Report

OUTLAST Stakeholders Engagement Workshop Lake Victoria Basin

04th and 05th September 2023
Nairobi, Kenya

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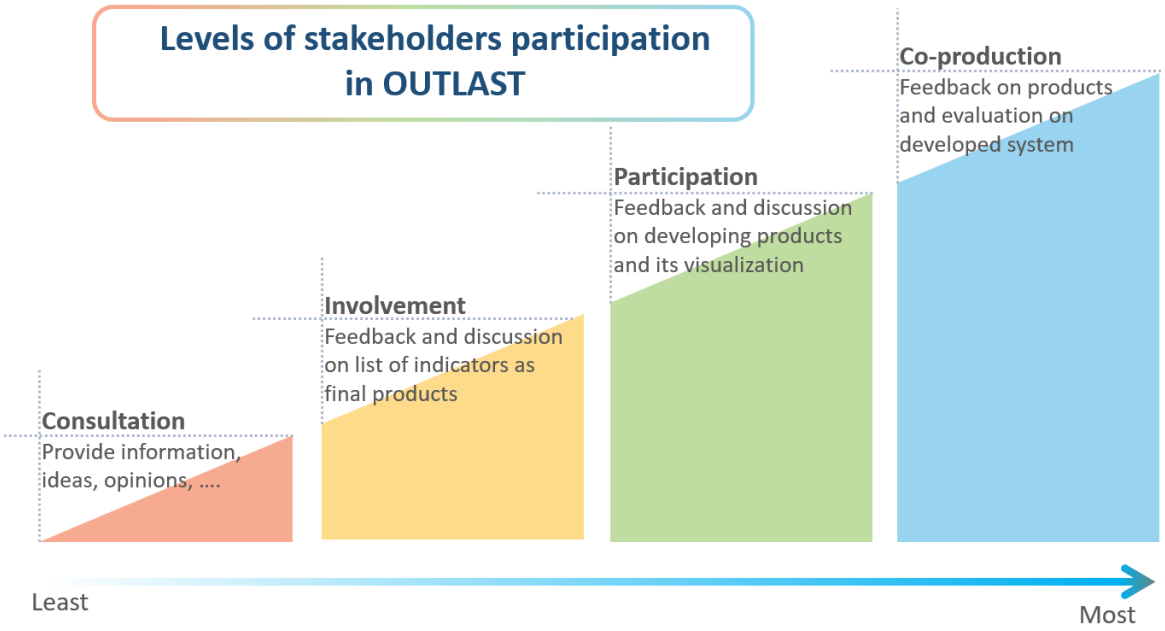
Introduction

OUTLAST (development of an operational, multi-sectoral global drought hazard forecasting system) is a research project funded by Federal Ministry of Education and Research (BMBF) to develop, for the first time, a forecasting drought hazard system across various sectors (water supply, riverine, and non-agricultural land ecosystems, rainfed and irrigated agriculture). Within OUTLAST a monthly model-based near-real-time drought hazard monitoring system which provides forecasts for the upcoming 6 months will be freely accessible via the HydroSOS web portal (WMO). Further information regarding project activities can be found at: http://outlast-project.net/

To ensure the developed system will be tailored to the needs of users, stakeholders, and policymakers from multiple sectors all around the world, the co-design approach was applied in OUTLAST. There, the participation of stakeholders in the two pilot regions: **Lake Victoria Basin** and **Central Asia** has been defined to be in the highest level and hence, the collaboration with them in the role of end-users plays a crucial part in OUTLAST.



Based on outcomes from the individual interviews with stakeholders (June and July, 2023), the first regional workshop with stakeholders from the Lake Victoria Basin took place from 4th to 5th September 2023 in Nairobi, Kenya. There, the participants were actively involved in different sessions to provide feedback and to discuss potential drought hazard indicators, focusing on three sectors: meteorology, agriculture, and hydrology. In each session, participants could provide their opinions on the presented indicators during group work and preliminarily define certain indicators, which are the most useful for them. Furthermore, they had opportunities to express their ideas and discuss the visualization of the end products on the HydroSOS web portal.

Goals and Objectives

The main aim of this workshop was to collect valuable insights and perspectives that would contribute to the selection and presentation of drought hazard indicators in the most informative possible way for all users of the HydroSOS web portal. Thus, during the workshop, the participants were expected to provide feedback on:

- which drought hazard indicators should be included on the HydroSOS web portal

- how to present the drought hazard indicators and (the uncertainty of) seasonal forecasts on the HydroSOS web portal

In the feedback and discussion section, the participants worked with the handouts and provided feedback on a list of presented drought hazard indicators: meteorological, agricultural, and hydrological, such as:

- *Regional drought events with different intensities during the last years and their impact on different sectors (meteorological, rainfed agriculture, irrigated agriculture, water supply, riverine ecosystems, non-agricultural land)*
- *Spatial and temporal resolutions which are most useful.*
- *Thresholds to define drought intensities e.g., a moderate drought occurs if there is less than 50% (or 75%) streamflow than normal.*

Workshop modality

The workshop was held in physical form in Nairobi, Kenya on 4th and 5th September. Some interested participants were able to join online using the link to the Zoom meeting below:

In person: Nairobi, Kenya, at the Four Points by Sheraton Nairobi Hurlingham (https://www.google.com/maps/@-1.2936314,36.7949661,20z?entry=ttu)

Online: https://us06web.zoom.us/j/81515579441?pwd=ZFMrY1VNNW9DNTV6R2lZVk8rdzNQZz09
Meeting ID: 815 1557 9441
Passcode: 653874

Workshop program can be found in Annex I.

Participants

The workshop brought together 30 participants, 22 of whom came from:

- various government agencies, research institutions, national meteorological and hydrological services, as well as NGOs and local farmers from five countries: Burundi, Kenya, Rwanda, Tanzania and Uganda.
- regional organisations (ICPAC, LVBC, NBI)
- host country Kenya

The workshop was coordinated by the WMO and OUTLAST team, led by Mr. Harald Koethe, Director of ICWRGC, with support from NBI (Ms. Juliet Nakasagga).

Main outcomes

During the workshop, the stakeholders were informed about:

- Current activities on drought hazard and management in each country and in the region (NBI, ICPAC).
- Current status of data sharing, web portal or information systems in each country that are under development or planned.
- The Hydrological Status and Outlook System (HydroSOS, WMO)
- The connection between OUTLAST and HydroSOS as well as opportunities and challenges for improving communication between different data providers (local, national, regional and global)
- General concepts for the derivation of drought hazard indicators and the potential use of a variety of meteorological, agricultural and hydrological drought hazard indicators.
- Ensemble forecasting and its benefits for seasonal forecasting

The main outcomes of the OUTLAST Workshop are:

1) Initial selection on the list of drought hazard indicators. This will be combined with the outcomes from the second regional workshop in Central Asia (in October, 2023) to obtain the finalist of the most informative indicators, which will be displayed on the HydroSOS web portal (see block 2 below).
2) Preliminary suggestions on how the drought hazard information on the web portal should be provided in the most useful and applicable way (see block 4 below)

Furthermore, participants have gained some knowledge about:

- How OUTLAST can be beneficial to the needs of stakeholders and end-users in their daily work as decision makers, technical staffs or scientific researchers.
- The integration of OUTLAST into HydroSOS and the potential outlook provision of a forecasting product from national and regional scales to global scale.

The highlights from the four blocks in during workshop are described below:

Block 1: HydroSOS and connection of OUTLAST to HydroSOS

Highlights:

- Programming languages are flexible, based on the data provider for HydroSOS, i.e. R, Python, Excel, ... but will be in a pre-signed format.
- The language used on the web portal is English.
- Data provided by local and national providers will not be used in HydroSOS, only indicators. OUTLAST provides a model-based product on a global scale and is able to share its calculated data.
- The presence of OUTLAST will be beneficial for national level users. OUTLAST can thus enrich the user community for HydroSOS.
- The different spatial scaling in OUTLAST (due to the availability of input data such as land cover, lake, soil, ...) can be a challenge for the user, but as the models are continuously developed and innovated, this is acceptable in the preparation phase to build a concept for a long-term operational system.
- It is expected that OUTLAST (global providers) can help to enhance the forecasting quality in short term.
- The most interesting points are to see how the data producers of the system connected to HydroSOS (local, basin, regional, global) can be exchanged and possibly harmonised. However, this is the long-term strategy of HydroSOS to build the capacity to solve these problems. OUTLAST can be a good case study to connect global data providers to HydroSOS and to test all the circumstances raised by this issue.

Block 2: Potential drought hazard indicators (DHIs)

Highlights:

- A wise selection of the most appropriate indicators among a wide-range of available indicators (e.g. a set of 198 indicators from NBI, handbook of drought from WMO, five main indicators from ICPAC, …) is challenging for the user.
- Meteological DHI: Temperature and temperature-derived indices are as an additional climate information important variable for the stakeholders. Also, of interest was the ending date of the rainy season since it is very important for the water availability in the coming dry season.
- Agricultural DHI: Two distinct DHIs i.e., CDI_{RF} (Crop drought index for rainfed agriculture) and CDI_{IR} (Crop drought index for irrigated agriculture) were presented. Participants had difficulty understanding these indicators, especially in drought intensities classes. They were interested in having crop-specific

indicators across rainfed and irrigated areas and suggested considering major crops instead of all crops. They also asked to have this product at a regional scale other than basin and national scales.

- Hydrological DHI: Overall, **the EP-1 indicators** (for streamflow and soil moisture) and the **CQDI-1(Q80)** (as cumulative DHI for streamflow) were rated the most useful by the participants. However, many of the hydrological DHIs, in particular the cumulative DHIS to describe the severity of drought events, were described as too technical and difficult to understand. Regarding aggregation periods, most participants suggested considering 12 months for the relative deviation from mean groundwater recharge, and 6 months for soil moisture DHIs. Nearly half of the participants are interested in an indicator for wildfire hazards, which at least should consider soil moisture and air temperature, but, if possible, also factors such as anthropogenic activities, the density of green cover, or sunshine hours.

Block 3: Ensemble forecasts

Highlights:

- OUTLAST will use a single model as input for the forecasts, the multi-model-ensemble approach yielded not the best results in other studies.

Block 4: Potential evaluation of visualisation products on the HydroSOS web portal

Highlights from each station during World-Cafe:

- **Legend and colour**: All participants preferred 3 to a maximum of 4 drought classes. Exceptional drought should not be used as a qualitative drought class. Qualitative classes should be shown to farmers, quantitative classes are of interest to technical staff. For frequency based DHIs, return period units are preferred but should be well explained. Almost all participants are interested in comparing the intensity of the current drought with historical droughts; about half of the participants would find it sufficient to compare only with the last drought of such intensity, while the other half would like to see a list of all droughts of such intensity in the reference period. Most participants prefer to see not only droughts but also wet conditions.
- **Spatial aggregation**: Basin-wise and 5min arc grid are most preferred by participants. The option to upload their shapefile to extract information becomes the most interesting point in this station. Standard statistical plots were chosen (mean, max, min). Only a few chose median and standard deviation. Box plots were suggested. Interquantile range (IQR) was mostly chosen to visualise the uncertainty of the ensemble forecast. Statistics for near real-time monitoring were preferred for the following variables: streamflow, rainfall intensity and flow duration curve (water level is not provided by OUTLAST).
- **Time series:** For the pixel box display, there is a fair distribution between 3 months (past), 6 months (forecast) and 12 months (past+future). Furthermore, the option to display historical data (10 years) and/or multiple indicators was also preferred, but it was mentioned that the choice of these different time intervals highly depends on the corresponding sector and drought hazard indicators.
- **Ensemble forecast:** Warnings should only be given when the forecast is very certain. This means in effect, that a warning will be very rare and only with the most extreme droughts. As statistics for the forecast, the mean of the ensemble, the minimal and maximal ensemble member and the standard deviation of the ensemble were named. The median was of subordinate interest.

Workshop evaluation[1] by participants about the interesting experiences during the workshop

Recommendations

- Due to the high level of interest in the project and its results, participants would want to be kept informed of any updates to the project.
- Technical training on modelling or further ensemble forecasting would be highly appreciated.
- Products should be available at different levels and resolutions for the OUTLAST (global, regional, country) down to 0.5 and 0.1 degree resolution. This will improve usability at the local level.

Follow-up and further steps

The majority of the participants expressed their wish to stay in contact with OUTLAST and to be informed about the current activities of the project. We therefore discussed the BSCW platform (Basic Support for Cooperative Work, provided by the ICWRGC), where OUTLAST and the partners can share updates, documents and reports of events. Meanwhile, participants can access this platform with a granted permission to work or use the content.

To develop and strengthen the connection with the participated countries in LVB, representatives which have core competences in the national hydrological services in each country and NBI agreed to accompany and support the further OUTLAST process via a working group with ICWRGC. These are:

- Uganda: Ms Faima Aimo
- Kenya: Ms Georgia Musau
- Tanzania: Mr Mangasa Ogoma
- Rwanda: Mr Thadée Twagirimana
- Burundi: Mr Ferdinand Kirura
- NBI: Mr Modathir Zaroug

They act as a core team for OUTLAST and support all further OUTLAST activities in the region. Their role is to provide contacts from their own country of competence whose colleagues might be helpful for operational

[1] Word cloud generated in R using input from in-site Mentimeter and in text form

water monitoring in their country and for the further development of the OUTLAST drought hazard forecasting system. For the next step, these experts have already been asked to look for further experts in their field of competence, if they think that these colleagues could be helpful for the operational water monitoring in their country and for the further development of the OUTLAST drought hazard forecasting system.

It is also the intention of this group to continue the exchange and cooperation regarding in-situ water monitoring, data management and product provision in each country:

- existing monitoring networks, their technical equipment and their need for improvement,
- national water databases and their need for development, including data standards for best interoperability (following the so-called FAIR[2] principles),
- existing hydrological models
- existing information systems.

In the co-design approach of OUTLAST, stakeholder participation is defined at the highest level. Therefore, the next step of the stakeholder dialogue with stakeholders from the LVB will be the second workshop in autumn 2024 in Koblenz, Germany. A shortlist of five participants from the LVB basin and five from Central Asia will be invited to Koblenz (Germany) to provide their feedback on the web portal in OUTLAST. The selection of this shortlist will be made based on their engagement and performance during the interview and regional workshop. This shortlist may differ from the five representatives mentioned above.

[2] Findability, Accessibility, Interoperability, and Reusability

Collaborations

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

FONA
Nachhaltiges Wassermanagement

GRoW
GLOBALE RESSOURCE WASSER

WORLD METEOROLOGICAL ORGANIZATION

ICWRGC
International Centre for Water Resources and Global Change

GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

WMO HydroSOS

GOETHE UNIVERSITÄT FRANKFURT AM MAIN

KIT
Karlsruher Institut für Technologie

EAST AFRICAN COMMUNITY
LAKE VICTORIA BASIN COMMISSION
One people, One Destiny

Annex I

Agenda

Day 1: Monday, 4th September

Time	Block	Items	Presenter(s)	Moderator
8:30 - 9:00	Registration		OUTLAST Team	Harald Koethe
9:00 - 9:40	**Welcoming**	Welcome addresses	Country host: Kenyan representative WMO secretariat OUTLAST consortium	
		Introduction of participants	All participants	
9:40 - 10:10	**HydroSOS**	Introduction to HydroSOS	WMO/Sulagna Mishra	
10:10 - 10:40	**Existing activities**	ICPAC and WMO	Viola Otieno (ICPAC) and Robert Stefanki (WMO)	
10:40 - 11:05	*Tea break*			
11:05 - 12:10	**OUTLAST introduction**	About OUTLAST	Harald Koethe	
		Overview of models	Jan Weber, Neda Abbasi, Tina Trautmann	
		Connection between OUTLAST and HydroSOS	Tinh Vu	
		Aims of this workshop	Harald Koethe	
		Discussion	All participants	
12:10 - 12:30	**Stakeholders interviews**	Summary of interviews	Tinh Vu	
12:30 - 14:00	*Lunch*			
14:00 - 14:30	**Potential drought hazard indicators**	Introduction to drought hazard indicators (DHI)	Tina Trautmann	
14:30 - 15:30		Meteorological DHIs (feedback and discussion)	Jan Weber	
15:30 - 16:00	*Tea break*			
16:00 - 17:20	**Potential drought hazard indicators**	Agricultural DHIs (feedback and discussion)	Neda Abbasi	
17:20 - 17:30	Wrap-up		Harald Koethe	

Day 2: Tuesday, 5th September

Time	Block	Items	Presenter(s)	Moderator
8:30 - 8:40	**Welcome**	Summary of the previous day and outlook of today	Tinh Vu	Tinh Vu
8:40 - 10:30	**Potential drought hazard indicators**	DHIs for water supply, riverine ecosystems and non-agricultural land ecosystems (feedback and discussion)	Tina Trautmann	
10:30 - 11:00	*Tea break*			
11:00 - 11:50	**Ensemble forecasts**	Introduction to ensemble forecasts	Jan Weber	
11:50 - 13:20	*Lunch*			
13:20 - 15:20	**Potential presentation on the HydroSOS web portal**	Feedback and discussion on the presentation of DHI and forecasts	Neda Abbasi, Jan Weber, Tina Trautmann	
15:20 - 15:50	*Tea break*			
15:50 - 16:00	**Summary and evaluation**	Wrap-up	Harald Koethe	
16:00 - 16:30		Survey and feedback	Tinh Vu	
16:30 - 16:45		Closing remarks	Harald Koethe and WMO/Sulagna Mishra	