Eawag:
Swiss Federal Institute of Aquatic Science and Technology

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

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FANFAR – Operational flood forecasting and alerts in West Africa: https://www.fanfar.eu
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 780118

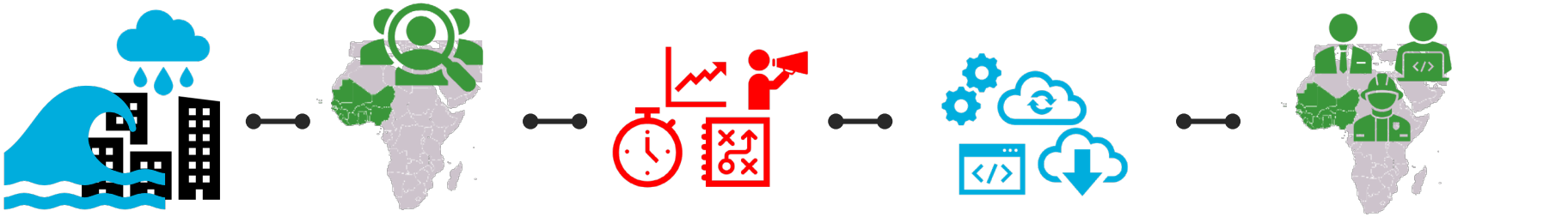
FANFAR: ReinForced cooperAtion to provide operatioNal Flood forecasts & Alerts in West AfRica

- Flooding is a growing concern in West Africa
- Great need for reliable access to operational flood forecasts and alerts

  … produced by a robust ICT system

  … adapted to regional conditions

  … operated by capable West African institutions



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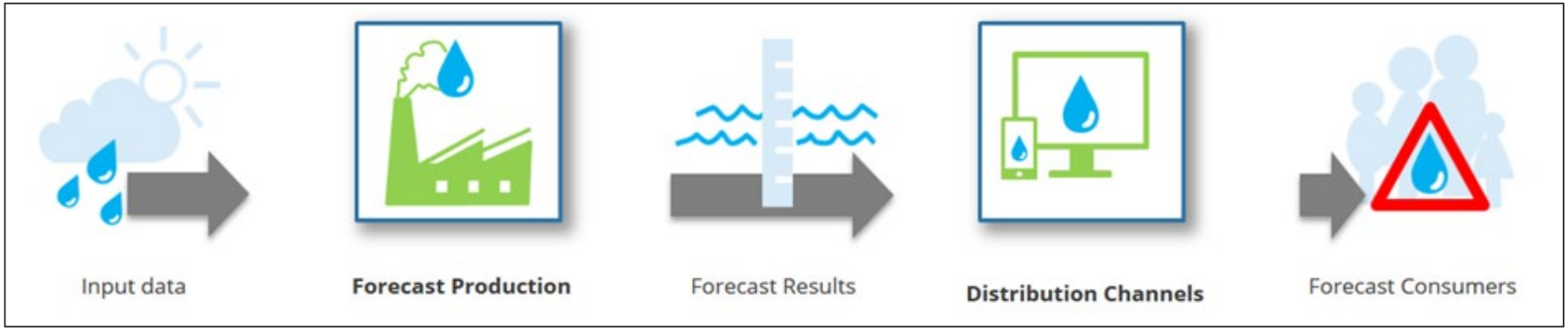
The operational forecasting chain used in FANFAR



- Each day a new hydrological forecast is produced and distributed to enable productive applications in West Africa
- FANFAR aims to enhance the capacity of West African institutions to forecast, alert for and manage floods
- FANFAR system is developed by West African and European consortium partners

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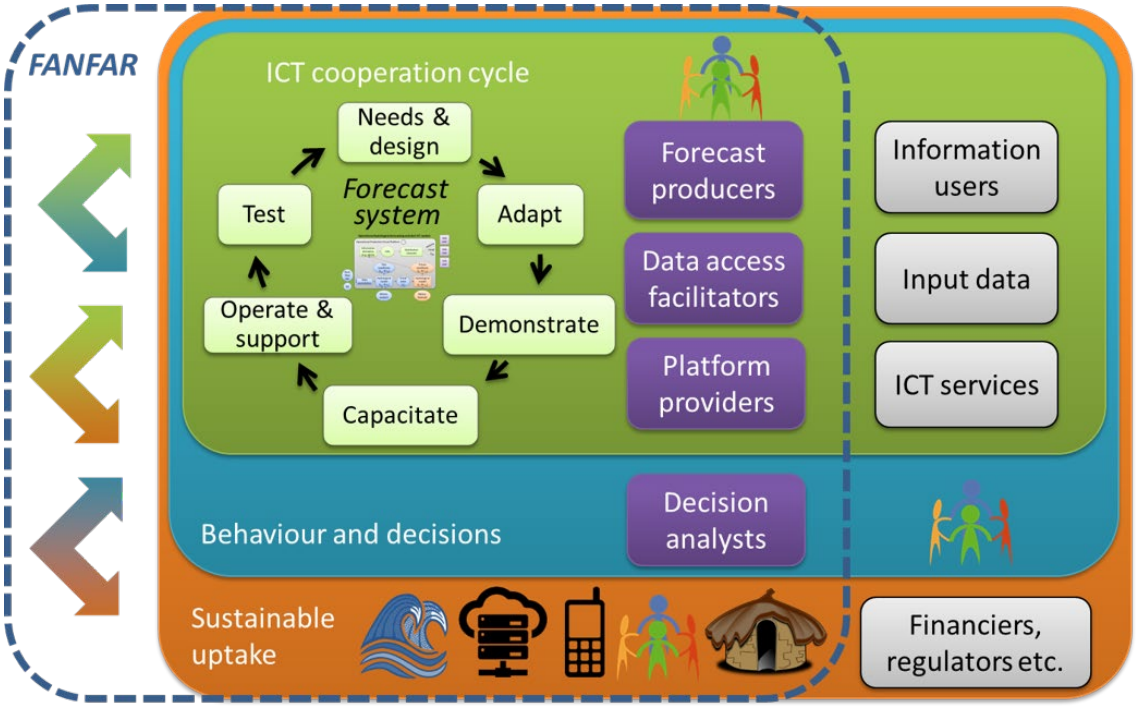
FANFAR co-development process

- FANFAR system is discussed and co-developed with representatives of 17 West African countries
- Four 1-week workshops are carried out in West Africa
- Around 30 to 50 participants: regional and national hydrological services and emergency management services



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FANFAR co-development process led by decision analysts from Eawag

Problem structuring and decision analysis methods:

- Stakeholder analysis *(who is important / who is affected?)*
- Different problem structuring methods to define objectives *(what is important when developing a forecast & alert system for West Africa?)* and system configurations *(what options?)*
- Participatory Multi-Criteria Decision Analysis (MCDA) to select best-performing system configurations
- Research on effective flood warning & risk communication by Dr. Martijn Kuller
  (see Monday session: EGU2020-9425 https://doi.org/10.5194/egusphere-egu2020-9425)

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Multi-Criteria Decision Analysis (MCDA)

Define decision:
Good flood forecast and alert system

WS-1

Preferences:
How important are objectives to you?

WS-2

Stakeholders:
Who decides?
Who is affected?

WS-1

Best system option?
Integrate all data in MCDA model

Ongoing

Predictions:
How well does each option achieve each objective?

WS-2

Options:
How can objectives be achieved?

WS-1

Objectives:
What is *really* important?

WS-1
WS-2
WS-3

WS = Workshop

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Objectives: Questionnaires & workshops

Aim: Produce operational flood forecasting and early warning system in FANFAR that is well-accepted and adopted by users

- What do you have to know to compare different options of FANFAR system with each other?
- What is really important to achieve when we develop the FANFAR system?
- Objectives developed using moderated pen & paper survey, online survey, group brainstorming, and group discussion and consensus sessions in workshop 1
- Objectives consolidated in workshop 2
- Importance of objectives (re-)elicited in workshops 1, 2, and 3

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Developing objectives, WS 1 in Niamey (Niger) 2018

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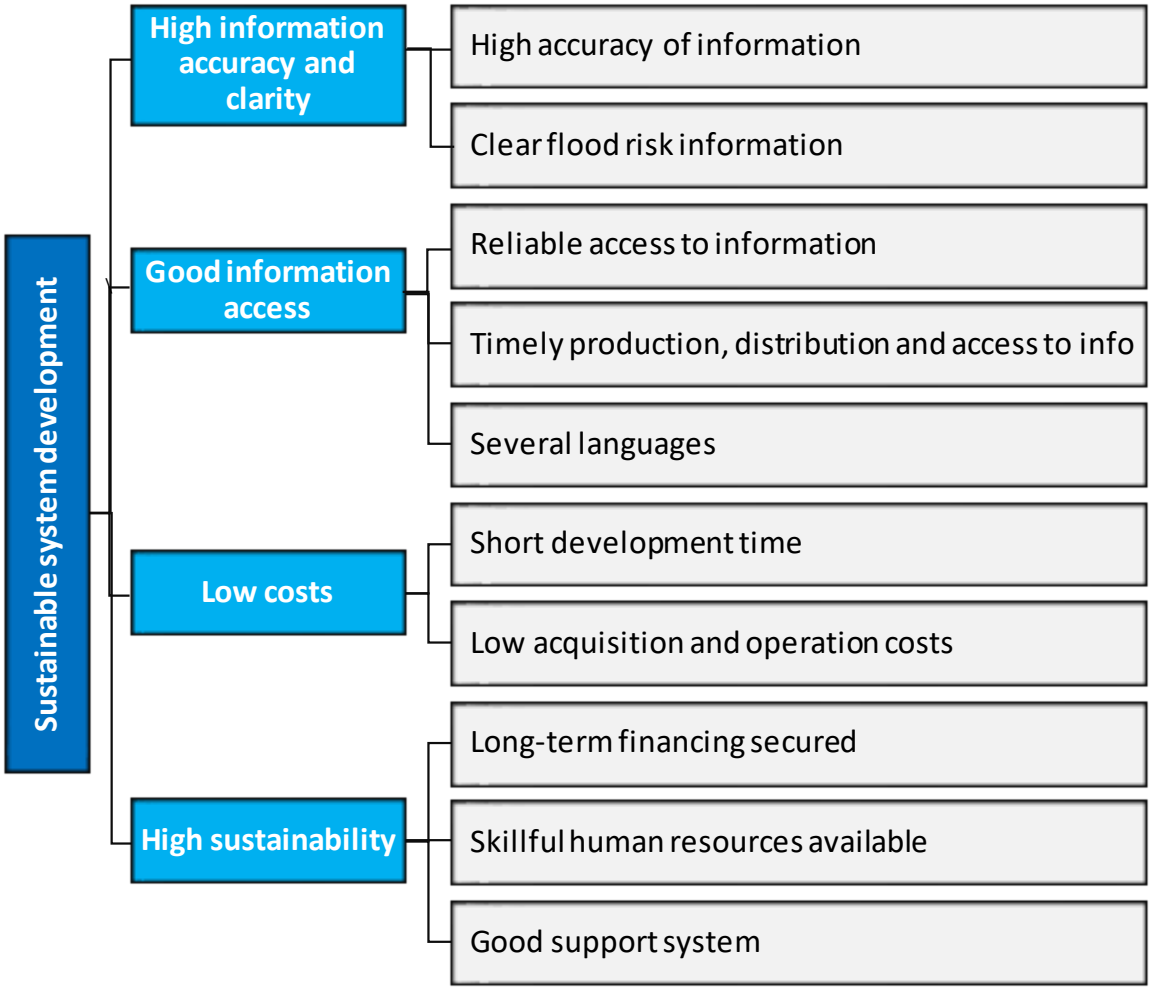
Hierarchy of objectives – used for the MCDA



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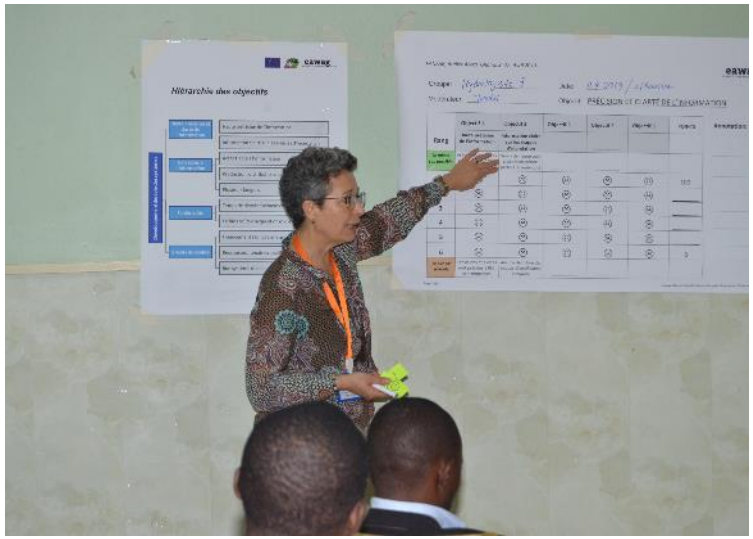
Eliciting importance of objectives, WS 2 in Accra (Ghana) 2019



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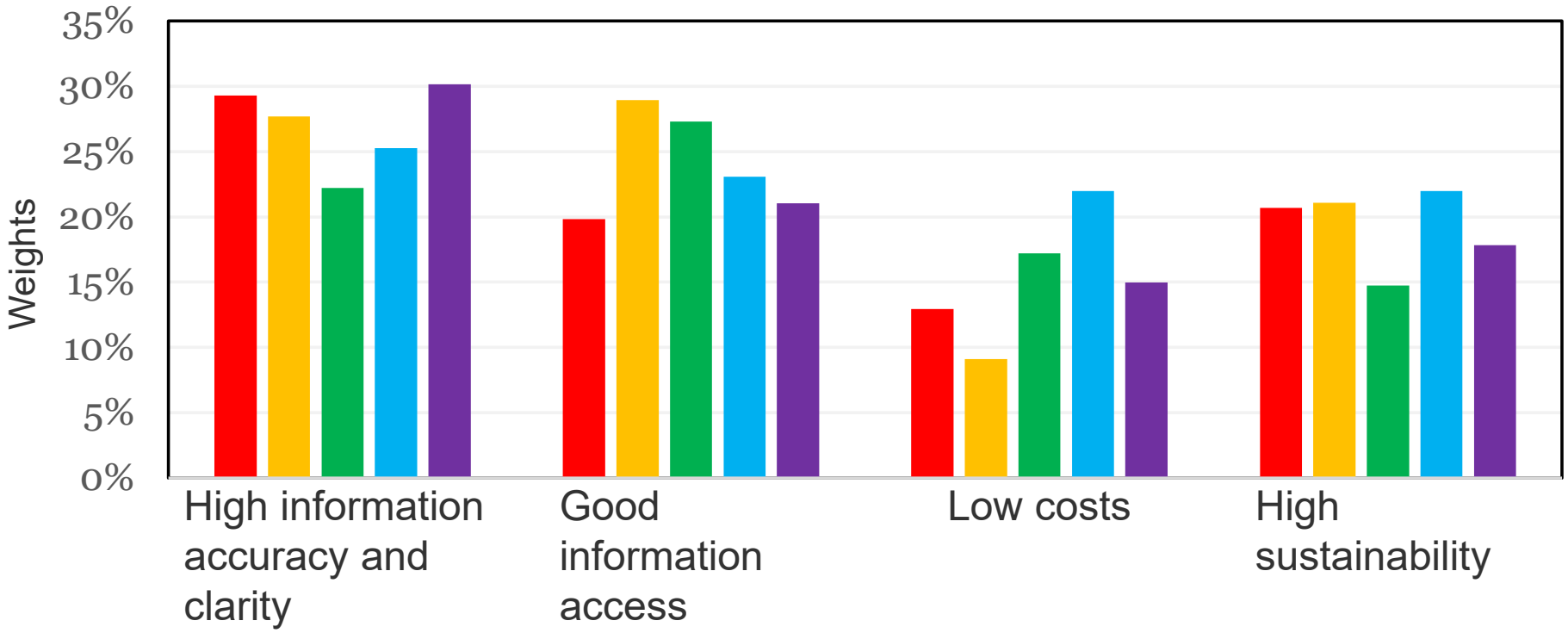
Example: weights assigned to main objectives in five groups

How important are objectives to you?

(How important is it to achieve each objective – considering trade-offs with the other objectives – when developing FANFAR system?)



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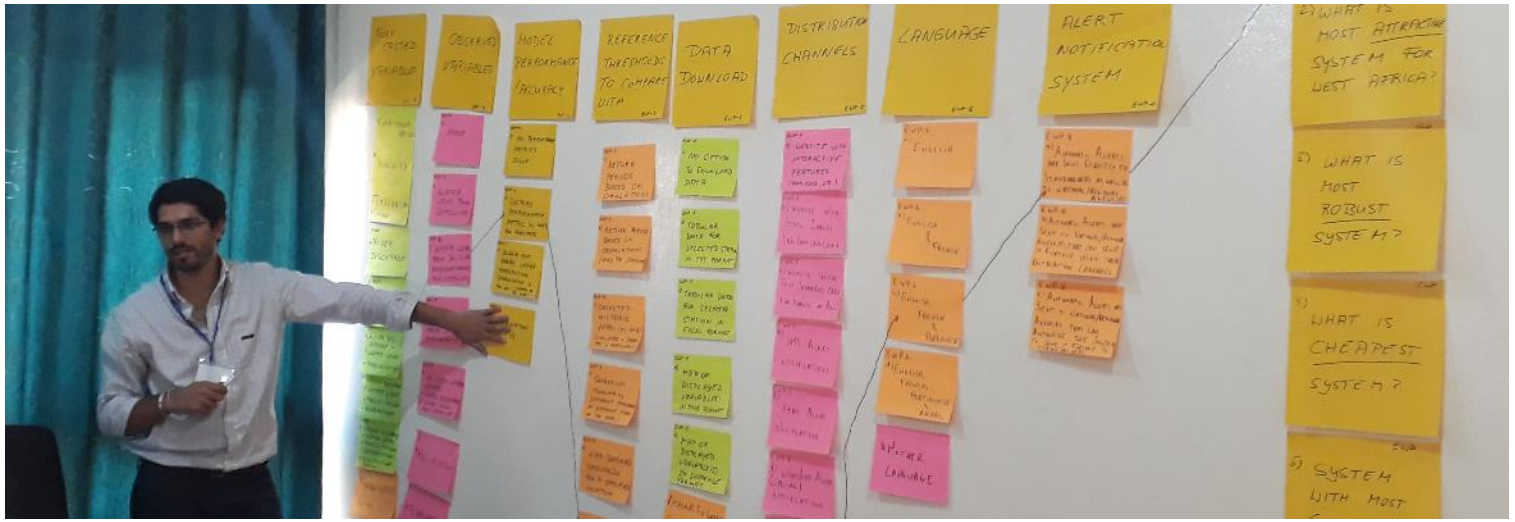
Creating options (system configurations) WS 1 Niamey 2018



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Example: creating options (system configurations) using "strategy generation table"

Option that can be implemented fastest

	A	B	C	D	E	F
	recasted ariables	**Observed variables**	**Model performance / accuracy**	**Data download**	**Distribution channels**	**Language**
	r discharge	None	No performance metrics shown	No option to download data	Website with interactive features	English
	discharge & ater level	Water level from satellites	Display performance metric for forecasts	Tabular data for selected station in TXT format	Website with static images	English and French
c	River discharge, water level, & precipitation	Water level from in-situ measurements and satellites	Blank out areas where forecasting performance is too low	Tabular data for selected station in Excel format	SMS alert notifications	English, French, and Portuguese
d	River discharge, water level, cipitation, & vaporation	River discharge from in-situ measurements		Map of displayed variable(s), in PNG format	Email alert notifications	English, French, Portuguese, Arabic
	r discharge, ater level, ecipitation, oration, soil sture storage	In-situ water level and river discharge, and water level from satellites		Tabular data in TXT format and map displayed in PNG format	Website with interactive features, SMS and Email	

Most attractive option in ideal world

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Eleven options elaborated for use in MCDA

1. Least resources for development
2. Least resources for users
3. Most easy to use
4. Fastest
5. Highest consensus
6. Most robust
7. Most attractive
8. Fully equipped
9. Calibrated models
10. Calibrated models + earth observation data (EO)
11. Calibrated models + EO + in situ data

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Predictions made for each of the eleven options (including uncertainty of this expert estimate)

Predictions:
How well does each option achieve each objective?

Objectives Options ↓	High accuracy and clarity	Clear risk information	Reliable access	Timely pro-duction, etc.	Several languages … etc.
1. Least resources for development	…	…	…	…	…
2. … for users	…	…	…	…	…
3. etc.	…	…	…	…	…

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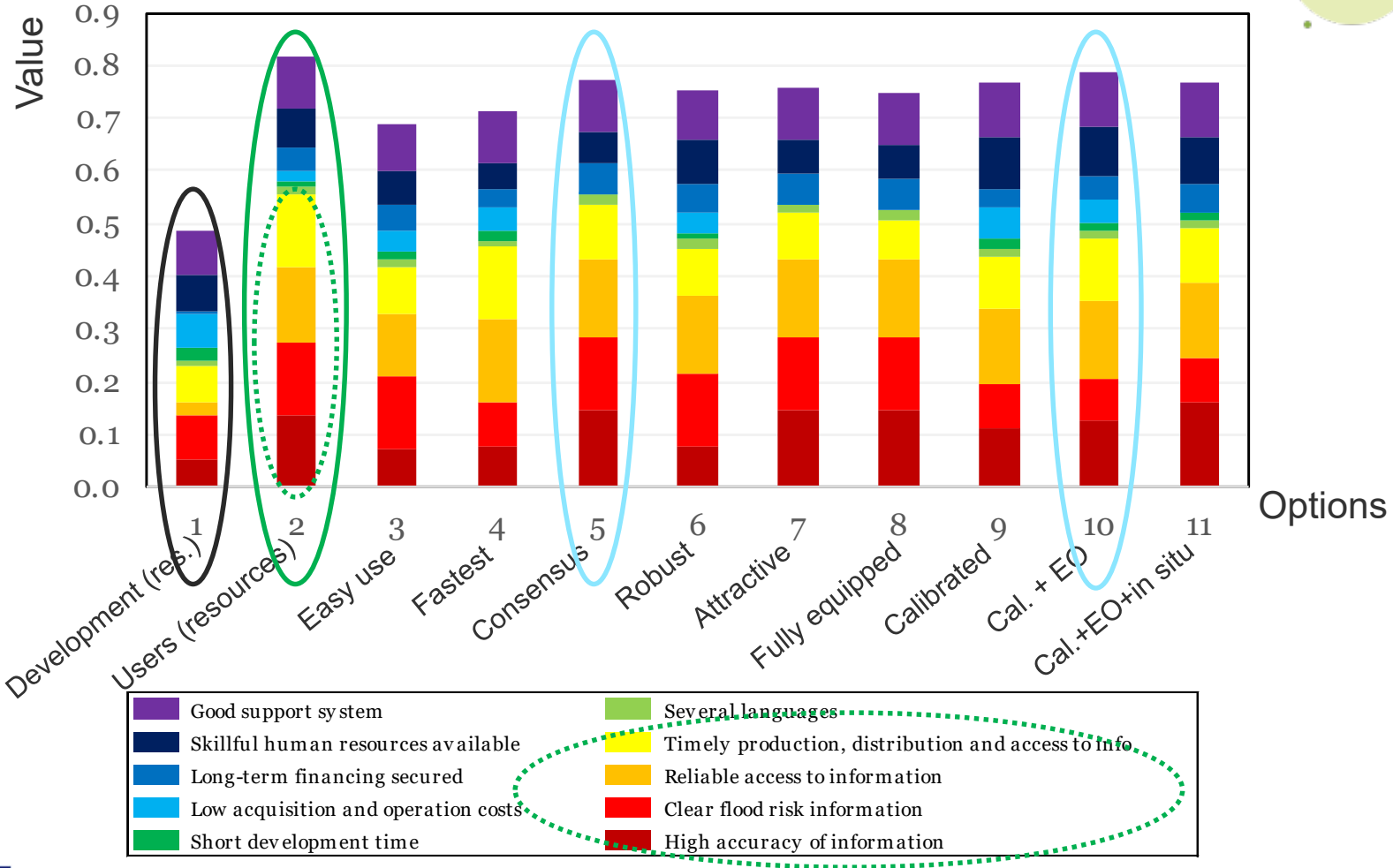
MCDA to model: which options are best?

(example group English-speaking hydrologists)



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Suitable options for all five stakeholder groups (with different preferences)

1. Least resources for development
2. Least resources for users
3. Most easy to use
4. Fastest
5. Highest consensus
6. Most robust
7. Most attractive
8. Fully equipped
9. Calibrated models
10. Calibrated models + earth observation data (EO)
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Conclusions of co-design process to find suitable system configurations (options) for an operational flood forecast and alert system in West Africa

- Different options achieve FANFAR objectives to different degrees
- Participants of the workshops (West African hydrologists and emergency managers) have different preferences regarding importance of objectives
- No problem!!
- Some FANFAR system options perform well / or even best for all groups
- Feedback from participants regarding co-design process is very positive

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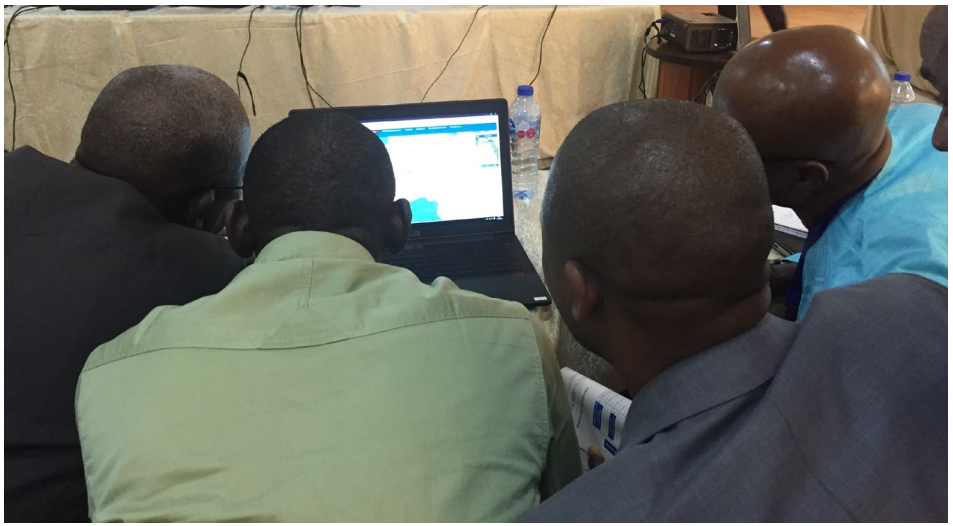
Impressions from workshop 3 Abuja (Nigeria) February 2020

Discussing, testing, analyzing – creating a good flood forecast and alert system together



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