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Editor	Jafet Andersson
Brief Description	This report describes the main capacity development activities that were carried out during the FANFAR project until December 2020. It describes the methods and main outcomes from the three workshops held with users, the Knowledge Base, video tutorials and various other capacity development activities.
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V1.0	2020-09-23	Lorna Little	First draft prepared with structure and main points
V2.0	2020-12-17	Lorna Little, Jafet Andersson	Major revisions to add new sections, text and figures and finalize the deliverable.

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Executive Summary

A central activity in the FANFAR project has been to develop capacity around operational hydrological forecasting and alerts in West Africa. The main focus has been to raise the capacity at national and regional West African hydrological and emergency management institutions mandated to manage floods in the region. However, the capacity of the European partners has also been enhanced through the reinforced cooperation and hands-on work in West Africa.

The capacity development focussed on a set of themes, namely:

A. Succinct communication
B. Conceptual understanding of the forecasting and alert system
C. Access, analysis and interpretation of the forecasting and alert information
D. Operation and maintenance of the system
E. Contributions to improve the system
F. Risk communication and hazard response

A range of activities were carried out. **Firstly**, an extensive set of capacity development material was prepared in the form of e.g. user guides, exercises, video tutorials, background documentation, example code and forecast results. These were integrated into the FANFAR Knowledge Base and YouTube channel and made available as offline PDF copies. **Secondly**, three ambitious workshops were carried out in Niamey, Niger in 2018; in Accra, Ghana in 2019; and in Abuja, Nigeria in 2020 each gathering on average 51 participants from 17 countries. The workshops covered all capacity development themes through brief lectures intertwined by hands-on exercises, feedback sessions and group discussions utilizing the capacity development material. A fourth workshop was initially planned but has not so far been possible due to the COVID-19 pandemic. **Thirdly**, three support channels were set up (a Forum, a Help Desk and a WhatsApp chat group) in which capacity was raised remotely in-between the workshops, particularly during the rainy seasons of 2019 and 2020. **Finally**, a set of additional activities were carried out aiming to deepen the capacity for key individuals (e.g. through individual expert exchanges and courses in hydrological modelling), and to extend the capacity to a larger group of active water managers in the region (at the PRESAO forum), to future generations (at AGRHYMET's Masters courses), and beyond West Africa (at a pan-African UN event).

It is our hope and belief that these activities together contribute to enhancing the capacity of West African societies to better manage the ever-increasing flood challenges in the region. It represents a significant step closer toward the vision of having an operational hydrological forecasting and alert system coordinated, operated, maintained, and refined by regional & national West African institutions. This is an essential and concrete climate change adaptation action in a region expected to experience even more severe flooding in the future.

1. Introduction

A core component of the ICT cooperation cycle employed in FANFAR is to demonstrate system adaptations and build human capacity in the West African user community on how to utilize the system. The FANFAR capacity development activities focused on how to:

- access, analyse and interpret forecasts and alerts using the distribution channels;
- operate, customize and maintain the forecasting chain and all components on the platform;
- utilize the support system; and
- contribute with system improvements, support, tutorials and documentation

A number of methods were employed to build capacity both among forecast producers (e.g. hydrologists, meteorologists, informaticians) and information end-users (e.g. emergency managers, dam operators). During the physical meetings (workshops), the system functionalities were demonstrated and several hands-on training sessions were held to allow participants to test all functionalities, practice on concrete examples, and get direct support from developers. Additional materials were made available to facilitate independent practice and application in-between the physical meetings. User guides were created that demonstrate and explain how to use the system (e.g. how to access information using the distribution channels, how to analyse and interpret the information, how to run tailored forecasts with locally available data, etc., which are all available on the FANFAR Knowledge Base). Tutorials were developed to address the most common tasks and stumbling blocks (e.g. with screenshots and explanatory texts). Exercises were crafted containing practical questions and answers (used at workshops and integrated into the Knowledge Base). All material used in the physical meetings, as well as the user guides, tutorials and examples, were produced and made available in both English and French to facilitate uptake across West Africa. In addition, the full technical documentation of the entire operational system (including deployed components and versions) is available as a background reference document in English. The material and training sessions were organized into different modules covering different topics and addressing different target audiences. The material was made available to all participants as offline copies (e.g. PDF files) during the physical meetings (given as USB sticks with all material), and was also put on the FANFAR online Knowledge Base for universal access.

2. Capacity Development Themes

The participants in the activities run during the FANFAR project developed capacity in six themes. Different themes were in focus during different project activities to account for development that had occurred and the evolution of capacity among the participants. The themes were:

A. Succinct communication

The ability to convey a simple, clear and comprehensive message during communication around e.g. current practices and challenges, user needs, feedback and decision-making.

B. Conceptual understanding of the forecasting and alert system

Understanding the different components that a hydrological forecasting and alert system is based on, i.e. all key components in a forecasting chain including observations (meteorological, hydrological, satellite), hydrological modelling, meteorological and hydrological forecast data, post-processing and distribution, automatic data handling, scheduled production, and ICT.

C. Access, analysis and interpretation of the forecasting and alert information

Learning how to access forecast and alert information, to analyse the information provided, and to interpret the results in a meaningful manner.

D. Operation and maintenance of the system

Clarifying roles and responsibilities that different actors and organisations have within a forecasting and alert system, running and maintaining various system components, training in operation and maintenance of the system.

E. Contributions to improve the system

Empowering users to contribute to various components of the system (e.g. with local alert thresholds, local observations, and code for analysing flood hazard severity and impact).

F. Risk communication and hazard response

Communicating flood risks effectively, and gaining knowledge and practice in taking appropriate actions in response to flood forecast information.

These capacities were developed using the following methods throughout the project:

- hands-on technical exercises with different system components (online and offline),
- hands-on technical exercises to analyse results outside of the system,
- communication exercises (building key messages for presentations, dialogues how to communicate flood risk information),
- individual expert exchanges with on-the-job training at partner institutes,
- presentations (lectures on different topics),
- remote online meetings (biweekly with partners, pre-season with others), and
- interactions through the support channels (tickets, WhatsApp etc.).

3. Capacity Development Activities

The following sections describe the different capacity development activities carried out in the project.

3.1 FANFAR Workshops

Three workshops have so far been arranged in the context of the FANFAR project, with on average 51 participants (Table 1). The participants came from national and regional (international) organisations and were identified by AGRHYMET. The workshops focussed on capacity development, ICT demonstration, user needs definition, and co-design of necessary adaptations. The workshops used hands-on technical exercises focussing on different system components, how to use the system online and offline, how to analyse results outside of the system, as well as communication exercises and presentations (lectures on different topics). In-between the workshops, capacity was strengthen using the online material, and other support channels. Plenary sessions and practical sessions were held for stakeholders on the available systems and options for development, and their views and wishes for improvement were gathered. For this purpose, the main resources used during the workshops include guidance to use the system, exercises on the Hydrology-TEP platform (the cloud-based ICT platform where the FANFAR forecasts are produced) and the Interactive Visualisation Portal. A substantial set of material, in both English and French, was prepared on all agenda points of the workshops.

Table 1. Number of participants at the workshops held during the FANFAR project. Primarily hydrologists and emergency managers, but also a set of participants with other backgrounds.

Workshop	No. of participants	Hydrologists	Emergency managers	Other
First workshop, September 2018, Niamey, Niger	49	31	11	7
Second workshop, April 2019, Accra, Ghana	48	27	11	10
Third workshop, February, Abuja, Nigeria	58	37	13	8

Table 2. Countries and organisations that have actively participated in at least one of the three workshops.

Country	Organisations
Benin	Direction Générale des Ressources en Eau, Agence Nationale de la Protection Civile
Burkina Faso	Autorité du Bassin de la Volta, Secrétariat Permanent du CONASUR, Direction Générale des Ressources en Eau
Cape Verde	Agência Nacional de Água e Saneamento
Chad	Direction des Ressources en Eau, Commission du Bassin du Lac Tchad
Gambia	Regional Disaster Management, Centre National de Gestion des Catastrophes et des Urgences Environnementales
Ghana	Hydrological Services Department, National Disaster Management Organisation
Guinea	Direction Nationale de l'Hydraulique, Centre National de Gestion des Catastrophes et des Urgences Environnementales
Guinea Bissau	Direction Générale des Ressources Hydriques, Service National de Protection Civile
Ivory Coast	Direction de l'Hydrologie, Plateforme Nationale pour la Réduction des Risques et Gestion des Catastrophes
Liberia	National Disaster Management Agency, Liberian Hydrological Service
Mali	Direction Générale de la Protection Civile, Direction Nationale de l'Hydraulique
Mauritania	Direction Aménagement Rural
Niger	Direction Nationale de l'Hydraulique, Direction Générale de la Protection Civile, Niger Basin Authority, AGRHYMET
Nigeria	Nigerian Hydrological Services Agency (NIHSA), National Space Research and Development Agency (NASRDA), North-South Power Company Limited, Shiroro (NSPCL SHIRORO)
Senegal	Direction de la Gestion et de la Planification des Ressources en Eau, Direction de la Protection Civile, Organisation de Mise en Valeur du Fleuve Gambie
Sierra Leone	National Water Resources Management Agency
Togo	Agence Nationale de la Protection Civile, Direction des Ressources en Eau
Switzerland	World Meteorological Organisation (WMO)

3.1.1 Workshop 1 (Niamey, Niger, 2018)

The 1st workshop took place on 17-20 September 2018 in Niamey, Niger. The main goal of this first workshop was to co-design the operational hydrological forecasting and alert system, to build conceptual understanding around the system, and train on the available system components. Representatives from national and regional agencies from 17 countries in West and Central Africa participated (Figure 1, Table 2).

Figure 1. Workshop participants in Niamey, Niger (September 2018).

The workshop established the current state of flood forecasting systems in West Africa and the expectations of the delegates on FANFAR. All invited participants presented three slides with their answers to specified questions. The presentations were drafted and revised based on feedback from project partners, so that only the key messages were presented instead of long text-heavy presentations (**capacity theme A**). The questions used were:

- Current information/production system for flood forecasting:
  - From where do you get your information?
  - Which data do you use for prediction?
  - How do you produce your flood forecast?
- Distribution channels on flood forecasting
  - To whom do you provide information?
  - In which form do you provide information?
  - Do you use scientific method to refine the original flood forecast to specific customers/users (tailoring)?
- Wish list for the future
  - What do you find most urgent to improve in your current system/production chain?
  - What is your ideal production system (long-term vision)?
  - What are you expecting from the FANFAR project?

The FANFAR prototype systems for streamflow forecast production (Hydrology-TEP) and visualisation (http://fanfar.eu/) were presented in detail to the participants. This was to build the conceptual understanding of an operational hydrological forecasting and alert system (**capacity theme B**).

Experiences from using the Hydrology-TEP and expectations from the forecast visualisation system were shared. Then all participants experimented with the systems and suggested adaptations during practical sessions and exercises (**capacity themes C and E**).

Preferences when adapting the flood forecasting systems to user needs were discussed (**capacity themes B, C, D, E, F**). This focused on identifying and prioritizing system options (how the system should be configured to meet the objectives). An exercise to reach consensus about which objectives are important and how to measure them was held. Then the participants were split into three groups to run in parallel exercises to co-design the forecast production and visualisation systems, to create and specify system options that are adapted to user needs using different methods (Figure 2).

Figure 2. Participants at the workshop in Niger, taking part in discussions (September, 2018).

The Executive Summary from this workshop can be found at https://fanfar.eu/news/executive-report-from-the-1st-workshop/.

3.1.2 Workshop 2 (Accra, Ghana, 2019)

The 2nd workshop took place on 9-12 April, 2019 in Accra, Ghana. Representatives regional and national agencies from 16 countries in West and Central Africa participated (Figure 3, Table 2).

Figure 3. Participants at the 2nd workshop in Accra, Ghana in April, 2019.

The main activities at the workshop were:

- Presentation of the updated forecasting and alert system (**capacity theme A and B**)
- Hands-on exercises on how to use system and interpret its outputs (**capacity theme C**)
- Clarification of institutional roles in an operational system (**capacity theme D**)
- Co-design activities aimed at prioritizing system improvements (**capacity theme E**)
- Planning of actions to test the system and contribute to its improvement during the forthcoming rainy season (**capacity theme E**)

The progress on the hydrological forecasting and alert system was presented, including all of its components: meteorological data, hydrological modelling, in situ hydrometric observations, EO-based water level data, flood risk derivation, the Hydrology-TEP production environment, the visualisation portal, and the support system (**capacity theme A and B**). Intertwined in each presentation was a continuous dialogue with the participants on how to improve the system and what to prioritize (**capacity theme E**, Figure 4).

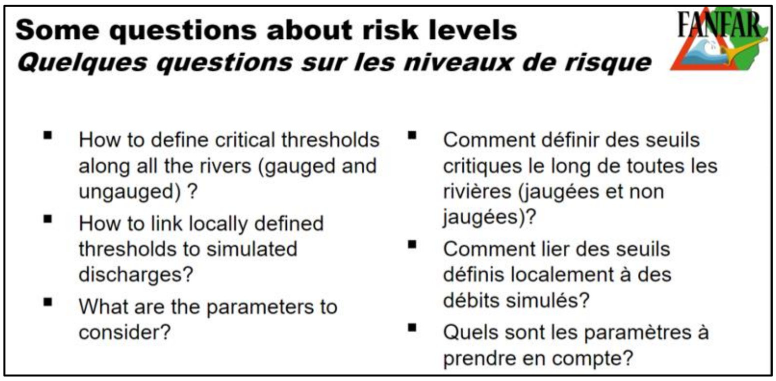


Figure 4. Example of co-design questions in English and French relating to flood risk derivation and tailoring to fit the specific countries (from presentation material).

Several sessions were held focussing on how to access, analyse and interpret the FANFAR information (**capacity theme C**). In particular, practical hands-on exercises were held focussing on the FANFAR visualisation portal (https://fanfar.eu/ivp/), accessing information from it, interpreting the data, graphs and maps available through it, and co-designing how it should be improved. These were designed in such a way that the participants were tasked to answer specific questions, and find the answers in the portal, which made it concrete and productive. Training during a sequence of days allowed the participants to grasp the fact that the system is updated every day since the information and answers to the questions also changed (Figure 5).

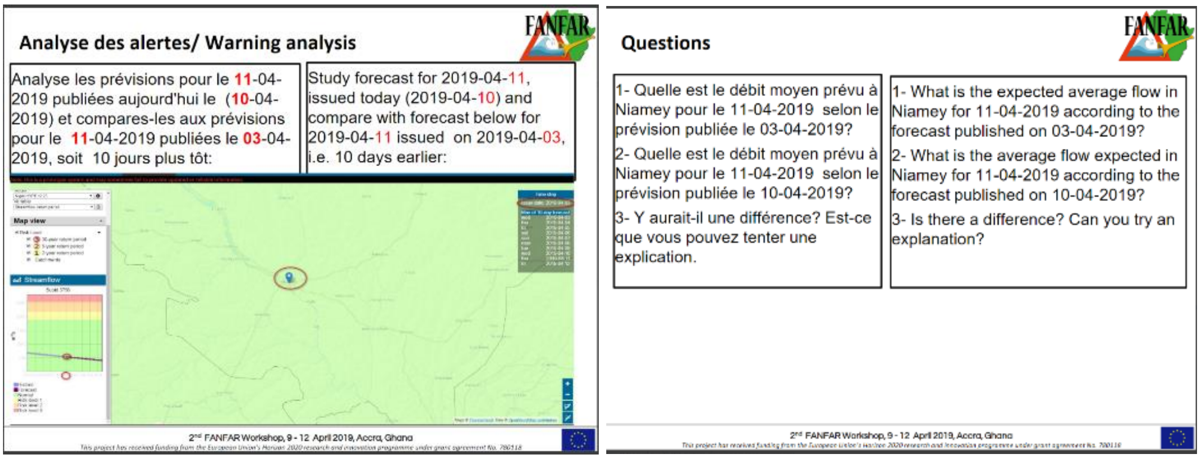


Figure 5. Example questions from the hands-on exercise on the FANFAR visualisation portal

Another set of exercises were held focussing on producing and accessing forecasts on the Hydrology-TEP (**capacity theme D**, Figure 6), and on mapping alerts with open-source GIS tools to facilitate appropriate communication and hazard response (**capacity theme C and F**). A dedicated session was also held for system developers with programming skills focussing on advanced usage of and contribution to the Hydrology-TEP platform (**capacity theme D**). This included e.g. data access and exchange protocols (API, Figure 6), data formatting and nomenclature, code structure and essential components of a processing service on Hydrology-TEP, how to work with virtual machines and version control etc.

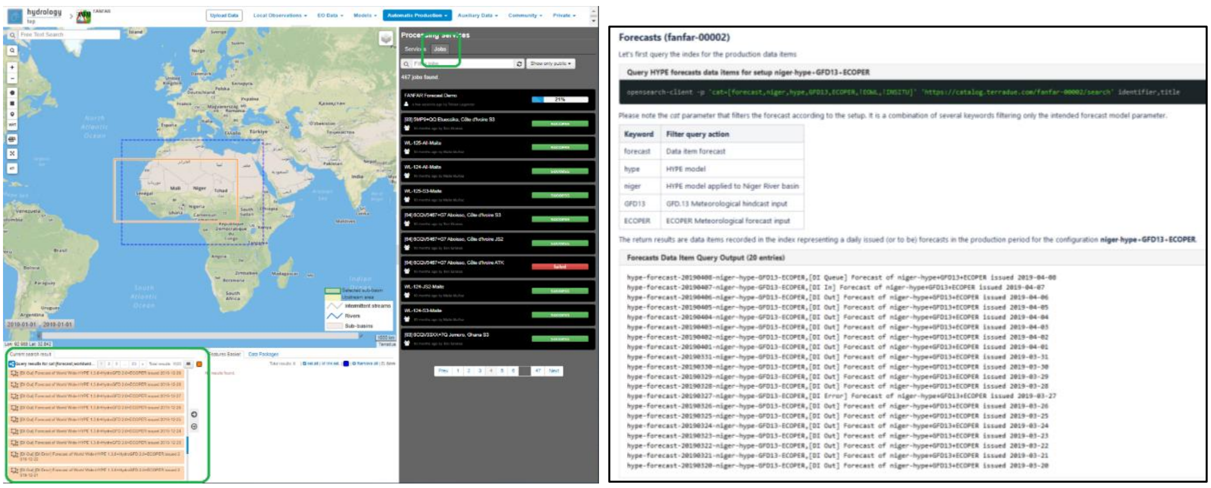
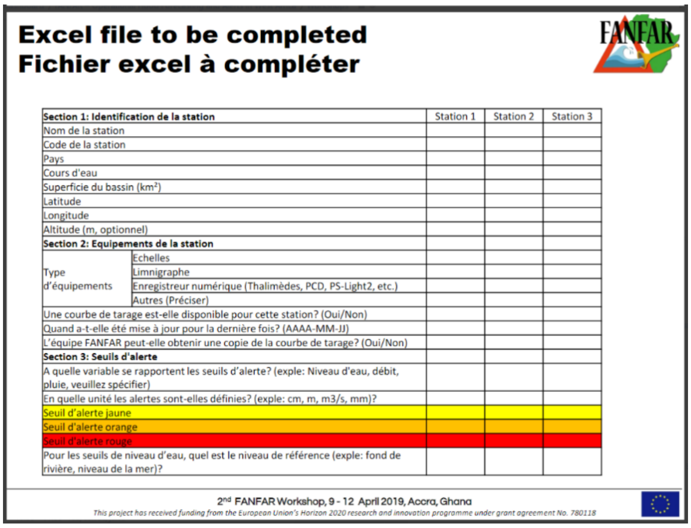


Figure 6. Left: exercise to produce forecasts interactively on Hydrology-TEP. Right: Advanced programming interface to interact with data on Hydrology-TEP through the "opensearch" software.

During the second workshop the participants also contributed with specific information by identifying flood-prone areas in each country and by defining the local alert thresholds that are used at specific hydrometric gauging sites (**capacity theme E**, Figure 7) making it more appropriate for local hazard response (**capacity theme F**). This contribution served as a foundation for further improvements of the flood alert representation in the information derivation algorithm (subsequently programmed by AGRHYMET). In connection to this, plans were also set for all participants to test the system during the forthcoming rainy season, and begin to contribute to its improvement by supplying operational streamflow observations to the system (**capacity theme D**).


Excel file to be completed
Fichier excel à compléter

Section 1: Identification de la station		Station 1	Station 2	Station 3
Nom de la station				
Code de la station				
Pays				
Cours d'eau				
Superficie du bassin (km²)				
Latitude				
Longitude				
Altitude (m, optionnel)				
Section 2: Equipements de la station				
Type d'équipements	Echelles			
	Limnigraphe			
	Enregistreur numérique (Thalimèdes, PCD, PS-Light2, etc.)			
	Autres (Préciser)			
Une courbe de tarage est-elle disponible pour cette station? (Oui/Non)				
Quand a-t-elle été mise à jour pour la dernière fois? (AAAA-MM-JJ)				
L'équipe FANFAR peut-elle obtenir une copie de la courbe de tarage? (Oui/Non)				
Section 3: Seuils d'alerte				
A quelle variable se rapportent les seuils d'alerte? (exple: Niveau d'eau, débit, pluie, veuillez spécifier)				
En quelle unité les alertes sont-elles définies? (exple: cm, m, m3/s, mm)?				
Seuil d'alerte jaune				
Seuil d'alerte orange				
Seuil d'alerte rouge				
Pour les seuils de niveau d'eau, quel est le niveau de référence (exple: fond de rivière, niveau de la mer)?				

2nd FANFAR Workshop, 9 - 12 April 2019, Accra, Ghana
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 780118

Figure 7. Local alert thresholds were collected from each country using the above template.

Finally, a roleplay activity was conducted to help clarify roles and responsibilities of different actors in an operational hydrological forecasting and alert system. In this way all participants were tasked to imagine that they had a different role compared with their professional role, and then indicate e.g. how they would act or what information would be most important to receive from the system (Figure 8). This helped set the frame for more detailed discussions on future operation and maintenance of the system (**capacity theme D**).

Figure 8. Roleplay to help clarify roles and associated needs in an operational hydrological forecasting and alert system.

All material produced for the workshop, including the agenda, presentations and exercises, were shared through USB sticks to the participants and also put online for public use at the FANFAR Knowledge Base (https://knowledge.terradue.com/display/FANFAR/Second+workshop%2C+9-12+April+2019%2C+Accra%2C+Ghana)

3.1.3 Workshop 3 (Abuja, Nigeria, 2020)

The third workshop was hosted by the Nigerian Hydrological Services Agency (NIHSA) and took place at Hotel De Bently 10th – 14th February 2020, in Abuja, Nigeria. The workshop hosted 58 participants, primarily the hydrologists and emergency managers that had participated in the previous workshops, but also a set of new participants (Figure 9). Taking advantage of the fact that the workshop was held in the Nigerian capital, several key persons from other agencies in Nigeria (e.g. NIMET and NASRDA) were also participating. Two representatives from the World Meteorological Organisation (WMO) were present the entire week, in their role as members of the Advisory Board. At the opening session, the director general of NIHSA, the director general of AGRHYMET, the head of economic cooperation & energy at the EU delegation to Nigeria and ECOWAS, and the Swedish Ambassador to Nigeria were also present. At the closing ceremony, a representative of ECOWAS also participated. News coverage of the workshop was on national Nigerian TV and in newspapers (AIT news, Nigerian Pilot, Sundiata Post).

Figure 9. Workshop participants in Abuja, Nigeria (February 2020).

In this workshop, the main objectives covered **capacity themes A, B, C, D, E and F,** and were to 1) share and discuss user experiences with the FANFAR forecasting system during the 2019 rainy season; 2) summarise the technical developments of the pilot forecasting and alert system; 3) practice on how to use the system; 4) review the stability of user objectives and preferences; 5) refine communication strategies of FANFAR outputs; 6) prepare to test the system during 2020; and 7) advance toward long-term sustainability.

Each country and regional institute were tasked to summarize their experience from using the FANFAR system during the 2019 rainy season using short flash presentations based on a common template. Prior to the live presentations, we held a review and feedback session in which all presenters were encouraged to improve their presentations, e.g. in terms of formulating a succinct and clear message and avoid lengthy texts, and to illustrate it with concrete evidence from their domain (**capacity theme A,** Figure 10).

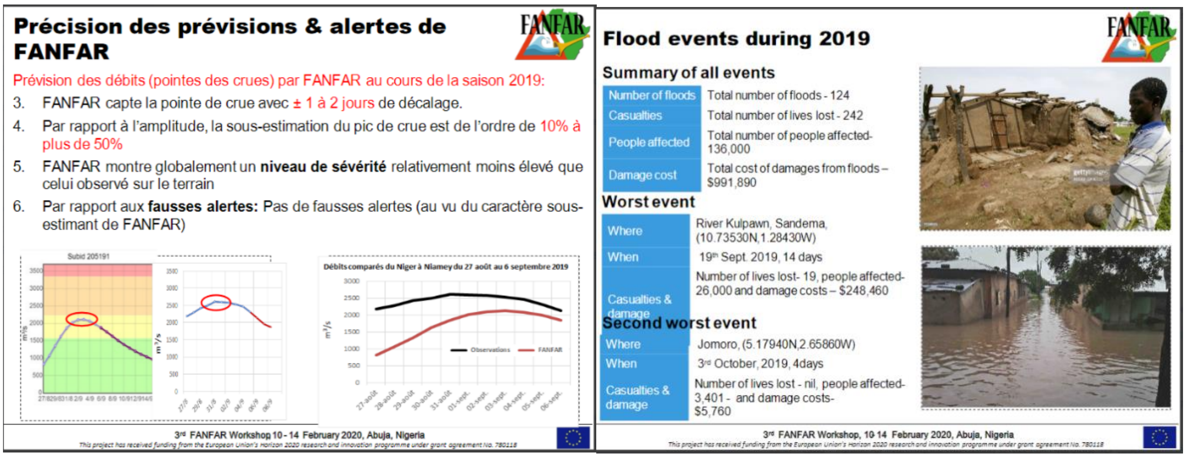


Figure 10. Example of presentations giving feedback on using the FANFAR system during the 2019 season, from AGRHYMET (left) and Ghana (right).

A substantial focus was put on raising the capacity around understanding the operational forecast and alert information, and being able to handle the free and open access to it through the visualisation portal. A central aspect is to grasp the way forecasts are post-processed into alert information, based on certain thresholds. A presentation was held to describe how the system currently worked, and a feedback session followed suit to co-design future improvements to the approach (**capacity theme B and E**, Figure 11-left). This was then followed up by hands-on exercises with the FANFAR visualisation portal, to ensure that all participants (old and new) grasped all the main features of it and were able to interpret the flood risk information available through it and prioritize how it should be improved (**capacity theme C and E**, Figure 11-right).

Figure 11. Left: AGRHYMET presenting and leading a feedback session on the way forecasts are post-processed into alert information. Right: Rands-on exercise with the FANFAR visualisation portal. AGRHYMET, NIHSA and all other project partners assists the national, regional and international participants in utilising the portal and interpreting its results.

Recognizing that all issues and questions do not emerge during a workshop, we highlighted the key ways in which the participants can get further support during the rainy season. In this process we also decided to launch a new communication channel through the WhatsApp social media platform, since many participants were already acquainted with that system and hence the barrier for using it was lower. It was constructed as a community in which all participants could pose questions, contribute with answers, but also to pass on forecast information and provide experiences from the field. This contributed to empowering the entire community toward handling more and more components of the system (**capacity theme B, C, D, E, F**).

Similar to Workshop 2, the progress on the hydrological forecasting and alert system was presented, including all of its components (**capacity theme A and B**). Intertwined in each presentation was a continuous dialogue with the participants on how to improve the system and what to prioritize (**capacity theme E**).

Since forecast accuracy was judged as most important by the participants (Deliverable 2.2), a set of sessions were held to illustrate the present accuracy as well as ways in which it could be improved. The evaluation of the forecast accuracy (Deliverable 3.2) indicated a significant opportunity to improve accuracy through assimilation of local hydrometric gauge observations and potentially also EO data. For this purpose, the national and regional agencies had already shared some observations during and after Workshop 2, which had been integrated into Hydrology-TEP. We therefore held a hands-on session on Workshop 3, in which all participating hydrologists were tasked to access and quality control the integrated observations. In this way the local expertise of the West African hydrologists was effectively combined with the FANFAR ICT experts to jointly improve the system (**capacity theme E,** Figure 12-**l**eft). A clear set of actions were also defined in which all hydrological agencies were encouraged to continue and expand their contributions to the system during the upcoming 2020 rainy season. This requires e.g. consistent data management (e.g. file formats) and operational procedures (e.g. a biweekly WhatsApp meeting), which were hence described and jointly refined to be applicable during the rainy season (**capacity theme D**, Figure 12-right).

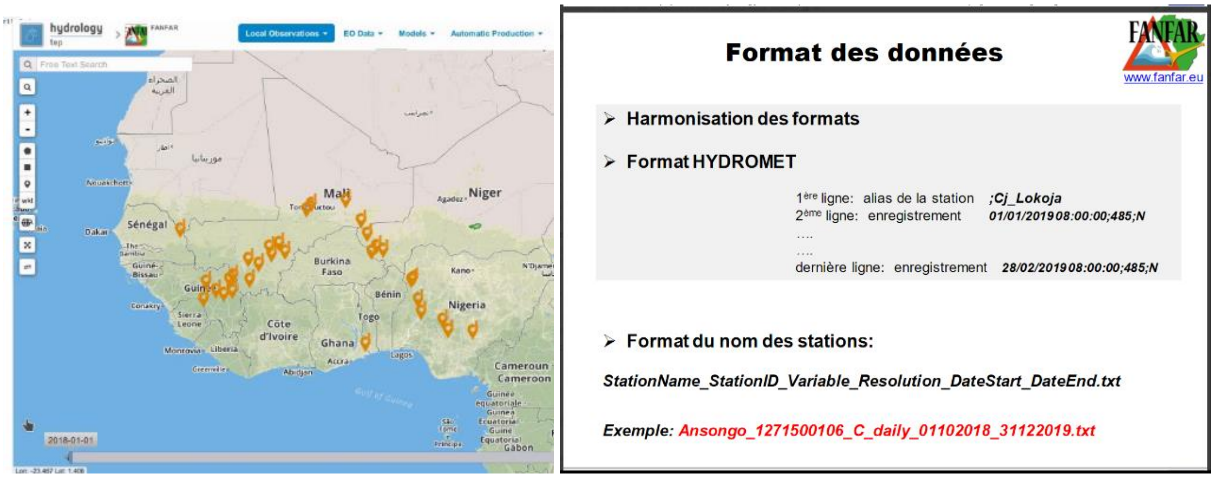


Figure 12. Left: local hydrometric observations integrated into the Hydrology-TEP operational production platform of FANFAR. Right: Example of the activity to improve data management by harmonizing data formats and nomenclature to enable operational ICT systems to automatically utilize the available observations to improve the forecast system.

To further ensure the West African participants would be able to utilize the system during the 2020 rainy season, a set of sessions were held revisiting how to access and retrieve automatically produced forecasts on Hydrology-TEP, how to interactively produce your own forecasts, and what each output file contains (**capacity theme C**, Figure 6). Moreover, a practical hands-on exercise session was held in which the forecast data and local observations were used to create graphs and maps in order to effectively interpret the information (**capacity theme C**, Figure 13).

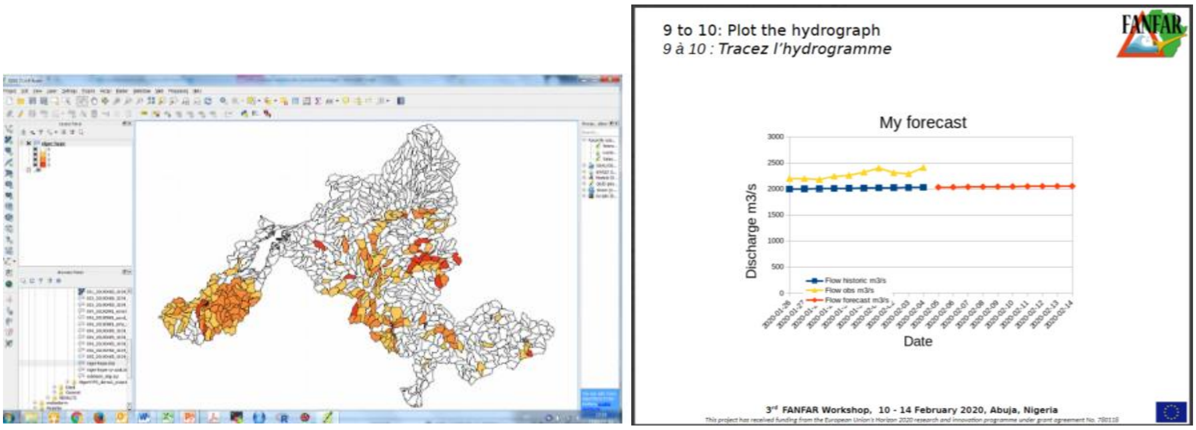


Figure 13. Results from exercise on creating maps and graphs from the forecast output data and local observations.

Risk information is useful only to the extent it can be effectively communicated, and that appropriate hazard response measures are taken. A set of interactive exercises were therefore arranged with the participating emergency managers focussing on these topics (**capacity theme F and E**). The risk communication exercise centred around the seemingly simple question "How to get information from FANFAR to the user?", which may not be as simple in practice. Specifically, the participants were tasked to judge the suitability of the content, format and channel in which the information is conveyed from FANFAR to the emergency managers, and from emergency mangers to downstream stakeholders (e.g. the general public) in different flood risk scenarios. The options discussed for each category are presented in Table 3. The results clearly indicated the need for conveying the information in different formats and through different channels to emergency managers (e.g. using maps) compared with to the general public (for which e.g. photos or text were judged more appropriate formats). Hence it underlines the critical need to raise capacity on how to understand and interpret the information correctly (**capacity theme B and C**) in order for it to be passed on in the most effective way. The hazard response activity focussed on another key question "who should do what and when?" It was mainly an exploratory dialogue which served to raise the capacity of thinking strategically and systematically about appropriate actions to take for various actors in various situations.

Table 3. Risk communication exercise focussing on assessing the suitability of content(s), format(s) and channel(s) to convey flood risk information.

Content	Format	Channel
• Severity level (e.g. red/level 3) • Location (e.g. Abuja) • Time (e.g. tomorrow) • Uncertainty (e.g. 70% risk) • Expected consequence (e.g. affecting 1000 people) • Suggested action (e.g. evacuate and move valuables) • Responsibility (e.g. ensure family is safe) • Contact (e.g. call 1234 for more information)	• Probabilities (e.g. 100-year return period) • Text (i.e. full sentences in common prose) • Personal accounts (e.g. "I remember… and that is what may come again in two days." • Photos of past events • Graphics (e.g. symbols and infographics) • Maps	• Printed media (e.g. flyers, newspaper ads.) • Banners, posters, flags • Social media (e.g. WhatsApp) • E-mail • SMS • Radio/TV • Flood wardens knock on doors • Sirens & megaphones • Website (e.g. FANFAR visualisation portal)

Toward the end of the workshop, a clear strategy was formulated on how to test the system during 2020. Finally, to advance toward long-term sustainability, a session highlighting gender and human diversity was arranged, along with a discussion on other important factors for sustainability.

All material produced for the workshop, including the agenda, presentations and exercises, were shared through USB sticks to the participants and also put online for public use at the FANFAR Knowledge Base (https://knowledge.terradue.com/display/FANFAR/Third+workshop%2C+10-14+February+2020%2C+Abuja%2C+Nigeria).

3.2 FANFAR Support Channels

The FANFAR project offers user support on several levels through different channels. Initially three support channels were envisioned and implemented (i.e. Knowledge Base, Forum and Help Desk, Figure 14), however as the project advanced we also implemented a fourth channel based on social media.

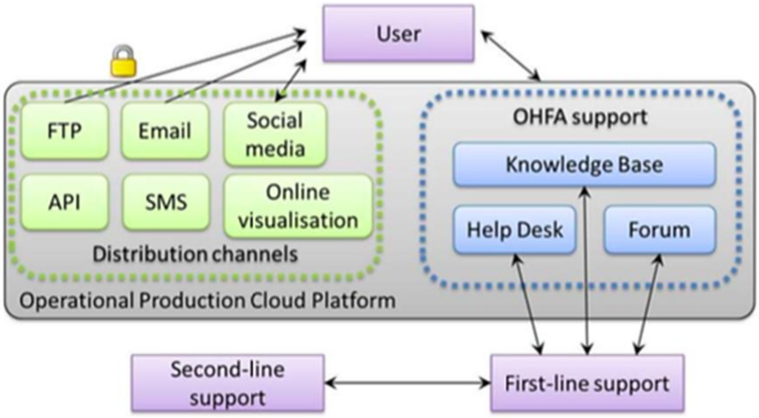


Figure 14. Blue section: the main user support channels in the FANFAR project at the onset of the project (Knowledge Base, Help Desk and Forum).

3.2.1 Knowledge Base

The FANFAR system is an advanced technical system, and all features of it are not immediately intuitive. Moreover, the system goes through continuous development and adaptation and hence evolves over time. Therefore, there has been a clear need to create and maintain an up-to-date and easily accessible reference database – i.e. the FANFAR Knowledge Base – explaining the system (Figure 15, https://knowledge.terradue.com/display/FANFAR). The Knowledge Base is hence the key FANFAR tool in which users can raise their own capacity by studying and applying the content of the Knowledge Base (**capacity theme A, B, C, D, E, F**). The Knowledge Base offers this through an openly accessible and searchable website and includes documentation, user guides, exercises, short video tutorials, presentations, workshop material, code examples etc. The wiki-style website also offers the FANFAR user community to contribute with improvements. The Knowledge Base has been exported (except for the videos) and shared as PDF to the workshop participants to ensure offline access to the information. In total the content currently covers 142 A4-pages (excluding videos).

The Knowledge Base is divided in sections that provide from a general overview of the service to a more detailed description of the different core elements of the FANFAR forecasting and early warning system. These divisions help direct less-advanced users to the most appropriate material, and subsequently more advanced users to the information most useful for them.

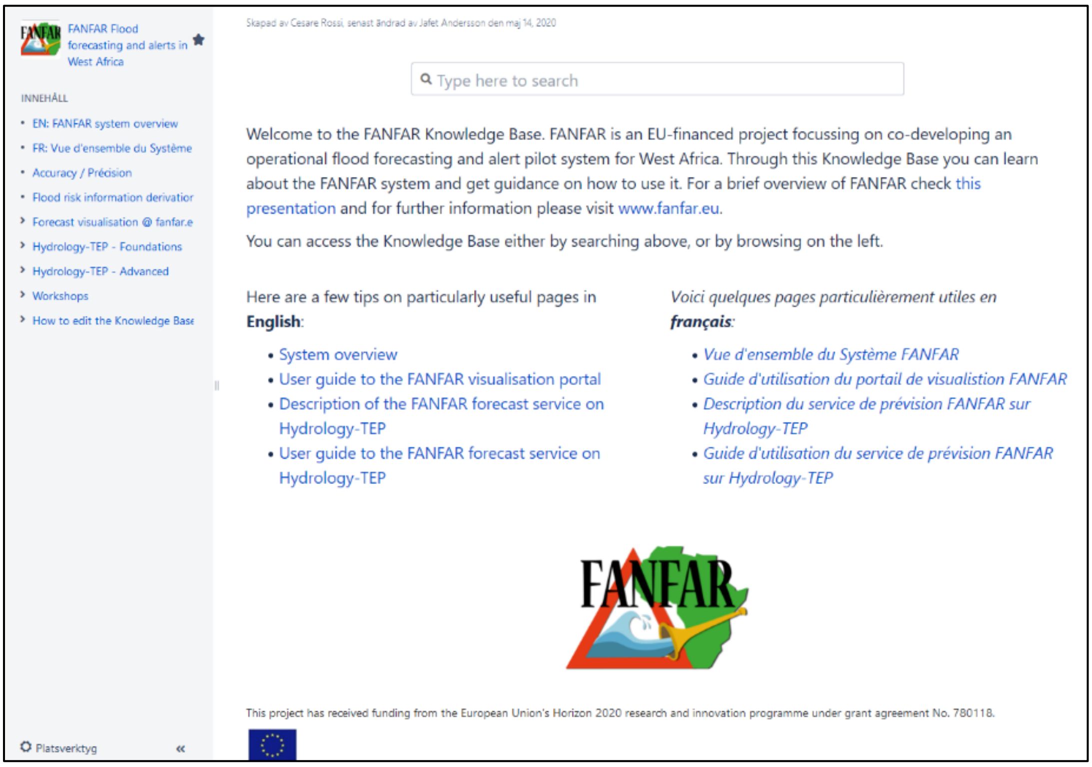


Figure 15. Screenshot of the first page in the Knowledge Base, https://knowledge.terradue.com/display/FANFAR.

The Knowledge Base gives information on the following topics, in English and in French:

- FANFAR system overview

An overview description of the FANFAR system producing operational short- and medium-term flood forecasts and alerts for West Africa, including the system architecture and responsible partners.

- Accuracy

It is highly important to understand the accuracy of the forecasts produced by the FANFAR system. Several efforts aimed at understanding and clarifying this forecast skill have either been carried out or are in the process of being carried out. This section collects all accuracy assessments available to date, and links to different reports and publications.

- Flood risk information derivation

FANFAR uses a terminology based on the United Nations Sendai Framework for Disaster Risk Reduction. (United Nations, 2016, Report A/71/644). This page gives an adapted version of the key concepts and definitions used by FANFAR. It also provides a description of the methods used to derive flood risk and flood hazards (e.g. threshold exceedance based on return periods).

- Forecast visualisation @ fanfar.eu

This section is dedicated to FANFAR's Interactive Visualisation Portal (IVP). It provides detailed information to guide users with examples on how to use all features of the IVP with labelled figures and instructions (e.g. Figure 16 showing how to use the Location menu to find a gauge of interest).

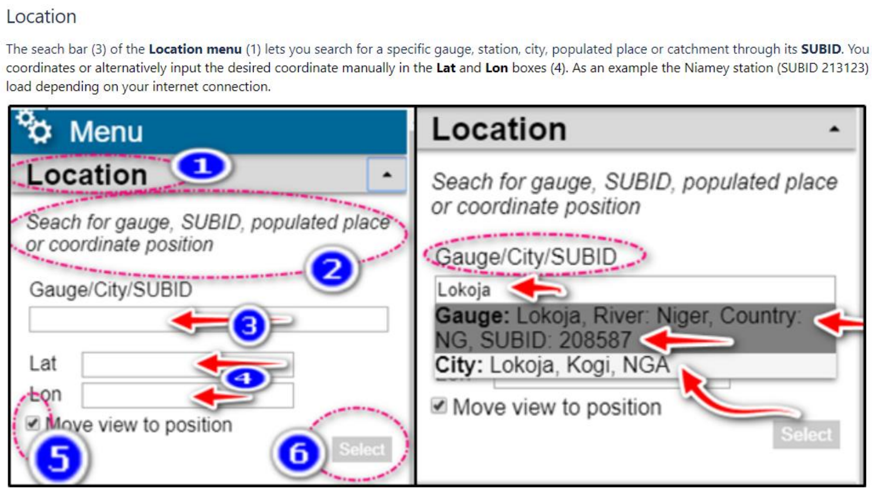


Figure 16. Example of user guidance on the Knowledge Base, showing how to select a location of interest and access the forecast relevant to this location.

- Hydrology-TEP - Foundations

This section of the Knowledge Base includes detailed information on the Hydrology-TEP platform for beginners and uses of the interactive web interface. For example, it describes what Hydrology-TEP is, how to register. It also provides detailed documentation of the FANFAR processing services (the underlying algorithms and code producing new forecasts every day), and a set of user guides describing how to utilize the services interactively (Figure 17). It also provides an overview of all the model configurations in FANFAR, both currently operational versions and earlier versions (in total 9 different configurations so far).

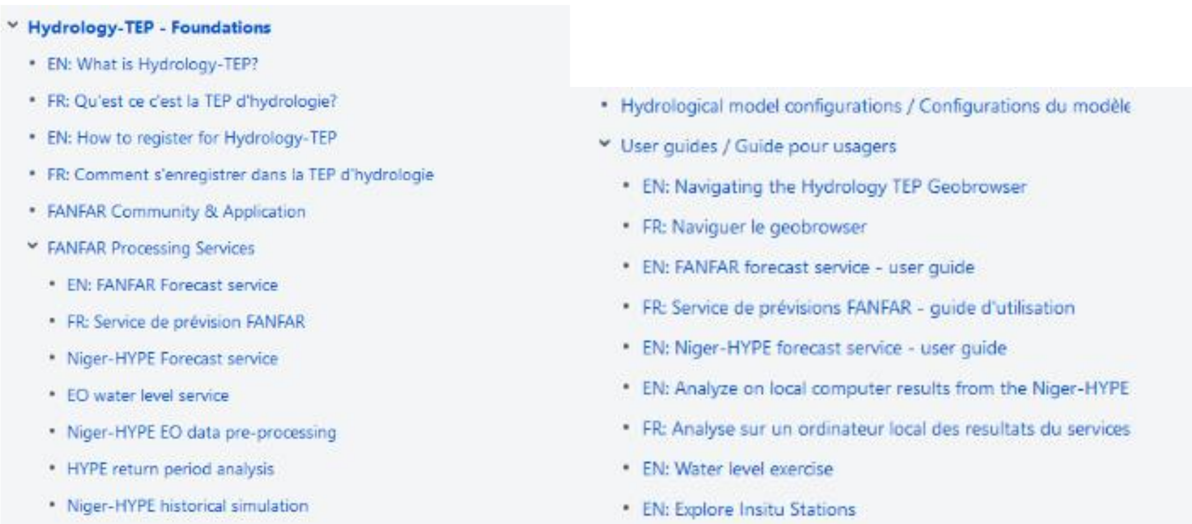


Figure 17. The topics under the section Hydrology-TEP – Foundations aimed at beginners and interactive users of Hydrology-TEP.

- Hydrology-TEP - Advanced

This section is aimed at advanced users of Hydrology-TEP, with programming skills and mainly interacting with the portal through APIs and scripted procedures. It contains documentation, user guides and code examples to perform advanced operations on the Hydrology-TEP. Topics include:

- Starting a T2 Developers Sandbox Virtual Machine (VM)
- Discovering & exploring FANFAR systematic scheduled production indices from the Data Catalogue using the API and the command line interface
- Downloading and uploading data from store using API
- Prepare & produce new data from external source and index them in the catalogue
- Create a new data series in the catalogue and publish in FANFAR App

• Workshops

In this section, one can find information and documents related to the workshops that have been held during the FANFAR project. Each workshop links to presentations, summaries of results and other supplementary information. The workshops linked in this section are:

- First workshop, September 2018, Niamey, Niger
- Second workshop, April 2019, Accra, Ghana
- Third workshop, February, Abuja, Nigeria

• How to edit the Knowledge Base

The pages in this section provide some practical tips on how to edit the Knowledge Base, which is built on the Atlassian Confluence system. It is intended to summarize the most relevant tips on using Confluence, in order to assist intra-community contributions to improve the Knowledge Base.

3.2.2 Video Tutorials

As a complement to the Knowledge Base, a set of video tutorials were created upon request from the user community. The video format offers an added ability to show the exact actions required to perform a certain task, and explain how to interpret certain visible features. In this way it is closer to the live coaching offered at the workshops, and such videos were specifically requested by the workshop participants and hence produced (**capacity theme B and C**). The videos were recorded in English, with French subtitles. Two videos focus on the FANFAR visualisation portal, and eight other videos give details in how to use and access different aspects of the Hydrology-TEP (Figure 18). All the videos were uploaded to a FANFAR playlist on YouTube (https://www.youtube.com/playlist?list=PLY03ZNzcRmDZZSlP-p-wd1fqVM6ovpe5h), and were then embedded into the Interactive Visualisation Portal and the Knowledge Base. In November 2020, the playlist had been viewed 74 times, and the video most often viewed was 'Overview of FANFAR Visualisation Portal (111 views), followed by 'Exploring in-situ stations' (32 views).

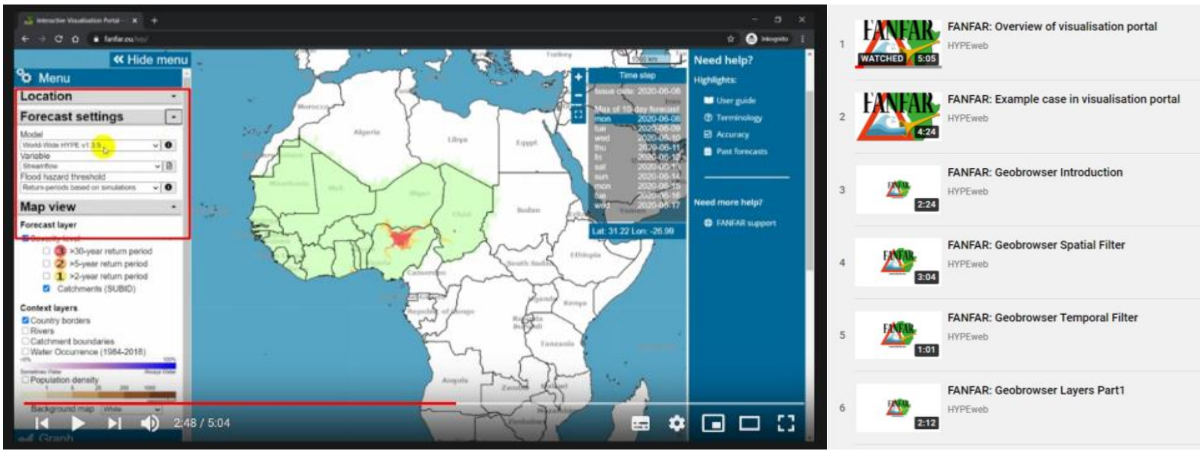


Figure 18. Left: example screenshot from the video presenting an overview of the interactive visualisation portal. Right: The YouTube playlist of FANFAR videos.

3.2.3 Forum

The FANFAR forum was created for people to ask open questions to developers or other users of the system (**capacity theme B, C, D, and E,** Figure 19). It was setup and made accessible to everyone with a Hydrology-TEP account. However, we found that it was not very much used during the project, and that users preferred interacting through e.g. email and WhatsApp instead.

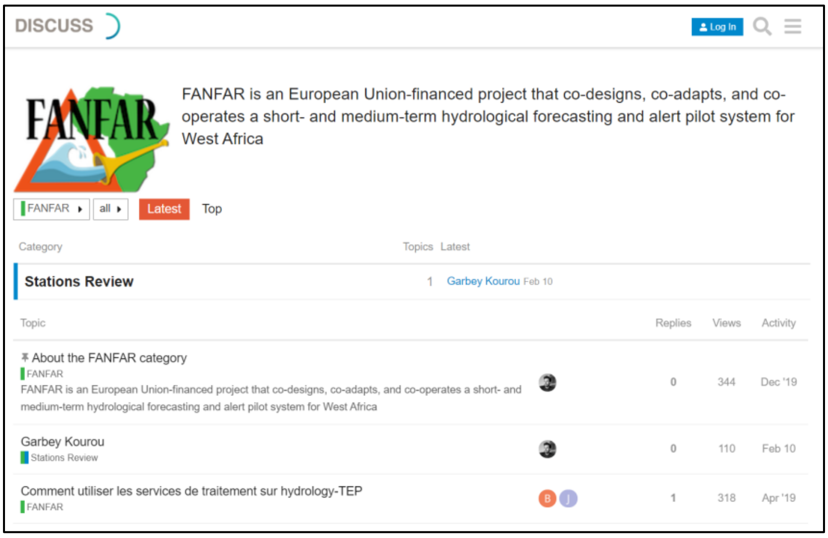


Figure 19. The FANFAR forum, found at https://discuss.terradue.com/c/fanfar/46

3.2.4 Help Desk

The Help Desk is a dedicated support channel for FANFAR project participants and associated organisations to get help and thereby raise their capacity on any topic (**capacity theme A, B, C, D and E**). It is essentially a professional ticketing system, coherently managing questions and responses by users and support agents in a traceable and time-controlled manner (Figure 20). The main difference to conventional email exchange is that the questions and answers are managed in one place (not getting lost in the regular email flood), that questions are allocated to the most appropriate respondent (not necessarily the project coordinator or any other contact), and that response-times can be easily tracked. Compared with the Forum, the Help Desk is a closed system, enabling communication on potentially sensitive topics without anyone else reading the conversation. In August 2020, 48 tickets had been received in total. Approximately half of the tickets were for technical support, about a quarter of the requests were related to registration and the remaining tickets related to test tickets sent by partners in the project and users.

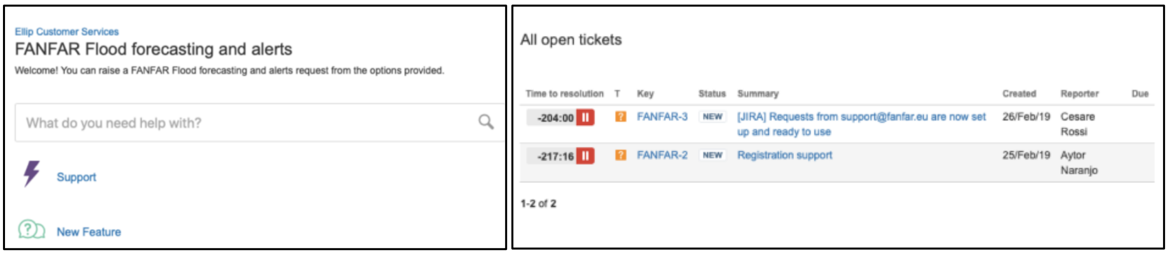


Figure 20. The FANFAR Help Desk system. Left: the interface for users to ask questions. Right: the dashboard for support agents to manage questions and respondents to interact with users, and keep track of the conversation history.

3.2.5 WhatsApp Chat

During the project we learned about the widespread use of WhatsApp in West Africa. Therefore, a chat group was created on the social media platform aiming to a) create a West African FANFAR community by connecting all workshop participants, b) to share experiences of flood issues and forecasting performance during the rainy season, and c) to connect FANFAR developers and users to facilitate exchange and support. There were 41 users in the group from all 17 countries involved in FANFAR. Initially the group consisted only of workshop participants, but upon request several additional stakeholders (e.g. dam managers) were subsequently added. The chat channel was used to share updates on the rainy season situation in different regions, what the FANFAR system showed during flooding, to ask questions and discuss hazard responses (**capacity theme A, B, C, D, E and F**). Some users also gave feedback on the FANFAR system in specific locations (Figure 21). Photos of the flooding situation, news articles, documents and video links were shared. It was in English and in French.

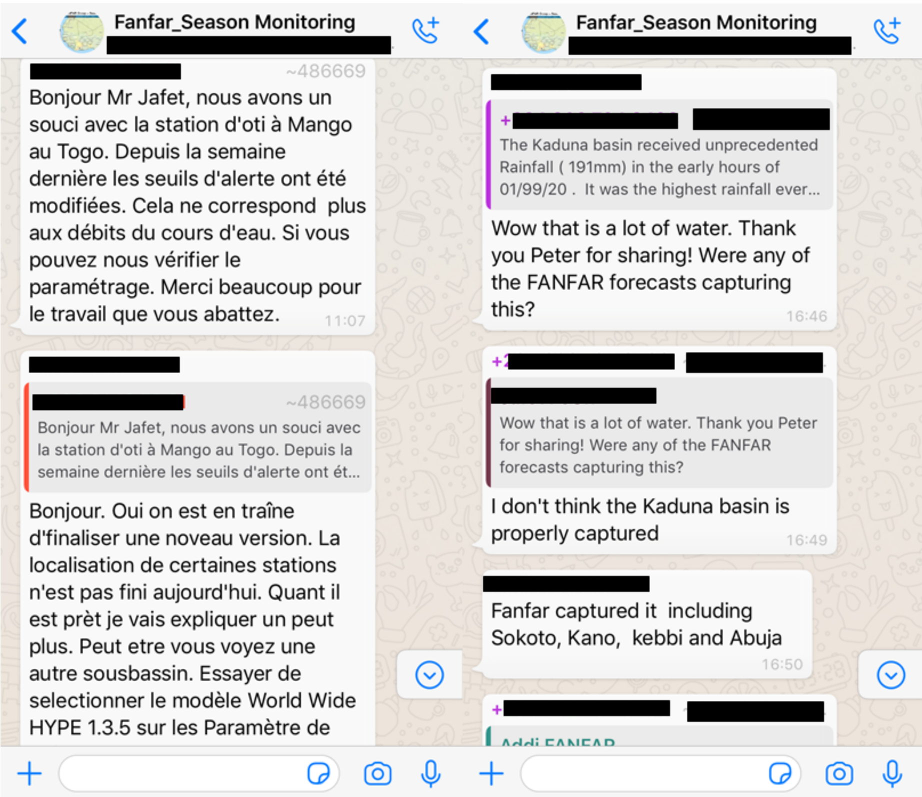


Figure 21. Examples of the chat on WhatsApp, with questions and feedback on the FANFAR system being discussed.

3.3 Additional Capacity Development Activities

3.3.1 Courses in hydrological modelling

All FANFAR participants were invited to apply for the annual HYPE course in 2018 and 2019. It is a technical course aimed at learning how to use, calibrate and otherwise improve the hydrological model HYPE, which is the model code employed to produce the hydrological forecasts in FANFAR. In total 10 FANFAR participants were selected and participated in the 2018 or 2019 course at SMHI in Sweden (Figure 22). The course provides three days of training and hands-on exercises around setting up and improving the HYPE model in general, and the World-Wide HYPE model in particular (which is used in FANFAR). There are lectures and exercises about **capacity themes B, C, D, and E**, specifically:

- improving the World-Wide HYPE model setup in participants' regions of interest,
- including participants' own data e.g. in assessing model performance or refining catchment delineations, and
- strategies and tools for calibration and analysis.

Figure 22. FANFAR project participants from Burkina Faso, Ghana and Senegal at the hydrological modelling course in Norrköping, Sweden, 2019

3.3.2 Masters Courses at AGRHYMET and the PRESAO Regional Climate Outlook Forum

AGRHYMET runs a Masters course in Climate Change that includes approximately 1 week on hydrological modelling and flood forecasting. AGRHYMET uses that week to give train the students in general about hydrological modelling and flood forecasting and alerts, particularly focussing on the HYPE model and FANFAR platform. Two groups (of 15 and 17 students) have been trained in this way (Figure 23). The course is structured so that lectures presented by experts are followed by hands on technical exercises. The lectures cover different concepts of the HYPE model and 'how to' information, for example how to understand input and output data in the model, and how to use FANFAR to visualise flood forecasts. The students listened to the lectures, then did the exercises (**capacity theme B and C**). The ambition of this activity was to spread the capacity also to future generations of West African hydrologists. In this way they are better prepared to work with both the FANFAR system, but also more generally with any operational hydrological forecasting and alert system, which we consider essential in the region.

Figure 23. Hydrology engineering students during the training in using the FANFAR system, May 2020.

The PRESAO Regional Climate Outlook Forum is an important annual meeting focussed on providing a combined forecast of the overall hydrometeorological and agricultural situation expected in the forthcoming rainy season each year. It is organised, carried out and attended by both technical experts and high-level political representatives from all West African countries. It gathers a large part of the currently active expertise in hydrology in the region. To complement the seasonal outlook, this group was shown presentations on how to use the FANFAR platform, and explanations of the flood forecasts were given. Then the group carried out some practical exercises on accessing, visualizing and interpreting current flood forecasts using the FANFAR platform (**capacity theme B and C**). The ambition with this activity was to expand the capacity to spread the capacity to a wider group of currently active West African hydrologists and meteorologists (wider than those that could attend the FANFAR workshops).

3.3.3 Individual Expert Exchanges

Another type of capacity development activity which we have carried out is individual expert exchanges. They essentially consist of specific individuals visiting a partner institute for an extended period of time (up to a few months) working alongside experts on particular components of the forecasting system (**capacity theme D and E**). It is a form of on-the-job training with individual coaching combined with independent work. This was carried out during the autumn of 2019 when one person from AGRYMET visited SMHI in Sweden focussing on two components of the forecasting system (the meteorological input data and the information derivation/post-processing service). The exchange was very successful and considered key to advancing those components of the system and to also pave the way for West African institutions to eventually take the main responsibility for the operation, maintenance, and improvement of the system. One additional exchange was planned for the spring 2020, but the COVID-19 pandemic unfortunately made that visit impossible.

3.3.4 UN-SPIDER conference and workshop

In November 2019, UN-SPIDER invited FANFAR project members to present at the International Conference “Space-based Solutions for Disaster Management in Africa” held in Bonn, Germany.
The FANFAR presentation provided an overview of the project objectives, results as well as countries and stakeholders involved in West Africa (**capacity theme B)**. This was followed by a hands-on exercise session, which provided the opportunity to a group of experts in disaster risk reduction to understand how the FANFAR systems works from a technical and operational perspective (**capacity theme C and D**). The workshop was divided in a theoretical session about satellite-based altimetry, the HYPE hydrology model and how virtual stations can complement data from in-situ stations in data-sparse areas in Africa. The second part of the workshop concentrated on how to use the FANFAR interactive visualisation portal at fanfar.eu as well as step-by-step walk through the Hydrology-TEP. The ambition of this activity was to spread the capacity around FANFAR and Hydrology-TEP to disaster managers across Africa, who had not had the opportunity to attend the FANFAR workshops.

4. Conclusions

In conclusion, capacity development has been a central activity within FANFAR, as exemplified by the large number, the breadth, and the depth of activities, aimed at both present and future generations in West Africa and beyond. The capacity was also covering a wide set of themes – all considered essential for meeting the challenges the region is facing, namely

A. Succinct communication
B. Conceptual understanding of the forecasting and alert system
C. Access, analysis and interpretation of the forecasting and alert information
D. Operation and maintenance of the system
E. Contributions to improve the system
F. Risk communication and hazard response

It is our hope and belief that these activities together contribute to enhancing the capacity of West African societies to better manage the ever-increasing flood challenges in the region. It represents a significant step closer toward the vision of having an operational hydrological forecasting and alert system coordinated, operated, maintained, and refined by regional & national West African institutions. This is an essential and concrete climate change adaptation action in a region expected to experience even more severe flooding in the future.