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Co-designing a flood forecasting and alert system in West Africa with decision-making methods: the transdisciplinary project FANFAR

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Floods are a serious concern in West Africa, and their severity will likely increase with climate change. The European Union-financed, inter- and transdisciplinary project FANFAR (https://fanfar.eu/) aims at providing an operational flood forecast and alert pilot system for West Africa, based on an open-source hydrological model employed in a cloud-based Information and Communications Technology (ICT) environment. To achieve this, an existing pilot ICT system is co-designed and co-adapted to meet needs and preferences of West African users. Four workshops are carried out in West Africa from 2018 to 2020, each with around 40 representatives from hydrological and emergency management agencies from 17 West African countries.

To better understand the stakeholders' needs and preferences, and to prioritize the development of the FANFAR ICT flood forecasting and alert system, we use Multi-Criteria Decision Analysis (MCDA). This MCDA framework guides through a stepwise procedure to develop the FANFAR ICT system such that it best fulfils those objectives that are fundamentally important to stakeholders. The first steps of MCDA are problem structuring; starting with a stakeholder analysis to identify the most important participants for the co-design workshops. In the first co-design workshop (Niamey, Niger, 2018), we then used different problem structuring methods (PSMs) to brainstorm which objectives are fundamentally important to West African stakeholders, and which options (ICT system configurations) might achieve these objectives. To generate objectives, we used online and pen-and-paper surveys, group brainstorming, and plenary discussions. To generate options, we used a strategy generation table and the brainwriting-635 method. Between workshops, the FANFAR consortium post-processed the objectives and options. We also interviewed experts to predict how well an option achieves each objective; including the uncertainty, which is later propagated to the MCDA results with Monte Carlo simulation.

The refined objectives were again discussed in plenary sessions in co-design workshop 2 (Accra, Ghana, 2019), and we elicited the participants' preferences in small group sessions. Weight elicitation captures the trade-offs stakeholders are willing to make regarding achieving objectives, if not all objectives can be fully fulfilled. We used the card procedure to elicit weights (Simos revised procedure), and the popular swing method. As additional preference information for the MCDA modelling, we elicited the shape of the most-important marginal value functions, which

“translate” the objectives’ measurement-units to a neutral value between 0 (objective is not achieved) and 1 (fully achieved). To give one example: for the objective “high accuracy of information”, the best case is “100% accuracy”, translated to the value v=1; the worst case “0% accuracy” translates to v=0. Furthermore, we asked whether stakeholders agree with the implications of the commonly used (linear) additive aggregation model in MCDA (weighted average).

We will present and discuss main results of the MCDA-modeling. Our main aim is to give some insights into the participatory co-design process employed in FANFAR, and recommendations for other projects. We will discuss the problem structuring and preference elicitation methods, and how well they worked in this interesting West African context.