and receiving feedback on systems with different functionalities, and at (iv) evaluating the overall performance of updated systems, based on technical performance and user preferences (...)"* (FANFAR proposal, 2017, page 56).

The first deliverable in WP2 is this report, D2.1: Report activities to establish co-design committee, stakeholder analysis (M10), (FANFAR proposal, 2017, p. 57).

1.3 Existing knowledge in FANFAR about hydro-innovation stakeholders and information end-users in West Africa

From the FANFAR proposal it becomes evident that already much is known about important stakeholders for flood forecasts and alerts in West Africa; thanks to the more than six years of cooperation between European and West African hydrologists, concerning the technical development of the ICT system.

Based on this background information, three key stakeholder groups were already defined in the FANFAR project proposal. It was foreseen that two stakeholder types participate in the co-design committee and workshops:

1. **Hydro-innovation stakeholders**, which are forecast producers, operating the hydrological forecasting and alert system; i.e. a person or organization practically involved in producing hydrological forecasts or setting up a hydrological forecasting system using state-of-the-art technologies, and
2. **information end-users**, which are persons or organizations utilizing the forecast and alert information for productive purposes in society (e.g. civil protection agencies, emergency response aid organizations, farming cooperatives, and reservoir managers), (FANFAR proposal, 2017, page 11). For better clarity, "information end-users" have been termed "**downstream stakeholders**" in the workshop.

The third stakeholder types are **financiers, regulators,** and similar. They play an important role in facilitating the full exploitation and sustainable uptake of the ICT system in West Africa. It is intended to hold targeted dialogues with potential financiers (FANFAR proposal, 2017, page 12). This third type of stakeholder is excluded from the current stakeholder analysis because activities toward this group have not yet been initiated. Our focus here is on the hydro-innovation stakeholders, and the downstream stakeholders.

Two key hydro-innovation stakeholders are included in FANFAR from the start as members of the consortium, namely:

> *"**AGRHYMET** is a hydro-innovation stakeholder, through its mandate to be the regional technical centre for agronomy, hydrology and meteorology and to provide early warning information on hydro-meteorological risks in West Africa. Moreover, AGRHYMET has the mandate to spread its*

knowledge for practical application to all its 13 national member states, and thereby diffuse innovations in the society.

***NIHSA** is a national hydro-innovation stakeholder in Nigeria, already operating some 20 automatic hydrometric stations and utilising models to forecast hydrological conditions" (FANFAR proposal, 2017, page 9).*

Another 15 organizations from 12 countries in the region had already expressed their willingness to take part in the project and have written a support letter (FANFAR proposal, 2017, Table I, pages 9-10). Their participation is key to ensure that the technologies developed by FANFAR will respond to their needs. Their participation will also facilitate practical applications of the project's results. These initial co-design committee and preliminary advisory board members can be grouped into the following types of stakeholders, representing different sectors and interests:

- Five national public agencies representing the sector: "Water resources, flood alerts, decision support" (Niger, Mali, Burkina Faso, Guinea, Senegal);
- Two multi-national river basin organizations, representing the sector: "River basin management; protecting people, food, reservoirs"; the two organizations are: Autorité du Bassin de la Volta (ABV) and Organisation pour la Mise en Valeur du fleuve Sénégal (OMVS); they represent 10 countries (Benin, Burkina Faso, Ivory Coast, Ghana, Mali, Togo, Senegal, Mauritania, Mali, Guinea)
- One international humanitarian NGO, representing: "Humanitarian aid, emergency preparation and response, agriculture"; namely the International Federation of the Red Cross and Red Crescent Societies (IFRC)
- Two national public agencies from Nigeria representing: "Emergency management/ protection, warnings and response";
- Two national public agencies from Mali representing: "Education, engineering", and: "Village protection, agricultural planning, navigation";
- One engineering society from Mali with 180 member companies representing: "Private engineering enterprises".

Additionally, two weather and climate related organizations were associated as members of the advisory board: World Meteorological Organisation (WMO)/ UN; West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL), (see Table I; FANFAR proposal, 2017). Table I is also given in the **Appendix A.2** of this report.

The mentioned entities entail a cascade of users and producers with, in general, different roles. **Figure 1** highlights the different types of stakeholders according to their reach (e.g. regional, national, and local) and their specific role.

Regional level	**National level**	**Local level**
• Use the H-TEP (production system) • Control flood forecasts every day • Design/Adapt the production system • Distribute customized info. • Evaluate and coordinate plans	• Use the forecasts and alerts • Produce river monitoring & alert levels • Design distribution channels (web, txt, FTP, bulletins, etc) • Quality control of forecasts & alerts • Communicate with local users	• Use the customized info. in flood management • Co-design distribution channels • Taking actions on the field!

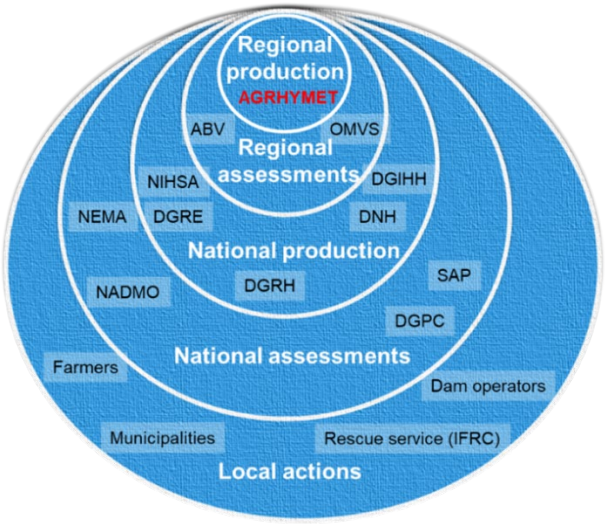

Figure 1. FANFAR cascade of users and producers (see list of acronyms in **Appendix A.1**).

The links between each type of stakeholder and the system *per se* is not so easily perceived. Therefore, in **Figure 2**, we present the data and information flow across the abovementioned entities.

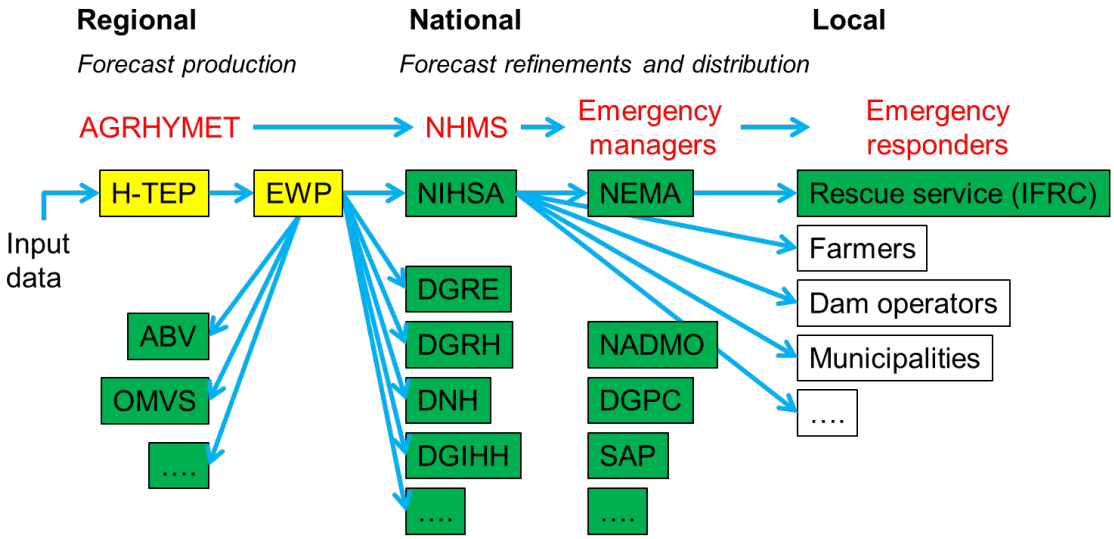

Figure 2. FANFAR data / information flow (roles of stakeholders).

1.4 Structure of the deliverable

The deliverable structure follows the conceptual nature of its purpose and aims (specified in Section 1.2). Two main aspects can be highlighted: one regarding the stakeholder analysis *per se*, and the second to introduce the co-design committee. On such grounds, this deliverable is split into 6 main sections.

After this comprehensive introduction, the methods used are described in section 2. Hereby, we highlight: 1) the details of a preliminary approach developed among the consortium partners during the FANFAR project kick-off-

meeting; 2) the participants of the FANFAR co-design workshop; 3) a "blueprint", or design, of the stakeholder analysis performed in the co-design workshop; 4) the co-design committee; and, 5) the classification attributed to the stakeholders covered by this analysis.

Section 3 highlights the results obtained outlining the stakeholders' interests and influence, as well as how affected they are.

Section 4 identifies the key stakeholders and the represented interests. This section ends with a critical evaluation regarding the sustainable uptake of the system (H-TEP) in West Africa.

The remaining sections provide a summary of the co-design committee results and draw some concluding remarks, respectively.

2 Stakeholder analysis: Methods

2.1 Preliminary stakeholder analysis among consortium members

A preliminary stakeholder analysis was carried out among the FANFAR consortium during the FANFAR kick-off-meeting, 17.-19. January 2018 in Norrköping, Sweden. Aim was to identify in a first attempt key West African (a) organizations, (b) end-users, and (c) system developers that should be included in the co-design committee.

To this end, a questionnaire was developed, consisting of three tables with the same questions, one for each stakeholder type (a, b, c). The participants of the kick-off meeting were assigned to small groups and were asked to answer the questionnaire together with a facilitator from Eawag. As an aid, the stakeholders from the FANFAR proposal (2017, Table I) were presented (see **Appendix A.2**). Following questions were asked (details are presented in **Appendix 0**):

1. "Stakeholder": *please list whoever comes to your mind. Who might play a role in FANFAR?*

2. "Specification": *be precise, please add organization, country, city, name of representative if known, etc.*

3. "Main interest": *shortly state his/ her presumed main interest in a flood forecast & alert system (why is system important to him / her? what his he / she specifically interested in?).*

4. "Importance": *rate on a scale of 0 – 10, how important this organization / person is for ensuring a sustainable uptake / use of the flood forecast & alert system.*

5. "Affected by": *rate on a scale of 0 – 10, how strongly this organization / person will be affected by a good or not so good flood forecast & alert system; i.e. positively affected if the system works well, negatively affected if it does not work well.*

6. "Co-design committee": *rate on a scale of 0 – 10, whether this stakeholder should be involved in the co-design committee. Reasons can be e.g. that he / she is very important as decision-maker, strongly influential, provides an important / different perspective, is strongly affected, etc.*

2.2 Participants FANFAR co-design workshop, Niamey, Niger, 16.-20.09.2018

Potential participants to be invited to the first co-design workshop in Niamey, Niger, 16.-20.09.2018, were compiled by the African partners, under the lead of AGRHYMET, together with SMHI. The West African stakeholders were then formally invited to participate in the workshop by AGRHYMET. Most, but not all of those invited were able to come to the workshop. The FANFAR consortium had decided to mainly focus on key hydro-innovation stakeholders in the first workshop, i.e. forecast producers, operating the hydrological forecasting and alert system. Additionally, important information end-users such as representatives from national civil protection or emergency response agencies were also invited.

In total, 26 external West African stakeholders participated in the workshop. Additionally, 10 people from AGRHYMET (located in Niger) and NIHSA (Nigeria) also participated, which with the remaining 11 participants from Eawag, IsardSAT, SMHI, and Terradue, make the total of 47 participants. They stem from 17 West African countries (including AGRHYMET and NISHA). For confidentiality reasons, we do not give personal details such as their names. A classification is a bit tricky, since some representatives of national organizations have multiple functions, while others have a more specific focus. Nevertheless, the stakeholder representatives can be summarized as follows:

- National hydrological services / water resource (water protection) agencies from 14 West African countries (Benin, Burkina Faso, Cape Verde, Ivory Coast, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Nigeria, Senegal, Sierra Leone, Tchad, Togo);
- National civil protection, emergency response and / or rescue agencies from 12 countries (Benin, Burkina Faso, Ivory Coast, Gambia, Guinea, Ghana, Guinea Bissau, Liberia, Mali, Niger, Togo, Senegal);
- National agricultural agency from one country (Mauritania);
- Two multi-national river basin organizations, Autorité du Bassin de la Volta (ABV), as well as Autorité du Bassin du Niger (ABN);
- Our host and project partner AGRHYMET, representing 13 national member states.

2.3 Stakeholder analysis; co-design workshop, Niamey, Niger, 16.-20.09.2018

On Thursday, 20.09.2018 the data for the stakeholder analysis were collected as pen & paper questionnaire from the workshop participants. First, we presented the aim of the stakeholder analysis, an overview of the method, and the type of results to be expected. The PowerPoint presentation also included detailed instructions, especially for the more difficult parts, such as the classification into categories with numbers (given in **Appendix A.4**). The workshop participants were then given the opportunity to ask questions. We clarified once again that any personal data would be anonymized and treated confidentially (the participants had given written informed consent regarding our confidentiality procedures at the beginning of the workshop).

We then asked the workshop participants to fill in the questionnaire in small groups, consisting of representatives from the same country. Most groups consisted of two people, some of three, and few people filled in the questionnaire on their own.

The questionnaire had been prepared in both languages of the workshop, i.e. in French and English. Filling in the questionnaire took about 2.5 hours, with a break in between. Some participants finished the questionnaire relatively fast; others would have required even more time. In these cases, we kindly asked them to fill in the most important data, but not the data concerning stakeholder details (e.g. names, Email address, etc.). We had asked for this information in case we would like to contact a new stakeholder; but could obviously also obtain this information from the participants after the workshop if needed. The two experts from Eawag continuously passed by the groups to answer questions and to check if everything was well understood.

The survey was individually completed by 18 groups, with a total of 31 participants of the workshop.

The workshop participants were kindly asked to fill in two tables, one to identify and better understand **key West African organizations** involved in the production and operation of the flood forecasts and early warning systems. The second table contained the same set of questions, but for the **downstream stakeholders** that might use flood forecasts and early warnings (i.e. Who might play a role because they use information from such systems in society?). In each table, they were asked to complete 8 tasks:

Task 1 [Task 9]. List organizations [downstream stakeholder] (Column A)

*First, we are interested in the **key West African organizations** [**downstream stakeholders**] that are involved in the production and operation of the [might use] flood forecasts and early warning systems. Who might play a role? Please list every stakeholder that comes to your mind in column A.*

Task 2 [Task 10]. Specify organizations [downstream stakeholder] (Column B)

Please add country, city, name of representative, Email (if known), and add any further information about the organization [downstream stakeholder] that could help us, in column B.

Task 3 [Task 11]. Main interest (Column C)

For each organization [downstream stakeholder], shortly state its presumed main interest in an operational flood forecasting and early warning system. Why is the system important to the organization [downstream stakeholder]? What is the organization [downstream stakeholder] specifically interested in? Put your answer for every stakeholder in column C.

Task 4 [Task 12]. Why use flood forecasting and early warning system (Column D)

Specify in column D why the organization [downstream stakeholder] uses (will use) the flood forecasting and early warning system, or why the organization [downstream stakeholder] does not (will not) use the system.

Task 5 [Task 13]. Distribution channels (Column E)

Specify in column E, which distribution channels are most suitable for each organization [downstream stakeholder]. Either because it already distributes / receives flood related information via this channel today. Or because it will preferably use this channel in future. If several channels are suitable, please list all. (Whatsapp, Facebook, Instagram, Twitter, SMS, Radio, Web visualization, Email, FTP site or others).

Task 6 [Task 14]. Importance of organizations' [downstream stakeholder] needs and interests (Column F)

How important is the organization [downstream stakeholder] to ensure an operational and useful flood forecasting and early warning system? Rate the importance of considering the needs and interests of all organizations on a scale from 0 to 10.

Read the information about the scale carefully, before answering.

Please indicate the importance of the organizations by writing the according number in column F.

Task 7 [Task 15]. Influence in the implementation (Column G)

Rate how much influence (power) each organization [downstream stakeholder] has in the implementation of an operational flood forecasting and early warning system. (... rest of text as column F)

Task 8 [Task 16]. Affected by the system (Column H)

Rate how strongly each organization [downstream stakeholder] will be affected by a flood forecasting and early warning system on a scale from 0 to 10. For this, consider how strongly a well-functioning or malfunctioning system would affect this stakeholder. (... rest of text as column F)

To better understand the rating system, the meaning of the numbers in words was projected as powerpoint slide at the front of the room during the entire survey (details see **Appendix A.4**).

2.4 Members of co-design committee; co-design workshop, Niamey, Niger, 16.-20.09.2018

A key objective of the FANFAR project is to involve key stakeholders in the design of the system. This co-design is primarily carried out through the project workshops. The workshop participants hence constitute the co-design committee (a.k.a. co-design working group) of the project. To better understand which stakeholders would like to participate in the future co-design. A slide was presented toward the end of the workshop to explain this concept and the workshop participants were asked to fill in the last question of the questionnaire if they had not already done so:

> **Task 17. Organizations / Stakeholders for co-design committee**
>
> *Which organization(s) or stakeholder(s) do you suggest to invite to the co-design committee, if any?"*
> *Please, consider all possible organizations and stakeholders, not only the ones present at this workshop.*

At the same time, a form was passed with all the participants' names on it, and they were asked to sign up in case they were willing to participate in the next co-design workshop, thus being part of the FANFAR co-design committee.

2.5 Classification of stakeholders and data analysis

In order to better understand the stakeholders, they need to be first identified, then classified. Our identification approach was a combination of stratified sampling, and snowball sampling (see e.g. Brugha and Varvasovszky, 2000; Reed et al., 2009). Stratified sampling was given by the fact that we had already pre-identified possible key stakeholders, and had invited representatives from many West African countries and different types of organizations with different mandates to the workshop. Snowball sampling means that we ask stakeholders about whom they think is important (or affected), and in case new stakeholders are prominently mentioned, we would again ask these for their view.

There are different possible approaches to classify stakeholders, e.g. top-down (a more analytical approach), or bottom-up (based on the stakeholders' inputs; Reed et al., 2009). A very fundamental division is: "(…) between those who affect (determine) a decision or action, and those affected by this decision or action", (Grimble and Wellard, 1997). We specifically asked for these foci in our questionnaire (see above). The rating scales we used, i.e. the numbers from 1 - 10 (see above), have been well tested by us in other projects (Lienert et al., 2013), and are more generally used and discussed in the literature (see e.g. Brugha and Varvasovszky, 2000; see textbooks concerning rating scales, e.g. Bortz and Döring, 2009). We entered all these data from the questionnaires into Excel®.

The participants of the workshops often used different names for the same type of stakeholders; and in such cases, we merged very similar ones. First, we grouped the stakeholders into the two fundamentally different groups described above that enjoy a different role in terms of their **information profile**, i.e. the hydro-innovation stakeholders and the information end-users, and analyzed these two data sets separately.

We then grouped the stakeholders into similar types, wherever this made sense. A classical typology is along the vertical axis (**decisional level**), starting at supranational (e.g. regional), over national, and local level; termed "Macro-Micro Continuum (Grimble and Wellard, 1997). Furthermore, we classified stakeholders along the horizontal axis (**sector**), i.e. assigning them to different fields or organizations (e.g. within the same country) with different functions and mandates. Furthermore, following Lienert et al. (2013), to characterize the stakeholders, we also assigned the **main interest** for each stakeholder in an operational flood forecasting and early warning system, those are sorted from the interests assigned by the respondents (**perceived interests**). As a last

classification, the reason **why** each stakeholder would **use the system** was also linked to each stakeholder. In **Table 1**, we highlight the typologies used, the rationale for them, as well as all the groups covered.

Table 1. Typologies, rationale, groups used and description (when required). SH = stakeholder.

Label	Description
Stakeholder	Aggregate very similar stakeholders
Main interest	The main interest of each stakeholder to use the system.
Economic service operations and planning	To improve the operations of that stakeholder's economic activity through preparedness concerns.
Technical capacity	To improve the stakeholder's output due to improved capacity in terms of data, information or modelling.
Environment	Protection of natural resources and ecosystems.
Resource planning	Strategic resources planning, decision support.
Disaster management	To improve the disaster response process and coordination.
Rescue and aid	To improve the outcome of rescue activities and required aid.
Civil society	Social interests, participation, cooperation, information, fulfill expectations of citizens, good reputation.
Why use system	To assess which parts of the system are wanted by each stakeholder, necessarily the proper distribution channels are a required feature.
Forecast production	To produce forecasts.
Forecast refinement	To refine the produced forecasts.
Meteorological data	To get meteorological data as precipitation.
Alert information	To get any type of alerts.
Water related information	To get water related information derived from the hydrological model as the water level, extent and river discharge.
Other	Has several of the previous with no clear distinction.
Information profile	Understand each SH importance regarding the information flow.
Hydro-innovation stakeholder	A person or organization practically involved in producing hydrological forecasts or setting up a hydrological forecasting system using state-of-the-art technologies.
Downstream stakeholder or Information end-user	Persons or organizations utilizing the forecast and alert information for productive purposes in society (e.g. civil protection agencies, emergency response aid organizations, farming cooperatives, and reservoir managers).
Decisional level	The coverage that each stakeholder has as a decision maker.
Supranational	Coverage surpasses national frontiers, even if the focus may be more narrow (e.g. national or local).
National	Coverage is national even with a narrower focus (e.g. local).
Local	Local coverage.
NA	Has several or unidentifiable.
Sector	The shareholder's field of activity.
Water resources	Hydrological services / water resources (water protection) agencies.
Water services	Water and sanitation services.
Civil protection	Civil protection, disaster management, emergency response and / or rescue agencies.
Agriculture	Agriculture, livestock and fisheries.
Energy	--
Research and education	Research, education and statistics.

Label	Description
Transportation	--
Humanitarian aid	--
Meteorology	--
Administration	--
Industry and Commerce	--
Development	--
Other	None or several of the previous.

In practice, similar (but usually simpler) sorting processes have been used across the literature. In a recent meta-survey about stakeholder participation in 21 environmental research projects in the UK (Phillipson et al., 2012), each project leader was asked to classify the participating stakeholders into the following categories: public, private, third sectors, and societal.

We used R to produce summary statistics (R Development Core Team, 2017). We calculated averages over all groups (and within groups) that mentioned the same stakeholder for the rating numbers in the questionnaire, i.e. the questions concerning the “importance”, “influence”, and being “affected” of every stakeholder. We calculated the total and the average number of times mentioned for the “main interest” (task 3; see above) of a stakeholder, and for “Why use flood forecasting and early warning system?” (task 4). We summarized these data over all groups, or within groups. These questions were not answered by all participants for time reasons.

From a total of 249 entries, we finally compiled 68 stakeholders, classified as shown in **Table 2**.

Table 2. Overview of the 68 stakeholders that were mentioned to play a role. In the header row, the columns relate to the specific questions asked (see Section 2.3); the task number is given in square brackets, e.g. task number 6 and 14, respectively: [6,14]. SH = stakeholder; Impt. = Importance of considering the SH's needs and interests; Infl. = Influence (power) in the implementation, Affect. = How strongly SH is affected by ICT system. The scale for Impt., Infl., and Affect. ranges from 0 - 10; we present the average. Count = total number of respondents that mentioned this SH in the survey.

Stakeholder	Main interest [3,11]	Why use system [4,12]	Information profile	Decisional level	Field	Impt. [6,14]	Infl. [7,15]	Affect. [8,16]	Count
ABN	Resource planning	Forecast refinement	Hydro-innovation	Supranational	Water resources	8,8	7,6	6,2	5
ABV	Resource planning	Forecast refinement	Hydro-innovation	Supranational	Water resources	9,3	7,7	9,3	6
ACF	Rescue and aid	Alert information	Downstream	Supranational	Humanitarian aid	6,0	6,0	5,0	2
ACMAD	Technical	Meteorological data	Hydro-innovation	Supranational	Meteorology	8,3	8,3	8,0	6
AGRHYMET	Technical	Forecast production	Hydro-innovation	Supranational	Water resources	9,8	9,1	8,7	10
ALG	Economic service operations and planning	Alert information	Downstream	Supranational	Agriculture	4,0	4,0	2,0	1
ARC	Economic service operations and planning	Alert information	Downstream	Supranational	Other	10,0	4,0	2,0	1
ASECNA	Economic service operations and planning	Meteorological data	Downstream	Supranational	Transportation	6,0	4,0	5,0	1
CBLT	Resource planning	Forecast refinement	Hydro-innovation	Supranational	Water resources	8,0	8,0	8,0	1
Community	Civil society	Alert information	Downstream	Local	Development	6,6	4,3	10,0	7
CRS	Rescue and aid	Alert information	Downstream	Supranational	Humanitarian aid	8,0	8,0	8,0	1
Dam Management Entity	Economic service operations and planning	Water related information	Downstream	National	Energy	8,2	7,6	8,4	5

Stakeholder	Main interest [3,11]	Why use system [4,12]	Information profile	Decisional level	Field	Impt. [6,14]	Infl. [7,15]	Affect. [8,16]	Count
ECOWAS	Economic service operations and planning	Other	Downstream	Supranational	Industry and Commerce	10,0	10,0	10,0	1
Educational Institution	Resource planning	Alert information	Hydro-innovation	National	Research and education	0,0	0,0	10,0	1
Electricity Utility	Economic service operations and planning	Water related information	Downstream	National	Energy	8,4	9,2	8,4	5
Environmental Research Institution	Environment	Other	Hydro-innovation	National	Research and education	5,5	5,0	8,0	3
EU	Resource planning	Other	Downstream	Supranational	Other	10,0	10,0	10,0	1
FEWSNET	Rescue and aid	Alert information	Downstream	Supranational	Humanitarian aid	8,0	8,0	8,0	1
Firestone	Economic service operations and planning	Water related information	Downstream	National	Agriculture	4,0	2,0	2,0	1
GWP/AO	Environment	Water related information	Hydro-innovation	Supranational	Water resources	4,0	4,0	2,0	1
Industry and Commerce Entities	Economic service operations and planning	Alert information	Downstream	Local	Industry and Commerce	6,0	6,0	3,0	3
IUCN	Environment	Water related information	Hydro-innovation	Supranational	Other	4,0	6,0	2,0	1
Local Administrative Entity	Civil society	Alert information	Downstream	Local	Administration	8,7	8,6	8,2	14
Local Association for Agriculture	Economic service operations and planning	Alert information	Downstream	Local	Agriculture	5,7	3,0	4,9	9
Local Entity for Civil Security Enforcement	Rescue and aid	Alert information	Downstream	Local	Civil protection	10,0	10,0	10,0	1

Stakeholder	Main interest [3,11]	Why use system [4,12]	Information profile	Decisional level	Field	Impt. [6,14]	Infl. [7,15]	Affect. [8,16]	Count
Local Entity for Development	Resource planning	Other	Downstream	Local	Development	6,0	4,0	3,5	2
Local Entity for Water Resources Planning	Resource planning	Forecast refinement	Hydro-innovation	Local	Water resources	4,3	3,8	7,3	4
Media	Civil society	Alert information	Downstream	NA	Other	10,0	6,0	2,0	2
Metal Steel	Economic service operations and planning	Meteorological data	Downstream	National	Industry and Commerce	4,0	2,0	2,0	1
MNG	Economic service operations and planning	Meteorological data	Downstream	National	Industry and Commerce	4,0	2,0	2,0	1
National Administrative Entitity	Civil society	Alert information	Downstream	National	Administration	7,2	8,0	5,8	5
National Agency for Disaster Management Planning	Disaster management	Alert information	Downstream	National	Civil protection	8,7	8,4	7,3	12
National Agency for Meteorology	Technical	Meteorological data	Hydro-innovation	National	Meteorology	10,0	9,2	6,7	7
National Agency for Water Resources	Resource planning	Forecast refinement	Hydro-innovation	National	Water resources	7,0	8,3	6,5	8
National Association for Agriculture	Economic service operations and planning	Alert information	Downstream	National	Agriculture	9,0	9,0	9,0	4
National Entity for Aerial Transportation	Economic service operations and planning	Meteorological data	Downstream	National	Transportation	10,0	10,0	0,0	1

Stakeholder	Main interest [3,11]	Why use system [4,12]	Information profile	Decisional level	Field	Impt. [6,14]	Infl. [7,15]	Affect. [8,16]	Count
National Entity for Agriculture Management	Economic service operations and planning	Water related information	Downstream	National	Agriculture	5,9	5,3	9,1	7
National Entity for Civil Security Enforcement	Rescue and aid	Alert information	Downstream	National	Civil protection	8,0	8,1	6,9	7
National Entity for Development	Resource planning	Alert information	Downstream	National	Development	6,0	9,0	2,0	2
National Entity for Energy Planning	Resource planning	Alert information	Downstream	National	Energy	10,0	10,0	10,0	1
National Entity for Transportation	Economic service operations and planning	Alert information	Downstream	National	Transportation	10,0	10,0	10,0	1
National Entity for Water Infrastructure	Resource planning	Water related information	Hydro-innovation	National	Water services	7,0	10,0	1,0	2
National Entity for Waterways Transport	Economic service operations and planning	Water related information	Downstream	National	Transportation	6,3	5,5	6,5	4
National Environment Protection Entity	Environment	Water related information	Hydro-innovation	National	Other	6,8	6,0	6,3	4
National Govern-mental Entity for Agriculture Planning	Economic service operations and planning	Alert information	Downstream	National	Agriculture	7,3	6,0	7,3	7
National Govern-mental Entity for Disaster	Disaster management	Alert information	Downstream	National	Civil protection	8,9	9,1	7,0	9

Stakeholder	Main interest [3,11]	Why use system [4,12]	Information profile	Decisional level	Field	Impt. [6,14]	Infl. [7,15]	Affect. [8,16]	Count
Management Planning									
National Governmental Entity for Meteorology	Technical	Meteorological data	Hydro-innovation	National	Meteorology	10,0	9,3	9,0	3
National Governmental Entity for Water Resources	Resource planning	Forecast refinement	Hydro-innovation	National	Water resources	9,6	9,4	8,5	14
National Governmental Entity for Water Services	Economic service operations and planning	Water related information	Downstream	National	Water services	7,3	9,3	6,3	3
National Health Service Entity	Rescue and aid	Alert information	Downstream	National	Other	0,0	0,0	10,0	1
National Humanitarian Aid Entity	Rescue and aid	Alert information	Downstream	National	Humanitarian aid	6,0	4,0	4,0	1
NGO	Rescue and aid	Alert information	Downstream	NA	Humanitarian aid	8,3	8,4	8,3	7
OCHA	Rescue and aid	Alert information	Downstream	Supranational	Humanitarian aid	8,0	9,0	8,0	2
OMVG	Resource planning	Forecast refinement	Hydro-innovation	Supranational	Water resources	8,0	8,0	9,3	4
OMVS	Resource planning	Forecast refinement	Hydro-innovation	Supranational	Water resources	7,4	7,4	8,8	5
OXFAM	Rescue and aid	Alert information	Downstream	Supranational	Humanitarian aid	6,0	6,0	5,0	2
PAM	Rescue and aid	Alert information	Downstream	Supranational	Humanitarian aid	8,0	8,0	8,0	1

Stakeholder	Main interest [3,11]	Why use system [4,12]	Information profile	Decisional level	Field	Impt. [6,14]	Infl. [7,15]	Affect. [8,16]	Count
Red Cross	Rescue and aid	Alert information	Downstream	Supranational	Humanitarian aid	7,5	6,5	5,4	8
Regional Dam Management Entity	Economic service operations and planning	Water related information	Downstream	Supranational	Energy	10,0	10,0	10,0	2
Regional Entity for Development	Resource planning	Alert information	Downstream	Supranational	Development	4,0	10,0	2,0	1
Research Institution	Economic service operations and planning	Other	Hydro-innovation	National	Research and education	5,5	4,5	7,0	2
Statistics Institution	Technical	Other	Downstream	National	Research and education	7,0	6,0	7,0	3
TOR	Economic service operations and planning	Meteorological data	Downstream	National	Energy	4,0	0,0	0,0	1
Tullow	Economic service operations and planning	Meteorological data	Downstream	Supranational	Energy	4,0	0,0	0,0	1
UN	Resource planning	Other	Downstream	Supranational	Other	10,0	10,0	10,0	1
WASCAL	Environment	Alert information	Hydro-innovation	Supranational	Research and education	4,0	4,0	2,0	1
Water Resources Development Programs	Resource planning	Water related information	Downstream	National	Water resources	4,0	8,5	3,0	3
Water Utility	Economic service operations and planning	Water related information	Downstream	National	Water services	8,5	8,3	8,8	4

3 Stakeholder analysis: Results

3.1 Preliminary stakeholder analysis among consortium members

A summary of the results of the preliminary stakeholder analysis among the FANFAR consortium members at the kick-off-meeting, 17.-19. January 2018 in Norrköping, Sweden is given in **Figure 3**. The main aim was a first attempt to identify key (a) West African organizations, (b) end-users, and (c) system developers that should be included in the co-design committee. Overall, 28 stakeholders were mentioned. Those stakeholders that are both very strongly affected by and very important for a FANFAR forecast and alert system can be found in the top-right corner of **Figure 3**. These include e.g., AGRHYMET, NIHSA, DNH Guinea, DNH Mali, among others. We will not further analyze or discuss these preliminary results, since they are somewhat biased (having been produced by the FANFAR consortium members themselves), and were only meant to provide some indications of whom to invite to the first FANFAR co-design workshop in West Africa in Niamey, Niger, 16.-20.09.2018. In the rest of this report, we rely on the results stemming from the stakeholder analysis drawn from the co-design workshop in Niamey, which are presented below (starting from section 3.2).

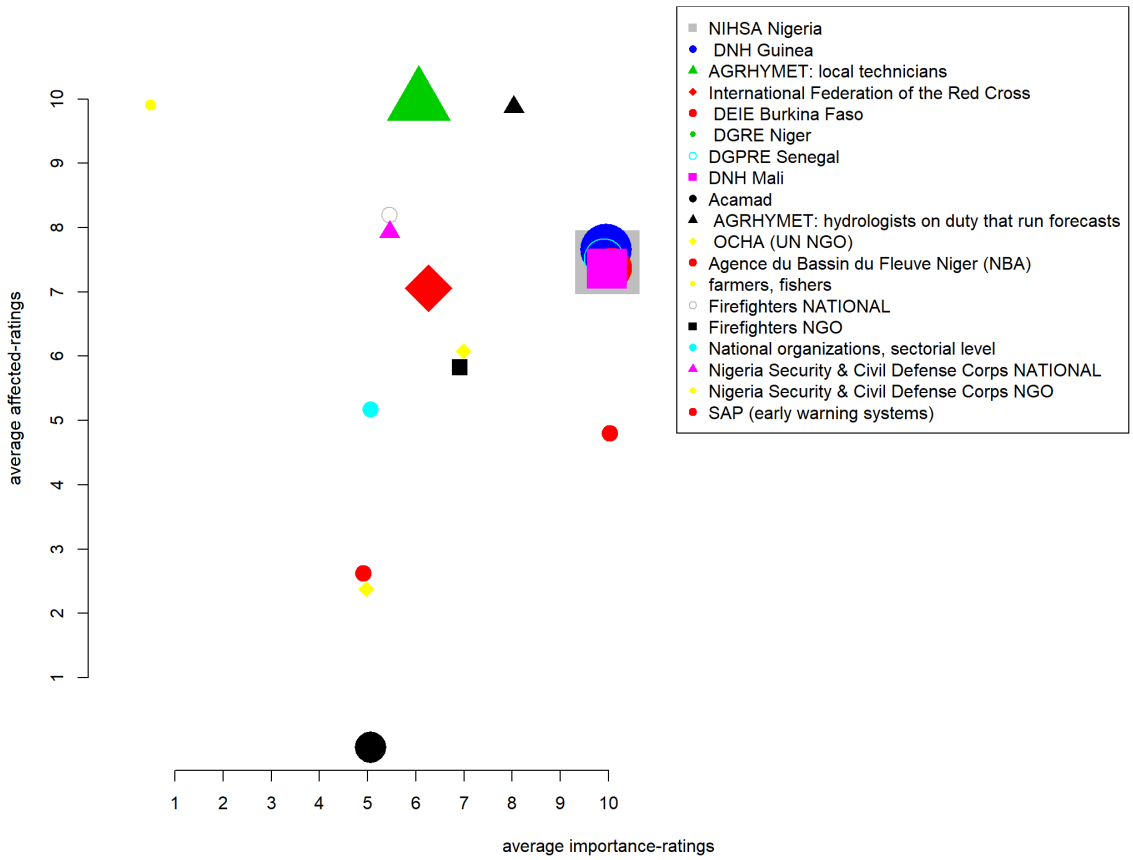

Figure 3. Preliminary stakeholder analysis among members of FANFAR consortium.

Note: x-axis: How important is this organization / person for ensuring a sustainable uptake / use of the flood forecast & alert system? y-axis: how strongly is / will this organization / person be affected by a good or not so good flood forecast & alert system? The rating ranges from 0 (no importance / not affected) to 10 (extremely

important / extremely affected). The size of the symbols indicates how often a stakeholder was mentioned by the consortium members (the larger the symbol, the more people mentioned this stakeholder). Note: The same ratings were given for many stakeholders. Therefore, the plot is jittered and not all mentioned stakeholders appear in the legend.

3.2 Main interests and their importance

The main drivers that stakeholders follow, or the interests they bear, is a key characteristic to understand their possible role in the FANFAR project as potential members of the co-design working group. Therefore, we assigned the perceived interests of each stakeholder with shared features to one of the main categories: 1) Civil society; 2) Disaster management; 3) Economic service operations and planning; 4) Environment; 5) Rescue and aid; 6) Resource planning; and 7) Technical capacity (explanations see **Table 1**).

In terms of main categories representation, the distribution of interests in the sample and how important they are perceived by the participants allow to frame the general picture (**Figure 4**, based on Task 3 (and 11) in Section 2.3).

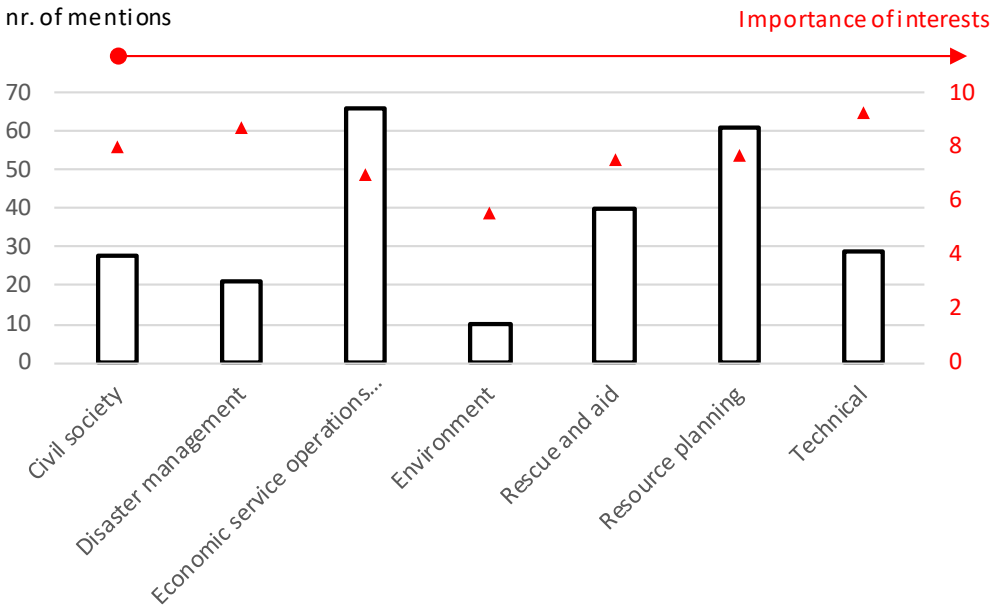

Figure 4. Number of mentions of each main interest (black bars) and the average importance given (orange triangle) by the survey respondents.

As illustrated, all the main interests, except the ”environmental” one, have an average importance equal to or higher than 7. This means that the respondents answering our survey perceived it to be between ”rather important” (= rating 6) and ”very important” (= rating 8) to include the respective main interest in order to ensure a sustainable uptake and use of the flood forecast and alert system. In other words, it is important to include organizations and stakeholders representing these interests in the FANFAR project. Regarding representation, all the main interests are significantly represented across the stakeholders by being mentioned from 10 to more than 60 times, even if the ”environment” interest was only mentioned 10 times.

A closely related topic is the reason why each stakeholder would use the system (task 4 and 12 in Section 2.3). The stakeholders were grouped in **Figure 5** according to: 1) Alert information; 2) Forecast production; 3) Forecast

refinement; 4) Meteorological data; 5) Water related information; or 6) Other (**Table 1**). In brief, besides ”forecast production”, which is (in theory) the main reason for AGRHYMET to use the system, and the ”Other” classification, all the remaining reasons are significantly represented. Notably, nearly half of the survey respondents (47%) mentioned ”Alert information” as a main reason for using the system.

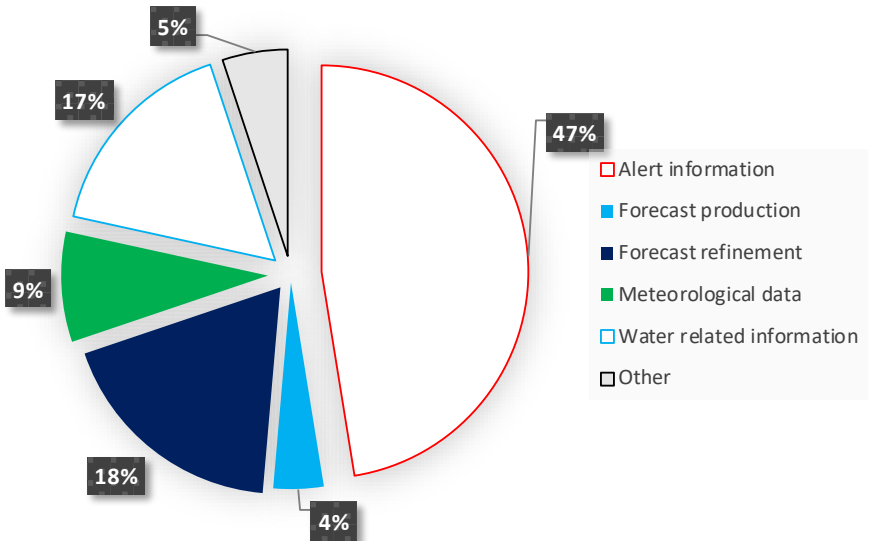

Figure 5. Main reason why the downstream organizations or stakeholders would use the flood forecasting and alert system as developed by FANFAR; based on the answers of the survey participants.

3.3 Influential and affected actors

After the assessment of the stakeholders’ main interests, there is a requirement to gauge their influence, or the power each stakeholder holds to reach the desired outcome (task 7 and 15; Section 2.3). It is also important to understand, how strongly each organization or downstream stakeholder will be affected by such a system (task 8 and 16). The desired outcome would be in this case the implementation and a sustainable uptake of an operational flood forecasting and alert system in West Africa. Therefore, we plotted the perceived influence (power) of stakeholders to contribute to such an end, against how much they are likely to be affected by a well-functioning or malfunctioning system (**Figure 6**).

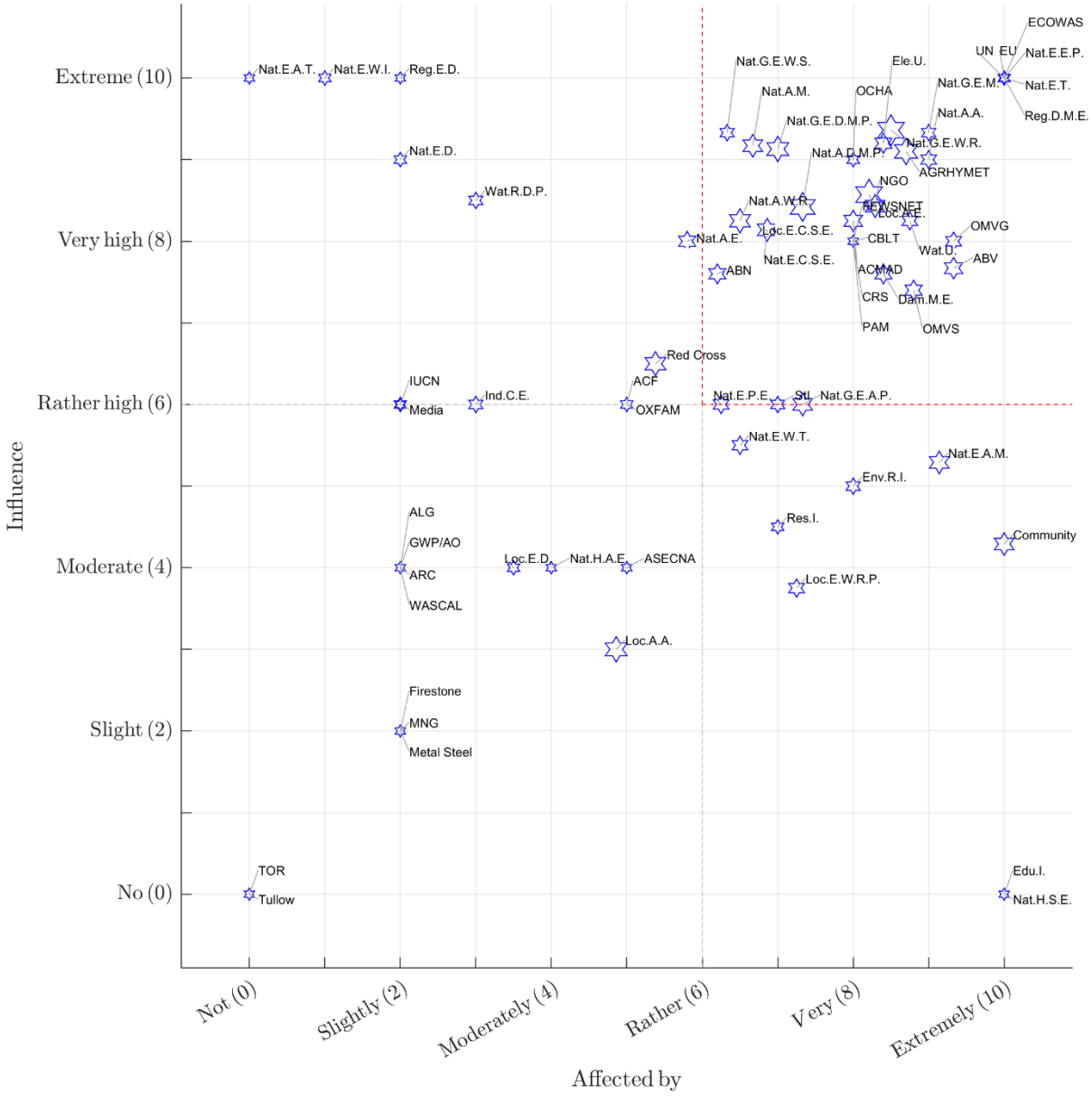

Figure 6. Perceived mean influence on contributing to a sustainable uptake of – and being affected by – a flood forecasting and alert system in West Africa.

Note: Scale from 0 ("actor has no influence/is not at all affected") to 10 ("actor decides/ is very strongly affected by"). Size of symbols: how often the respective organization or stakeholder was mentioned by the survey respondents (e.g. mentioned 10 times in the questionnaires regarding this question has a smaller symbol than if mentioned 20 times). The acronyms are given in **Appendix A.1**.

The plot (**Figure 6**) shows that several actors lie in the top-right quadrant, which means that they are both important to implement the system, but would also be strongly affected by such a system. These are, for instance, national entities for disaster management planning, other (governmental) administrative entities, entities for water resources and infrastructure, NGO's, but also electricity utilities, etc. A number of specific organizations were also perceived as both highly important and strongly affected, including e.g.: ABN, ABV,

AGRHYMET, CRS, FEWSNET, OCHA, OMVS, etc. Of slightly lower perceived importance and affectedness are for instance the Red Cross, or environmental protection entities (in the center of **Figure 6**). Rather or very strongly affected, but with lower perceived importance (power) are for instance educational institutions and (to the right in **Figure 6**). The media and commerce entities, on the other hand, have high perceived influence, but are not strongly affected (to the left in **Figure 6**). These and other outliers such as oil companies (to the bottom in **Figure 6**), may still be important to consider in FANFAR as they may provide a different view to the problem.

The broad perspective is important to evaluate the trend of the sampled stakeholders (i.e. those were the stakeholders chosen by the workshop participants). However, to better understand their relevance, there is a need to group the stakeholders by their characteristics. First, we assess the alleged interests, i.e., the main interests assigned to those stakeholders (**Figure 7**). Of high importance, and being highly affected are, for instance, representatives with interest in economic service operations and planning, with technical interests, engaged in disaster management, rescue and aid, but also in civil society (top-right quadrant). Less strongly affected are those with an assigned interest in ”resource planning” (top-left).

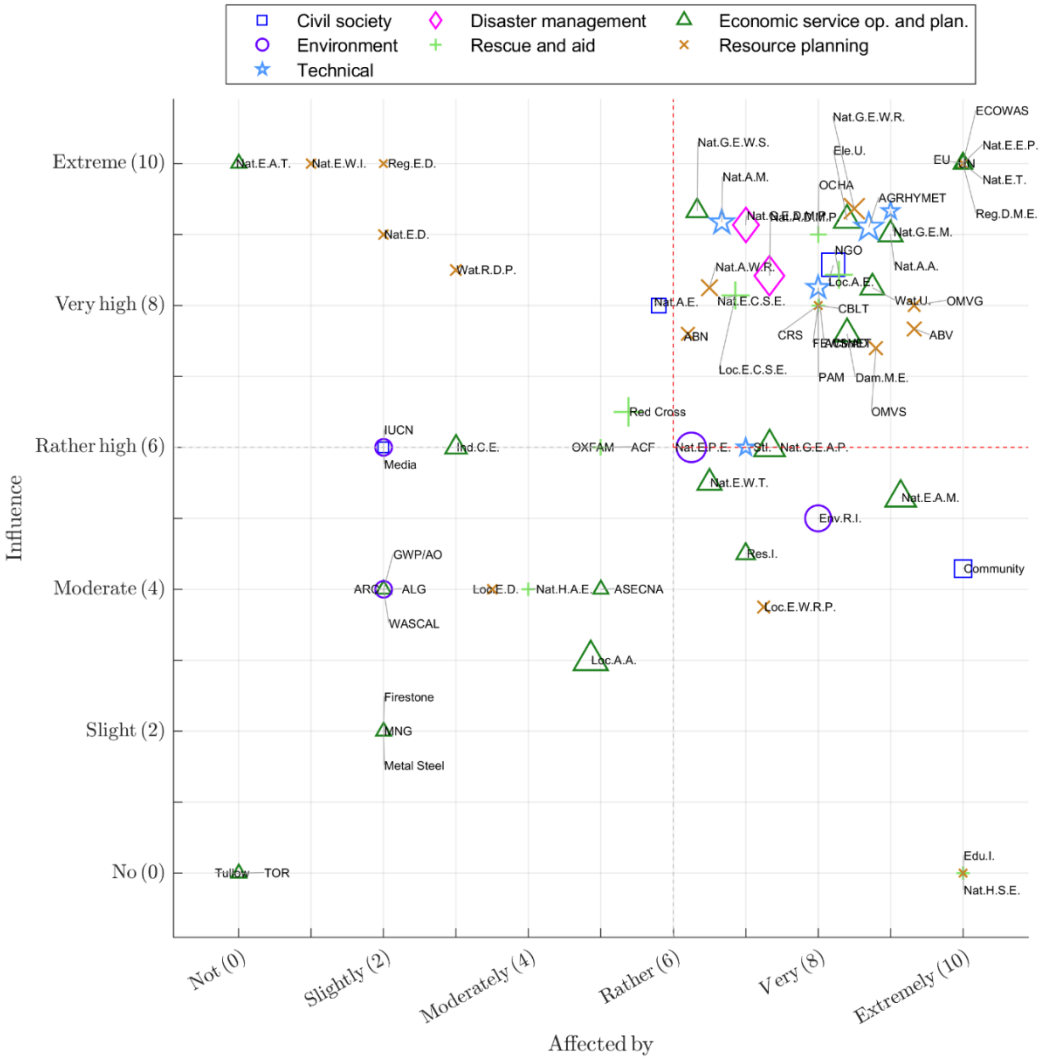

Figure 7. "Influence" / "affected by" plot according to the assigned main interest.

Note: Scale from 0 (“actor has no influence/is not at all affected”) to 10 (“actor decides/ is very strongly affected by”). Size of symbols: how often the respective organization or stakeholder was mentioned by the survey respondents; the acronyms are given in **Appendix A.1**.

Each stakeholder information profile is important to perceive how the particpants, in general, rate each stakeholder according to their respective information use. Therefore, in **Figure 8** we plot the stakeholders according to their profile as hydro-innovation stakeholders, or as downstream stakeholders (i.e. information end-users).

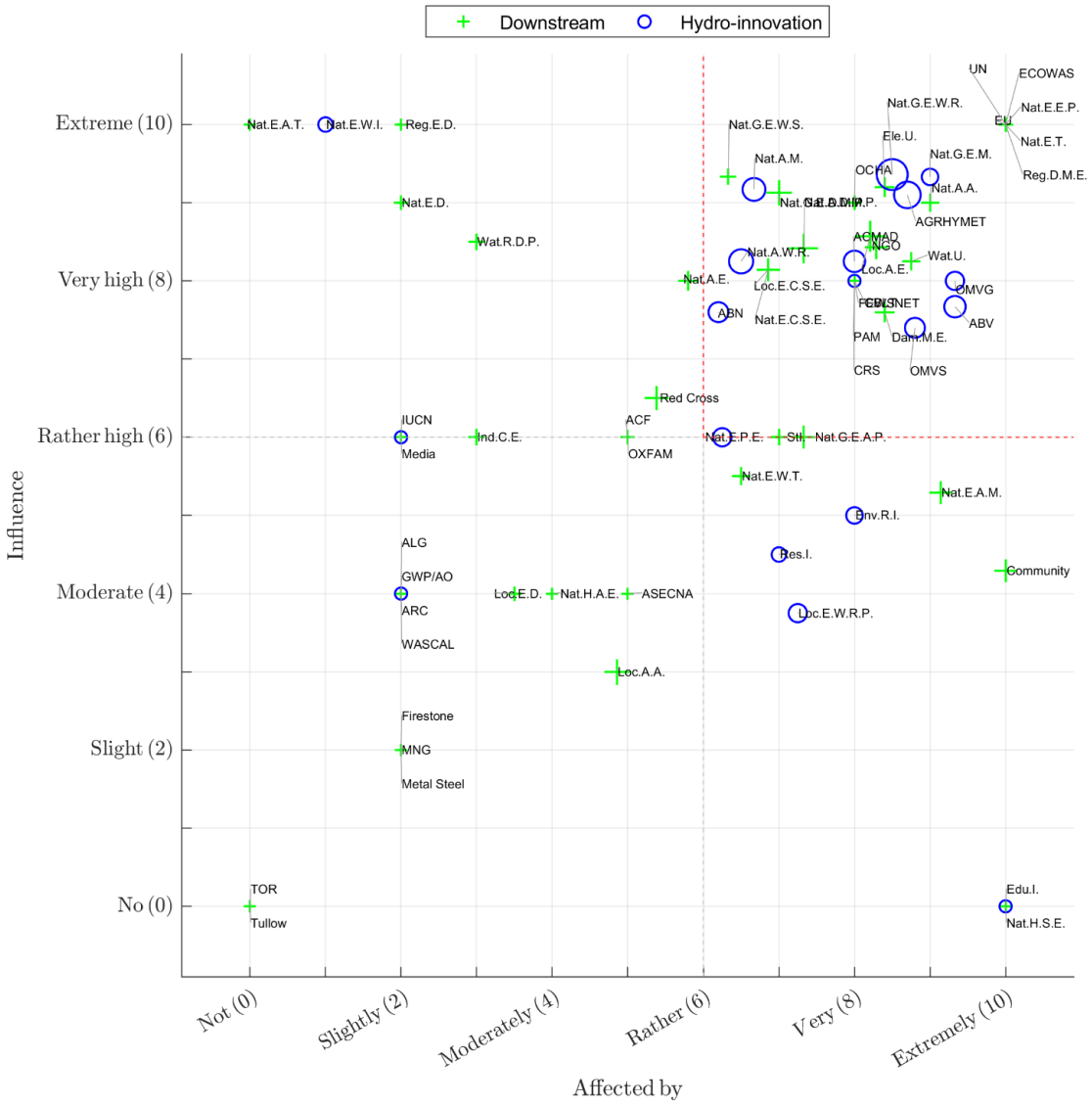

Figure 8. "Influence" / "affected by" plot according to the classification of stakeholders as hydro-innovation stakeholders (blue circles), or as downstream stakeholders (i.e. information end-users; green crosses).

Note: Scale from 0 (“actor has no influence/is not at all affected”) to 10 (“actor decides/ is very strongly affected by”). Size of symbols: how often the respective organization or stakeholder was mentioned by the survey respondents; acronyms see **Appendix A.1**.

The division between ”producers” and ”users” of the ICT information indicates that the former, the hydro-innovation stakeholders (blue circles) are nearly consistently classified as both of rather high to extreme importance as well as to being rather to extremely strongly affected by the FANFAR ICT system: they are all in the top-right quadrant of **Figure 8**. These include the entities for environmental protection and for water resources and infrastucture, and many of the specifically mentioned organizations such as ABN, ABV, AGRHYMET, CRS, FEWSNET, OCHA, OMVG, etc. Some information end-users (green crosses) are also in the top-right quadrant. However, a larger number of the information end-users are perceived as being only strongly affected by the ICT system, but not important - or without power - to ensure its' implementation and uptake.

An important factor is also their decisional level, i.e., their territorial coverage. Thus, in **Figure 9** we plot the stakeholders according to their decisional level considering a supranational, national, or local coverage. Many national (green crosses) and supranational stakeholders (green circles) are in the top-right quadrant, while most local stakeholders (blue squares) were perceived as to having less strong influence (lower half of **Figure 9**).

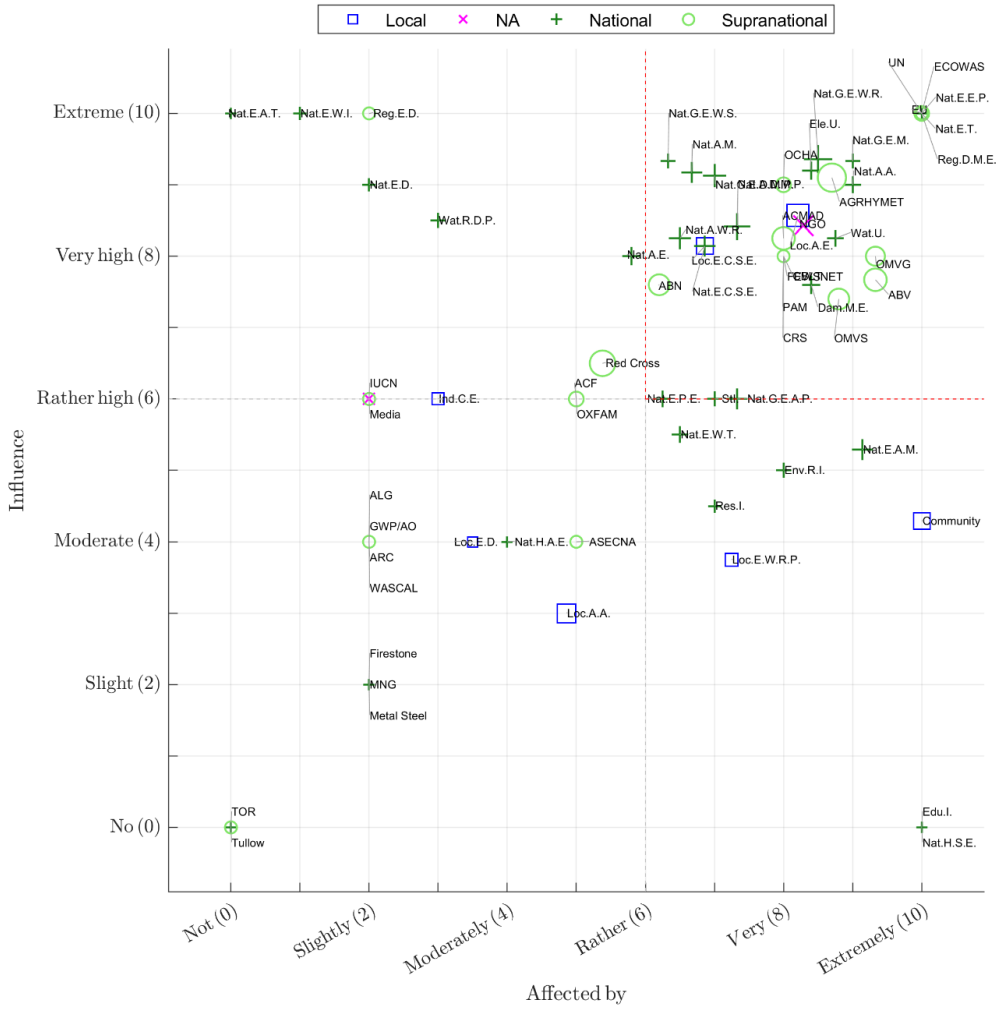

Figure 9. "Influence" / "affected by" plot according to the decisional level.

Note: Scale from 0 (“actor has no influence/is not at all affected”) to 10 (“actor decides/ is very strongly affected by”). Size of symbols: how often the respective organization or stakeholder was mentioned by the survey respondents; acronyms see **Appendix A.1**.

The last assessment of this type covers the sector that was assigned to each stakeholder (**Figure 10).** Many stakeholders with high influence or being highly affected (top-right quadrant) come from the water resources sector (yellow stars), civil protection (green stars), meteorology (upside-down dark triangles), and administration in general (blue circles). Humanitarian aid representatives can also be found in the top-right quadrant, but some are on a middle level (e.g. Red Cross, Oxfam; brown trapeze). Representatives from research and education are often perceived as being strongly affected, but of not having so much influence (brown triangles, bottom-right quadrant). Industry and commerce representatives are little affected, but also have little influence (blue triangles, mostly bottom-left), similarly representatives from transportation (pink stars, but see exception top-left). The same applies to representatives from energy industry, but note again the exception of dam managers, which are found in the top-right quadrant (green squares).

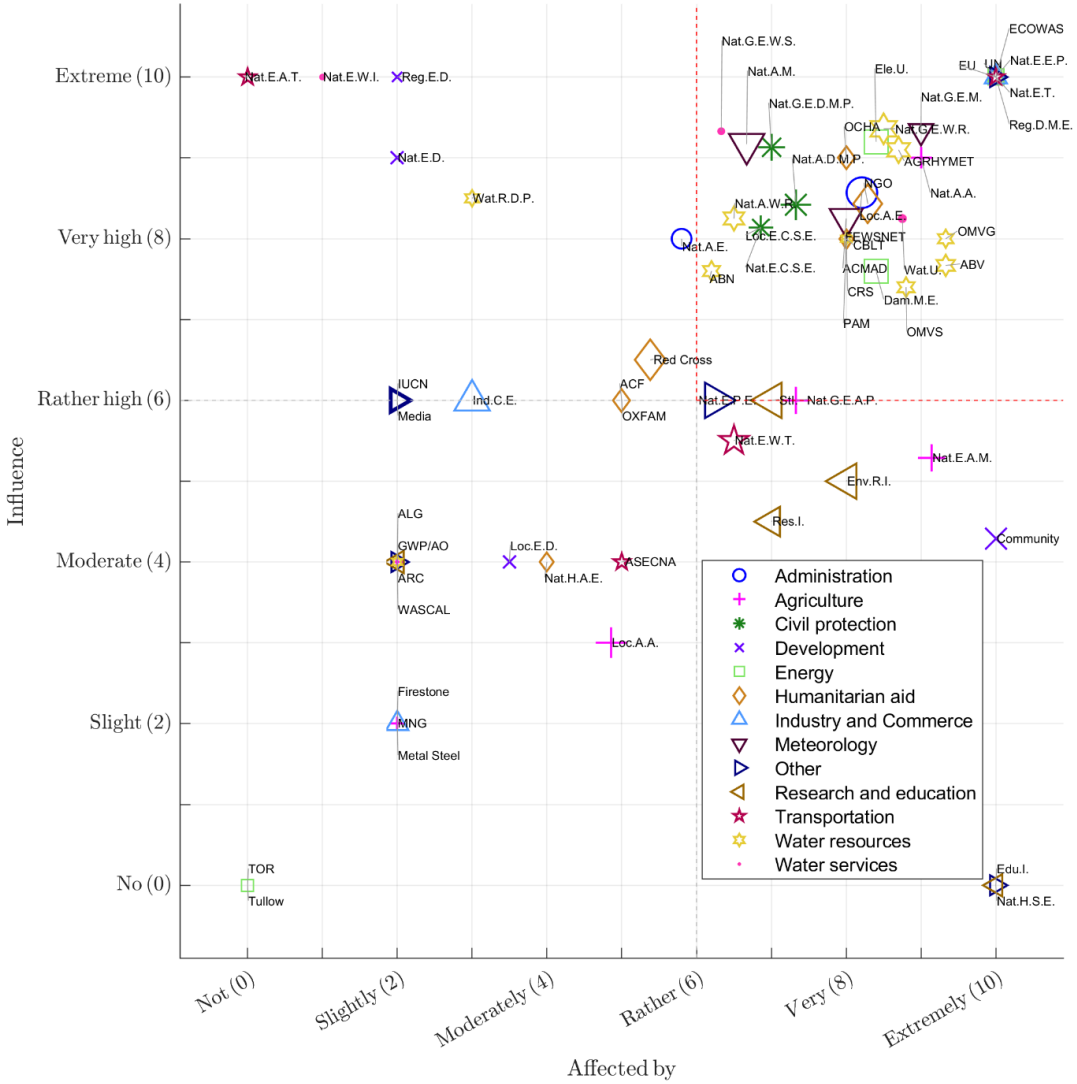

Figure 10. "Influence" / "affected by" plot according to the stakeholders' sector.

Note: Scale from 0 ("actor has no influence/is not at all affected") to 10 ("actor decides/ is very strongly affected by"). Size of symbols: how often the respective organization or stakeholder was mentioned by the survey respondents; acronyms see **Appendix A.1**.

4 Stakeholder analysis: Discussion

4.1 Key stakeholders

A sustainable uptake of an operational flood forecasting and alert system in West Africa requires seemingly, or ideally, the involvement of all possible stakeholders. However, due to the unfeasibility of such an endeavor, we performed a structured and well-defined process to build a co-design committee, where key stakeholders would be selected. As mentioned above, the framework used in this stakeholder analysis allowed us to understand the required missing players in terms of their main interests, how and why they would want to use such system. The two most important questions in this analysis concern their perceived influence (or power) they hold to implement such an ICT system and how strongly they would be affected once such a system is in place and working (or not working well).

From the 249 stakeholders mentioned by the 18 groups or 31 survey participants, 68 represent the aggregated sample of possibilities. The selected stakeholders can now be filtered according to their features to understand how encompassing the assessment is. We produced several graphs to allow better understanding the importance and affectedness of stakeholders that we had filtered into different groups (**Figure 6 to Figure 10**). Furthermore, all those positioned on the top-right quadrant of these figures are the natural candidates to select as participants for the co-design committee. This stakeholder analysis is also important to understand if those stakeholders that are not located in the top-right quadrant can nevertheless be relevant to the co-designing process, for instance because they provide a very different perspective. In **Figure 11**, we highlight the different quadrants that can guide our selection process.

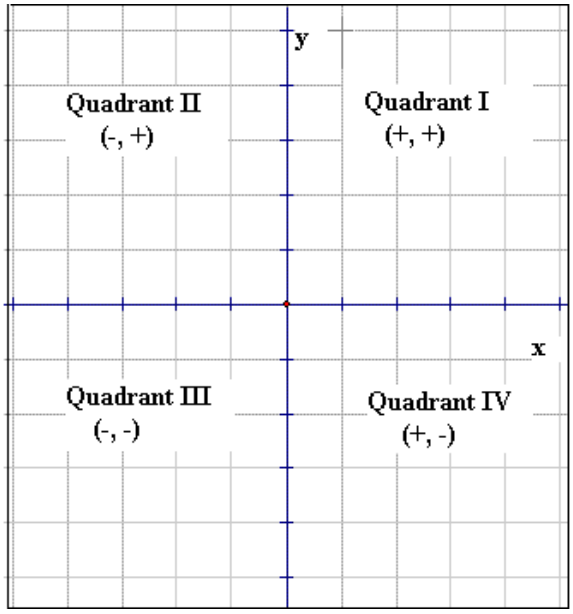

Figure 11. Example of a "disassembled" plot into quadrants (”+” more favorable to select stakeholder along this axis, ”-” less favorable along the axis).

In this selection procedure, there is a possibility for bias as the analysis is based on the perception of those stakeholders that filled in the questionnaire. The role of these survey participants may define how they perceive the other stakeholders. Nonetheless, by guiding the stakeholders to elicit an extensive list, there is a possibility to critically assess the ones not represented in Quadrant I and evaluate their situation, mostly those located on Quadrant II and IV.

In order to provide a more filtered list of the relevant stakeholders, we included all those that were represented in Quadrant I and analyzed those that were represented on Quadrant II and IV. In this way, an improved insight over those stakeholders is gained and will be presented in Section 5.

4.2 Represented interests

The main interests considered and the requirement to cover them when selecting the stakeholders to include in the co-design process is the starting point for the selection. It is key to assess how represented those interests are, to allow them to contribute to the co-design activities. Therefore, it is also relevant to jointly assess what are the valued uses, i.e. what do they want from the system, to include them in the system design.

As illustrated in **Figure 7 and Figure 8**, the distribution of all the stakeholders to their main interest and role as information producer (hydro-innovation stakeholder) or receiver of flood warning information (downstream stakeholder) is clear, which should enable a pragmatic approach towards their selection as potential members of the co-design working group.

Figure 12 highlights the representation of interests along those stakeholders that had a rating higher than 6 on each of the "Importance of interests" [task 6 and 14], "Influence" (power) [task 7 and 15], and "Affected by" [task 8 and 16] fields. Hereby, 31% have an assigned interest in "resource planning", 25% in "economic service and operations planning", and 18% in "rescue aid" (**Figure 12, left**). Other important interests were "technical (mentioned by 10% of the survey participants for those stakeholders that had been given a high rating on the three dimensions), "civil society" 8%, and "disaster management" and "environment", with 4% each. Nearly half of the stakeholders (46%) would use the FANFAR flood forecast and alert system for "alert information", 21% for "forecast refinement", and 16% for "water related information" (**Figure 12, right**). Only few would use it for "meteorological data" (8%), and "forecast production" (4%).

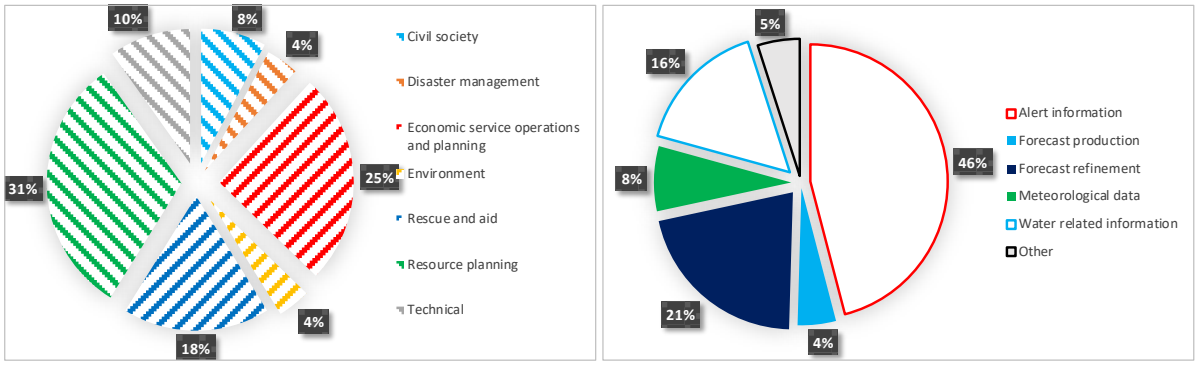

Figure 12. "Represented interests" (**LEFT**) and "Use of system" (**RIGHT**) on those stakeholders that had a rating higher than 6 on each of the "Importance of interests" [task 6 and 14], "Influence" (power) [task 7 and 15], and "Affected by" [task 8 and 16] fields.

4.3 Sustainable uptake of the system (H-TEP) in West Africa

For a sustainable uptake of the system in West Africa, stakeholders with a different coverage (**Figure 8**), information profile (**Figure 9**), and from several sectors (**Figure 10**) also need to be selected. That is, not only those stakeholders that analyze the data and render it into useful information, but also those that will use such information. The inclusion of different stakeholder characteristics can clearly provide a more adapted design, i.e. by considering the stakeholders, they can voice their concerns regarding the flood forecasting and alert system and their suggestions for improving it.

In this case, we have a clear representation of all those characteristics in the sample as can be seen in **Figure 13**.

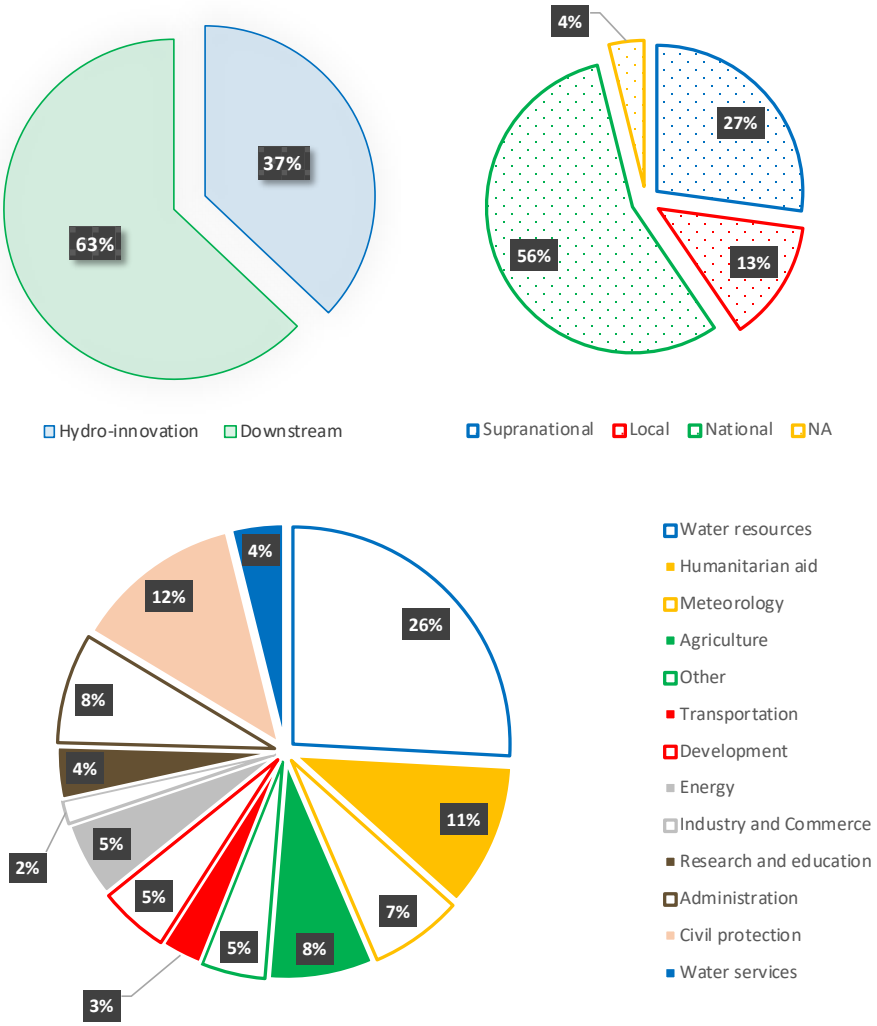

Figure 13. ”Information profile” (**TOP-LEFT**), ”Decisional level” (**TOP-RIGHT**), and ”Sector” (**BOTTOM**) on those stakeholders that had a rating of higher than 6 on each of the “Importance of interests” [task 6 and 14], “Influence” (power) [task 7 and 15], and “Affected by” [task 8 and 16] fields.

The selection of further stakeholders to participate in the co-design of the ICT system has to be seen as a living process, on the basis that those included are the ones where:

1. without considering their needs and interests, it would be difficult to ensure an operational and useful system, thus, they are rather important to guarantee a sustainable uptake of the system;
2. they can assist the project though their power to facilitate or support, and hence, ensuring that a sustainable implementation of the system would be much easier;
3. they are affected by a suitable implementation of the system in a substantial way.

5 The co-design committee

As mentioned in Section 2.4, the participants were asked during the co-design workshop in Niamey, September 2018, to declare their interest to participate in further co-design activities by signing a form. This was a key step to understand the participants' interest and commitment to engage in the continuous FANFAR co-design activities.

Table 3 highlights the participants (represented by their organizations as for confidentiality reasons, we cannot provide their names) that signed their interest to participate in the co-design committee (a.k.a. co-design working group). They come from 15 West African countries and represent a range of different functions and interests.

Table 3. Workshop participants that signed the form to continue to participate in the co-design working group.

Country	Stakeholder
Benin	Direction Générale de l'Eau
Burkina Faso	Direction Générale des Ressources en Eau
Burkina Faso	Secrétariat Permanent du CONASUR
Cap Vert	Agence Nationale de l'Eau
Côte d'Ivoire	Direction Générale des Infrastructures de l'Hydraulique Humaine
Côte d'Ivoire	Plateforme Nationale pour la Réduction des Risques et Catastrophes
Gambie	National Disaster Management Agency
Ghana	Hydrological Services Department
Ghana	National Disaster Management Organisation
Guinée	Centre National de Gestion des Catastrophes et des Urgences Env.
Guinée	Direction Nationale de l'Hydraulique
Guinée Bissau	Direction Générale des Ressources Hydriques
Guinée Bissau	Services de Prévention, Recherches, planifications et Gestions des Risques
Liberia	Liberia Hydrological Service
Liberia	National Disaster Management Agency
Mali	Direction Générale de la Protection civile
Mauritanie	Direction de l'Aménagement Agricole
Sénégal	Direction de la Gestion et de la Planification des Ressources en Eau
Sénégal	Direction de la Protection Civile
Sierra Leone	Ministry of Water Resources
Supranational	Autorité du Bassin de la Volta
Tchad	Direction des Ressources en Eau
Togo	Agence Nationale de la Protection Civile
Togo	Direction des Ressources en Eau

Additionally, **Table 4** highlights the stakeholders directly identified by the participants, during the workshop (Task 17), as key potential participants in the co-design activities. Please note that all the stakeholders already mentioned in **Appendix A.2** are not mentioned in the following tables, as they were already identified as potential participants.

Table 4. Stakeholders explicitly identified as key potential participants in the co-design working group activities.

Country	Stakeholder
Cabo Verde	INMG
Cabo Verde	SNPC
Côte d'Ivoire	AGEROUTE
Côte d'Ivoire	Côte d'Ivoire Energie
Côte d'Ivoire	Office Nationale de la Protection Civile
Côte d'Ivoire	SODEXAM
Gambia	Department of Agriculture
Gambia	Department of Water Resources
Gambia	Gambia Bureau of Statistics
Ghana	Ghana Metereological Agency
Guinée-Bissau	Méteo National (INM)
Guinée-Bissau	Service National de la Protection Civile (SNPC)
Liberia	Ministry of Transport (meteorological service)
Mali	Mali Méteo
Nigeria	NEMA
Nigeria	NIMET
Nigeria	NIWA
Nigeria	RBDA
Sierra Leone	EPA-SL
Sierra Leone	ONS
Supranational	ABN (Autorité du Bassin du Niger)
Supranational	ACMAD
Supranational	Africa Risk Capacity
Supranational	CBLT
Supranational	Centrale Hydroelectrique du Bénin (CEB), Togo / Bénin
Supranational	OMVG
Tchad	Ministère de l'Administration du Territoire - La Direction de la Protection Civile
Togo	Université de Lomé, Département de Géographie

Finally, **Table 5** highlights the types of stakeholders that, even though they were not directly identified, could be considered as potential co-design members due to the importance of their interests, or their influence, or how strongly affected they are, or any combination of the previous. All stakeholders are included in **Table 5** that had a rating higher than 6 on each of the "Importance of interests" [task 6 and 14], "Influence" (power) [task 7 and 15], and "Affected by" [task 8 and 16] fields, and were not in the previous tables (**Table 3** and **Table 4**) or in **Appendix A.2**.

Obviously, this is still a large list, and for practicability reasons, it will not be possible to include all of the potential stakeholders in **Table 5** in the future FANFAR co-design activities. There are several ways to deal with this. Firstly, **Table 5** contains overlaps within the table and with other tables. For instance, it might be possible to include one or two representatives from the agricultural sector, instead of several with different functions. The same goes for humanitarian aid organizations, and others. Secondly, it can be possible to include some stakeholders for very specific activities only, rather than including them in the entire co-design process. This applies especially to downstream stakeholders, who are at the "receiving end" of the flood forecast and alert information chain. They are represented by green crosses in **Figure 8**, and listed in the fourth column of **Table 5**. It is important for the co-design process in FANFAR to understand *how* (via which channels) they receive flood-related information, i.e. which distributions channels are effective in reaching them, and which are not effective. This information may

be gathered, for instance, via country representatives that are already participating in the co-design committee, or by inviting some selected downstream stakeholders to a specific FANFAR event. It would certainly not be necessary to invite all the downstream stakeholders to all future FANFAR co-design workshops, where more-technical details of the ICT system are discussed. Of the stakeholders listed in **Table 5**, only 11 are classified as hydro-innovation stakeholders (grey shading). The stakeholder analysis thus illustrates that many of the important hydro-innovation stakeholders were already selected to participate in the FANFAR co-design committee.

Table 5. Stakeholders that should potentially be considered as participants in the co-design working group activities and that have not been considered so far. Grey shading: hydro-innovation stakeholders.

Stakeholder	Main interest	Why use system	Info profile	Decisional level	Sector
ACF	Rescue and aid	Alert information	Downstream	Supranational	Humanitarian aid
ACMAD	Technical	Meteoro-logical data	Hydro-innovation	Supranational	Meteorology
Community	Civil society	Alert information	Downstream	Local	Development
CRS	Rescue and aid	Alert information	Downstream	Supranational	Humanitarian aid
Dam manage-ment entity	Economic service operations and planning	Water related information	Downstream	National	Energy
ECOWAS	Economic service operations and planning	Other	Downstream	Supranational	Industry and Commerce
Educational institution	Resource planning	Alert information	Hydro-innovation	National	Research and education
Electricity utility	Economic service operations and planning	Water related information	Downstream	National	Energy
Environmental research institution	Environment	Other	Hydro-innovation	National	Research and education
EU	Resource planning	Other	Downstream	Supranational	Other
FEWSNET	Rescue and aid	Alert information	Downstream	Supranational	Humanitarian aid
Industry and commerce entities	Economic service operations and planning	Alert information	Downstream	Local	Industry and Commerce
Local admin-istrative entity	Civil society	Alert information	Downstream	Local	Administration
Local asso-ciation for agriculture	Economic service operations and planning	Alert information	Downstream	Local	Agriculture

Stakeholder	Main interest	Why use system	Info profile	Decisional level	Sector
Local Entity for civil security enforcement	Rescue and aid	Alert information	Downstream	Local	Civil protection
Local Entity for Water Resources planning	Resource planning	Forecast refinement	Hydro-innovation	Local	Water resources
Media	Civil society	Alert information	Downstream	NA	Other
National administrative entity	Civil society	Alert information	Downstream	National	Administration
National Agency for disaster management planning	Disaster management	Alert information	Downstream	National	Civil protection
National Agency for meteorology	Technical	Meteorological data	Hydro-innovation	National	Meteorology
National Agency for Water Resources	Resource planning	Forecast refinement	Hydro-innovation	National	Water resources
National Association for agriculture	Economic service operations and planning	Alert information	Downstream	National	Agriculture
National Entity for agriculture management	Economic service operations and planning	Water related information	Downstream	National	Agriculture
National Entity for civil security enforcement	Rescue and aid	Alert information	Downstream	National	Civil protection
National entity for development	Resource planning	Alert information	Downstream	National	Development
National entity for water infrastructure	Resource planning	Water related information	Hydro-innovation	National	Water services
National Entity for waterways transport	Economic service operations and planning	Water related information	Downstream	National	Transportation
National environment protection entity	Environment	Water related information	Hydro-innovation	National	Other
National Governmental Entity for agriculture planning	Economic service operations and planning	Alert information	Downstream	National	Agriculture

Stakeholder	Main interest	Why use system	Info profile	Decisional level	Sector
National Governmental Entity for disaster management planning	Disaster management	Alert information	Downstream	National	Civil protection
National Governmental Entity for meteorology	Technical	Meteorological data	Hydro-innovation	National	Meteorology
National Governmental Entity for Water Resources	Resource planning	Forecast refinement	Hydro-innovation	National	Water resources
National Governmental Entity for Water services	Economic service operations and planning	Water related information	Downstream	National	Water services
National health service entity	Rescue and aid	Alert information	Downstream	National	Other
NGO	Rescue and aid	Alert information	Downstream	NA	Humanitarian aid
OCHA	Rescue and aid	Alert information	Downstream	Supra-national	Humanitarian aid
OXFAM	Rescue and aid	Alert information	Downstream	Supra-national	Humanitarian aid
PAM	Rescue and aid	Alert information	Downstream	Supra-national	Humanitarian aid
Red Cross	Rescue and aid	Alert information	Downstream	Supra-national	Humanitarian aid
Regional dam management entity	Economic service operations and planning	Water related information	Downstream	Supra-national	Energy
Regional entity for development	Resource planning	Alert information	Downstream	Supra-national	Development
Research institution	Economic service operations and planning	Other	Hydro-innovation	National	Research and education
Statistics Institution	Technical	Other	Downstream	National	Research and education
UN	Resource planning	Other	Downstream	Supra-national	Other
Water resources development programs	Resource planning	Water related information	Downstream	National	Water resources

Stakeholder	Main interest	Why use system	Info profile	Decisional level	Sector
Water utility	Economic service operations and planning	Water related information	Downstream	National	Water services

As seen in **Table 3** almost all survey participants signed up to be part of the co-design committee (over 90%). Furthermore, according to the analysis above, all the listed stakeholders are a very good representation of what should be required to enlarge the established co-design committee. To back the previous statement, it is important to highlight that all West African countries were represented and are included in this stakeholder analysis, and therefore, in this co-design working group section.

6 Concluding remarks

Based on the activities, surveys, and analyses presented in this document, we report the key developments to establish a co-design committee. This establishment is a living process that at this stage has a sound basis, not only in terms of actual members, but also prospective ones.

The results obtained promoted the identification of stakeholders that should be interested and willing to participate in defining user needs, and co-designing necessary adaptations in two different ways: 1) those suggested by the workshop participants; and, 2) those that due to their interests, influence, and "affectedness", should also be considered. The results seem very promising and allow us to acknowledge that there is already a very strong commitment of a representative selection of stakeholders to participate in the FANFAR refinement process. This therefore ensures that the existing FANFAR ICT system for flood forecasting and alerts will be adapted in such a way to West African conditions to enable its sustainable uptake.

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Appendix A

A.1 List of Acronyms

AAT	Autorité pour l'Aménagement de Taoussa
ABFN	Agence du Bassin du Fleuve Niger au Mali
ABN	Autorité du Bassin Niger
ABV	Autorité du Bassin de la Volta
ACF	Action contre la Faim
ACMAD	African Centre of Meteorological Applications for Development
AGEROUTE	Agence de Gestion des Routes - Ivory Coast
AGRHYMET	Centre Regional AGRiculture, HYdrology and METeorology
ALG	Autorité du Liptako-Gourma (regional organization seeking to develop the contiguous areas of Mali, Burkina Faso, and Niger)
ANAM	Agence Nationale de la Météorologie
ANAS	National water agency - Cabo Verde
ANMCV	National association of Municipalities - Cabo Verde
ANPC	Agence Nationale de la Protection civile
ARC	Africa Risk Capacity
ASECNA	Agence pour la sécurité de la navigation aérienne en Afrique et à Madagascar
Bagré Pôle	Le projet pôle de croissance de Bagré
BWMA	Bumbuna Watershed Management Authority
CARI	Central Agricultural Research Institute
CBDI	Water planning related agency
CBLT	Commission du Bassin du Lac Tchad
CEB	Centrale Hydroelectrique du Bénin, Togo / Bénin
CERESCOR	Centre de Recherche Scientifique Conakry Rogbané
CIE	Compagnie Ivoirienne d'Electricité
CI-ENERGIES	Côte d'Ivoire Energie
CMDL	Comité Malien des barrages et lacs
CNGCUC	Centre Nationale de Gestion des Catastrophes et Urgences Environnementales
CNU	Coordination Nationale des usages des RN du Bassin du Niger, Mali
COMANAV	Compagnie Malienne de navigation
CONASUR	Secrétariat Permanent CONASUR
CR	Croix Rouge
CRS	Catholique Relief Service
CVEL	Secrétariat Permanent CVEL (Gestion des Crises et Vulnérabilités en Elevage)
Dam.M.E.	Dam Management Entity
DGASP	Directorate of agriculture and swine culture and livestock
DG-Eau	Direction Centrale de l'Eau
DGIH	Direction Générale des Infrastructures Hydrauliques
DGIHH	Direction Générale des Infrastructures Hydrauliques Humaines

DGMN	Direction Générale de la Météorologie Nationale
DGPC	Direction Générale de la Protection Civile
DGPRE	Direction de la Gestion et de la Planifcication des Ressources en Eau du Sénégal
DGRE	Direction Générale des Ressources en Eau
DGRH	Direcao Geral dos Recursos Hidricos
DNACPM	National Directorate of Sanitation
DNEF	Direction Nationale des Eaux et Forêts
DNGR	Direction Nationale du Génie Rural
DNH	Direction Nationale de l'Hydrologie
DNM	Directeur Nationale de la Météorologie
DNTTMF	Direction Nationale des Transports Terrestres, Maritimes et Fluviaux
DPC	Direction de la Protection Civile
DRE	Direction des Ressources en Eau
DSID	Agriculture / DSID - Direction des Statistiques Agricoles, de l'Informatique et de la Documentation
ECOWAS	Economic Community of West African States
EDM - SA	Énergie du Mali
Edu.I.	Educational Institution
Ele.U.	Electricity Utility
ENI	Ecole Nationale d'Ingénieurs
Env.R.I.	Environmental Research Institution
EPA-SL	Environmental Protection Agency - Sierra Leone
EU	European Union
FAT	Forces Armées Togolaise
FEWSNET	Famine Early Warning System Network
Firestone	Firestone, Liberia (company)
FNAEM	Fédération Nationale des Agriculteurs et Eleveurs de Mauritanie
GBoS	Gambia Bureau of Statistics
GHS	Ghana Health Service
GMA	Ghana Metereological Agency
GNAP	Gouvernement National des Associations pastorales
GRCS	Gambia Red Cross Society
GWP/AO	Global Water Partnership / Afrique l'Ouest
HPGC	Dam manager (Hydro Plants Generation Company)
IDA	Ghana Irrigation Development Authority
IFRC	International Federation of Red Cross
Ind.C.E.	Industry and Commerce Entities
INE	National Statistics - Cabo Verde
INM	Météo National
INMG	National institute for meteorology and geophisics
IUCN	Union Internationale pour la Conservation de la Nature

LEC	Liberia electricity corporation
LHS - DMER	Ministry of Mines and Energy - Liberian Hydrological Service
LNE	Laboratoire National des Eaux
Loc.A.A.	Local Association for Agriculture
Loc.A.E.	Local Administrative Entity
Loc.E.C.S.E.	Local Entity for Civil Security Enforcement
Loc.E.D.	Local Entity for Development
Loc.E.W.R.P.	Local Entity for Water Resources Planning
LWSC	Liberia water and sewerage corporation
MAFS	Ministry of Agriculture and Food Security
Média	National and local media
Metal Steel	Metal Steel
MNG	MNG Gold mine
MoT-MS	Ministry of Transport, meteorological service - Liberia
NADMO	National Disaster Management Organisation
Nat.A.A.	National Association for Agriculture
Nat.A.D.M.P.	National Agency for Disaster Management Planning
Nat.A.E.	National Administrative Entitity
Nat.A.M.	National Agency for Meteorology
Nat.A.W.R.	National Agency for Water Resources
Nat.E.A.M.	National Entity for Agriculture Management
Nat.E.A.T.	National Entity for Aerial Transportation
Nat.E.C.S.E.	National Entity for Civil Security Enforcement
Nat.E.D.	National Entity for Development
Nat.E.E.P.	National Entity for Energy Planning
Nat.E.P.E.	National Environment Protection Entity
Nat.E.T.	National Entity for Transportation
Nat.E.W.I.	National Entity for Water Infrastructure
Nat.E.W.T.	National Entity for Waterways Transport
Nat.G.E.A.P.	National Governmental Entity for Agriculture Planning
Nat.G.E.D.M.P.	National Governmental Entity for Disaster Management Planning
Nat.G.E.M.	National Governmental Entity for Meteorology
Nat.G.E.W.R.	National Governmental Entity for Water Resources
Nat.G.E.W.S.	National Governmental Entity for Water Services
Nat.H.A.E.	National Humanitarian Aid Entity
Nat.H.S.E.	National Health Service Entity
NDMA	National Disaster Management Agency
NEMA	National Emergency Management Agency
NFP	National Farmers Platform
NGO	Non governmental organization

NIHSA	Nigeria Hydrological Services Agency
NIMET	Nigerian Meteorological Agency
NIWA	National Inland Waterways Authority
NLA	National Livestock Association
NSCDC	Nigeria Security and Civil Defence Corps
NWRMA	National Water Resources Management Agency - Sierra Leone
O. Niger	Office du Niger (semi-autonomous government agency in Mali that administers a large irrigation scheme)
OCHA	Office for the Coordination of Humanitarian Affairs - UN
OERS	Organisation des Etats riverains du fleuve Sénégal
OMG	Alliance pour la Promotion de la Gouvernance et des initiatives locale
OMVF	Office pour la mise en valeur du système Faguibine
OMVG	Organisation de mise en valeur du fleuve Gambie
OMVS	Organisation de mise en valeur du fleuve Sénégal
ONDD	Observation National pour le Développement Durable
ONEA	L'Office national de l'eau et de l'assainissement
ONPC	Office Nationale de la Protection Civile
ONS	Office of National Security - Sierra Leone
OPIB	Office du Périmètre Irrigué de Baguinéda
ORM	Office Riz Mopti
ORS	Office Riz Segou
OXFAM	previously Oxford Committee for Famine Relief
PAM	Programme Alimentaire Mondiale - UN programme
PDIS	Projet de dev. Intégré de Samandéni
PNRRC	Plateforme Nationale pour Reduction et Gestion Risques Catastrophes
RBDA	River Basin Development Authorities
Reg.D.M.E.	Regional Dam Management Entity
Reg.E.D.	Regional Entity for Development
Res.I.	Research Institution
SAP	Système d'Alerte Précoce
SAP Agriculture	Système d'Alerte Précoce
SENAH	Service Nationale l'Action Humanitaire
SHN	Services Hydrologiques Nationaux
SMN	Services Météorologiques Nationaux
SNPC	Service National de la Protection Civile
SODECI	Société de Distribution d'Eau de Côte d'Ivoire
SODEXAM	Societe d'exploitation de Developpement Aeroportuaire Aeronautique Meteo au Côte d'Ivoire
SOMA GEP	Société Malienne de gestion de l'eau potable
SONABEL	Société Nationale d'etectricité du Burkina Faso
StI.	Statistics Institution

TOR	Tema Oil Refinery
Tullow	Tullow Oil Company
UN - Gambia	United Nations - Gambia Office
VRA	Volta River Authority - Electricity supplier
WASCAL	West African Science Service Center on Climate Change and Adapted Land Use
Wat.R.D.P.	Water Resources Development Programs
Wat.U.	Water Utility
WRC	Water Resources Commission

A.2 From proposal: members of co-design committee

Table A.1. Organizations who stated in the FANFAR proposal that they are willing to support FANFAR and to participate in co-design committee and the Advisory Board.

Note: A support letter is provided from each organization expressing their willingness to take part in the project in order to ensure that the technologies developed will respond to their needs and to facilitate practical applications of the project's results. The support letters are attached after section 5 (from FANFAR proposal, 2017, Table I, pages 9-10).

Organisation	Country/ies	Sectors	Type	Role in FANFAR
Direction Générale des Ressources en Eau (DGRE)	Niger	Water resources, flood alerts, decision support	National public agency	Co-design, end-user and hydro-innovation stakeholder
Direction Nationale de l'Hydraulique (DNH)	Mali	Water resources, flood alerts, decision support	National public agency	Co-design, end-user and hydro-innovation stakeholder
Direction des Etudes et de l'Information sur l'Eau (DEIE)	Burkina Faso	Water resources, flood alerts, decision support	National public agency	Co-design, end-user and hydro-innovation stakeholder
Direction Nationale de l'Hydraulique (DNH)	Guinea	Water resources, flood alerts, decision support	National public agency	Co-design, end-user and hydro-innovation stakeholder
Direction de la Gestion et de la Planification des Ressources en Eau (DGPRE)	Senegal	Water resources, flood alerts, decision support	National public agency	Co-design, end-user and hydro-innovation stakeholder
Autorite du Bassin de la Volta (ABV)	Benin, Burkina Faso, Ivory Coast, Ghana, Mali, Togo	River basin management. Protecting people, food, reservoirs.	Multi-national river basin organisation	Co-design, end-user and hydro-innovation stakeholder
Organisation pour la Mise en Valeur du fleuve Sénégal (OMVS)	Senegal, Mauritania, Mali, Guinea	River basin management. Protecting people, food, reservoirs.	Multi-national river basin organisation	Co-design, end-user and hydro-innovation stakeholder
International Federation of the Red Cross and Red Crescent Societies (IFRC)	International	Humanitarian aid, emergency preparation and response, agriculture	Non-governmental organisation	Co-design, end-user
National Emergency Management Agency (NEMA)	Nigeria	Emergency management, warnings and response	National public agency	Co-design, end-user

Organisation	Country/ies	Sectors	Type	Role in FANFAR
Nigeria Security & Civil Defence Corps (NSCDC)	Nigeria	Emergency protection and response	National public agency	Co-design, end-user
Agence du Bassin du Fleuve Niger (ABFN)	Mali	Village protection, agricultural planning, navigation	National public agency	Co-design, end-user
Ordre des Ingénieurs Conseils du Mali (OICM)	Mali	Engineering, private enterprises	Engineering society with 180 member companies	Co-design, end-user and hydro-innovation stakeholder
Ecole Nationale d'Ingenieurs Abderhamane Baba Toure (ENI-ABT)	Mali	Education, Engineering	National public agency	Co-design, end-user and hydro-innovation stakeholder
World Meteorological Organisation (WMO)	International, United Nations	Weather, climate, water	Specialized agency of the United Nations	Advisory board member
West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL)	Benin, Burkina Faso, Ivory Coast, Gambia, Ghana, Mali, Niger, Nigeria, Senegal, Togo	Education, research, climate services	Multi-national research and service centre	Advisory board member

A.3 Preliminary stakeholder analysis among members of FANFAR consortium

The participants of the FANFAR kick-off meeting, 17.-19. January, 2018 in Norrköping, Sweden, answered following questions:

Who are key West African organizations, end-users, system developers? How important are they?

Below, you will be asked to fill in three forms (A, B, C), one for each different type of "user". For all, please do the following:

Tasks:

1. **Column A, "Stakeholder":** *please list whoever comes to your mind. Who might play a role in FANFAR?*
2. **Column B, "Specification"**: *be precise, please add organization, country, city, name of representative if known, etc.*
3. **Column C, "Main interest":** *shortly state his/ her presumed main interest in a flood forecast & alert system (why is system important to him / her? what his he / she specifically interested in?).*
4. **Column D, "Importance":** *rate on a scale of 0 – 10, how important this organization / person is for ensuring a sustainable uptake / use of the flood forecast & alert system.*

   Scale:

   10 Extremely important: Without this stakeholder it is virtually impossible to ensure a sustainable uptake / use of the system
   7.5 Very high importance: This stakeholder has a very high influence to ensure a sustainable uptake / use of the system
   5 Moderate importance: This stakeholder has a moderate influence to ensure a sustainable uptake / use of the system
   2.5 Little importance: This stakeholder does not strongly influence whether the system is used or not
   0 No importance: No influence: the system will be used (or not), regardless of this stakeholder.
5. **Column E, "Affected by":** *rate on a scale of 0 – 10, how strongly this organization / person will be affected by a good or not so good flood forecast & alert system; i.e. positively affected if the system works well, negatively affected if it does not work well.*

   Scale:

   10 Extremely affected: This stakeholder will be extremely strongly (directly) affected by the system
   7.5 Strongly affected: This stakeholder will be strongly (directly) affected by the system
   5 Moderately affected: The system will affect this stakeholder to some effect, but not very strongly, or not always
   2.5 Hardly affected: The system will hardly have an effect on this stakeholder
   0 Not affected: This stakeholder will not at all be affected by the system.
6. **Column E, "Co-design committee":** *rate on a scale of 0 – 10, whether this stakeholder should be involved in the co-design committee. Reasons can be e.g. that he / she is very important as decision-maker, strongly influential, provides an important / different perspective, is strongly affected, etc.*

   Scale:

   10 Must definitely be included: It is mandatory to include this stakeholder
   7.5 Should be included: It is very important to include this stakeholder
   5 Can be included: It would be nice to include this stakeholder, but it is possible to carry out the work without him / her
   2.5 Not necessary: It is not necessary to include this stakeholder, but if there is capacity, inclusion is nice
   0 Unimportant: It is not in any way important to include this stakeholder in the co-design committee.

A.4 Rating system used for the stakeholder analysis

The participants of the first FANFAR co-design workshop in Niamey, Niger, 16.-20. September 2018 were asked to fill in a pen & paper questionnaire (see main text). For three questions, they were asked to use the following rating system to classify stakeholders with numbers. We give the questions for the key West African organizations; the same classification was used for downstream stakeholders:

Task 6. Importance of organizations' needs and interests (Column F)

How important is the organization to ensure an operational and useful flood forecasting and early warning system? Rate the importance of considering the needs and interests of all organizations on a scale from 0 to 10.

Read the information about the scale carefully, before answering.

Please indicate the importance of the organizations by writing the according number in column F.

[0]	**not important**	This organization's needs and interests do not need to be considered to ensure an operational and useful system. This stakeholder is not important to guarantee a sustainable uptake of the system.
[2]	**slightly important**	Even without considering this organization's needs and interests, it would be easy to ensure an operational and useful system. This stakeholder is slightly important to guarantee a sustainable uptake of the system.
[4]	**moderately important**	This organization's needs and interests should be considered to avoid difficulties in ensuring an operational and useful system This stakeholder is moderately important to guarantee a sustainable uptake of the system.
[6]	**rather important**	Without considering this organization's needs and interests, it would be difficult to ensure an operational and useful system. This stakeholder is rather important to guarantee a sustainable uptake of the system.
[8]	**very important**	Without considering this organization's needs and interests, it would be very difficult to ensure an operational and useful system. This stakeholder is very important to guarantee a sustainable uptake of the system.
[10]	**extremely important**	Without considering this organization's needs and interests it is virtually impossible to ensure an operational and useful system. This stakeholder is extremely important to guarantee a sustainable uptake of the system.

Task 7. Influence in the implementation (Column G)

Rate how much influence (power) each organization has in the implementation of an operational flood forecasting and early warning system.

Read the information about the scale carefully, before answering.

Please indicate the influence of the organizations by writing the according number in column G.

[0]	**no influence**	This organization has no power to facilitate or support a sustainable implementation of the system.
[2]	**slight influence**	This organization has little power to facilitate or support the initiative. There are no great difficulties to ensure a sustainable implementation of the system without this stakeholder.
[4]	**moderate influence**	This organization has moderate power to facilitate or support the initiative. There would not be much difficulties to ensure a sustainable

		implementation of the system without this stakeholder, but it would be easier with this stakeholder involved.
[6]	**rather high influence**	This organization has a rather high power to facilitate or support the initiative. Ensuring a sustainable implementation of the system would be much easier, if this stakeholder was involved than if it / he / she was not.
[8]	**very high influence**	This organization has a high power to facilitate or support the initiative. It would be very difficult to ensure a sustainable implementation of the system without this stakeholder.
[10]	**extreme influence**	Without the support of this organization it is virtually impossible to ensure a sustainable implementation of the system.

Task 8. Affected by the system (Column H)

Rate how strongly each organization will be affected by a flood forecasting and early warning system on a scale from 0 to 10. For this, consider how strongly a well-functioning or malfunctioning system would affect this organization.

Read the information about the scale carefully, before answering.

Please indicate how strongly affected the organizations will be by the system, by writing the according number in column H.

[0]	**not affected**	The system does not change this stakeholder's everyday life at all.
[2]	**slightly affected**	The system changes this stakeholder's everyday life a little bit.
[4]	**moderately affected**	The system has a moderate impact on the everyday life of this stakeholder.
[6]	**rather affected**	The system changes this stakeholder's everyday life quite a bit.
[8]	**very affected**	The system changes this stakeholder's everyday life markedly.
[10]	**extremely affected**	The system has a major impact on the everyday life of this stakeholder.