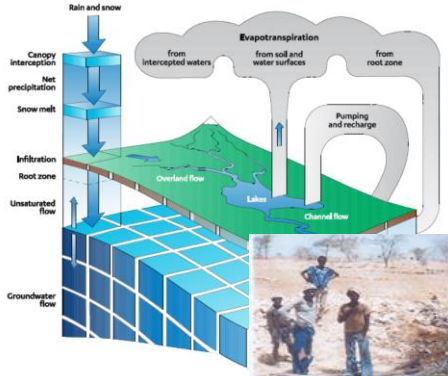
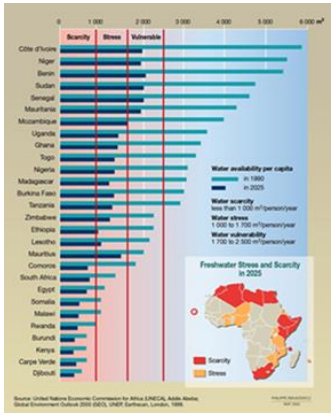
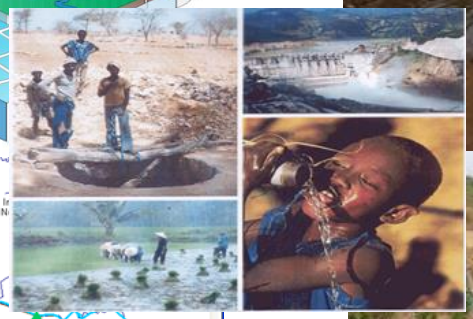
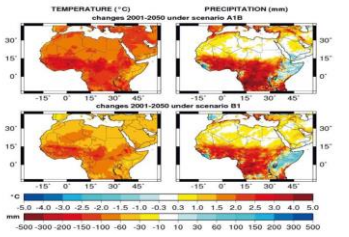
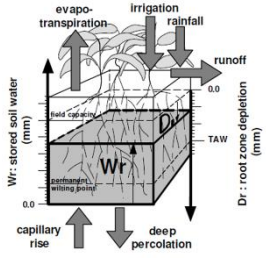
PAUWES Research Agenda / Part on Water: Priorities and framework for engagement and actions











Procedure / steps / features in working out the PAUWES Research Agenda

Process of working out the **Research Agenda** was **initiated**, **structured**, **guided** and **funded** by the German Federal Ministry of Education and Research (**BMBF**) **with** and **for** PAUWES

Workshop in **Tlemcen** in October 2015 on **collecting** ideas (experts from Africa and Germany; rather big group: - 70 experts)

Meeting in **Bonn** in May 2016 for **consolidating** the ideas and discussing / deriving a **detailed** structure

Putting findings in an **Agenda** document (**thematic** working **groups** co-chaired by a representative from **Africa** and **Germany**; Water: Prof. Buckley and Prof. J. Rhyner; contribution by the consortium) via **synthesizing** detailed **fact sheets** provided by the experts

Validation Conference in Addis Ababa in October 2017 on presenting, discussing and revising the **Research Agenda** at **PAU**

Research agenda: ‚**living** document'; implemention start via projects

Challenges on water management – options by PAU(WES)

ZEF

Africa is facing a **challenging** (water) situation due to a **mix** of **reasons** (with **potentiating** impacts):

- high **vulnerability** of population (rainfed agriculture; irrigated systems, infrastructure, urbanization, …)
- current problems in terms of **water** and **food** (**in)security**
- rather high **uncertainty** of climate **predictions** (rainfall!)
- further influential **drivers** of **change** (land use dynamics)
- limited **economic** resources and shortcomings in **governance** capacities

Options by **PAU(WES)**:

- **mandate** and **structure** (water - energy – climate change)
- **embeddedness** in **Africa-wide science-** and **capacity building networks** (and beyond)

RESEARCH AGENDA

Overarching goal – features of research

ZEF

Overarching goal (referring to water):

‚**equitable**, **sustainable** use and **management** of **water** resources for **socio-economic development**, regional **cooperation** and the **environment**‘ (agenda 2063; African Union Commission)

Need for

science-based information, options, tools, strategies

/ o**ptions** to **action** being technically feasable, economically affordable, socially acceptable, environmentally sustainable

Guiding/framing **features of research**:

- **demand-oriented**; yet, with **strategically** thinking
- **innovative** and **applied** in nature
- utilizing competitive **strengths** of **PAU(WES**)
- **inter-/transdisciplinary** perspective & integrative / **nexus-** oriented
- **research** agenda as a working (‚**living**‘) document

Approach for suggesting an agenda

ZEF

Relevance for Africa

State of the art

Research fields

Water and Food Security

Water Management

Water and environment

Water economics and governance

recommendations on research options / priorities

to cope with challenges by water management (‚surplus versus scarcity‘)

linking / integrating approaches (nexus)

Water and food security

ZEF

Relevance for **Africa**

- **water** and **food security** is endangered by a **rising demand** (drivers: **population** growth; changing **nutritional** behavior) versus **limited** and increasingly **variable** water **resources** (**climate** and **land use** changes)
- urgent need to raise (water) **productivity** in order to provide more food (due to currently **low** (irrigation) **efficiency** and effectiveness and **insufficient coordination** in application of **water** and further **agricultural inputs wasting** resources and impacting severely environment and peoples‘ health)
- **full irrigation** is ‚**backbone**‘ of agriculture in large parts of Africa and (**supplemental**) **irrigation** becoming a **core** element in (climate change!) **adaptation strategies**
- need for and lack of **low-cost productivity** increases
- high **vulnerability** to **extreme** situations (floods, droughts)

State of the art and challenges:

- wide range of **expertise** in **water management** and **irrigation** is available
- **yet**: **scattered** in **domains** of climate, bio-physical, socio-economic and institutional settings - **limiting** / hindering wide-spread **utilization**
- limited **exchange** of **knowledge** between **science, administration, practice, commercial sectors, end-users**
- insufficient water **information systems** / meteo-hydro **databases**, **forecast** options on hydro-meteo events (for example: on shifts and intensity of rainy seasons (and on the **response** in **agriculture** on **changes**)

Recommendations on research fields/topics:

- approaches, tools and strategies to raise **efficiency**, **effectiveness** and **productivity** of irrigation and at the same time to **lower** the **impact** on **environment** particularly under increasingly **variable** conditions on supply- and demand-side
- contribution by water management towards sustainable use and conserving/enhancing **ecosystems** (and their services)
- concept of virtual water and **water footprint** as tools to improve large-scale water use and allocation
- valuation tools and **water (right) trade** for higher productivity among multiple user systems
- **remote sensing** techniques for data provision, upscaling, forecasting and analyses (Geographical Information Systems)

Water management

ZEF

Relevance for Africa (rural, urban):

- water **management** requires (and provides ideally) detailed information on relevant **hydro / water-related** components regarding the **supply** as well as the **demand-side** (high spatio-temporal resolution, water quantities and qualities)
- high potential **benefit** of / **need** for short-, mid- and long-term **forecast tools**
- dramatic **urbanization** rate in Africa; informal settlements
- increasing **risks** (floods), detrimental **impacts** on **health**
- **flood** management and water supply & sanitation **systems**
- high potential of **circular systems** (re-use of nutrients in urban / peri-urban agriculture)

Water management

ZEF

State of the art and challenges:

- **limited expertise** on short-, mid-, long-term **forecast**
- lack of **monitoring** systems (even declining) and occurrence of **data gaps** (quality check!)
- insufficient capacities in terms of **hydrological modeling**
- still **national** instead of **basin-wide** perspective in water management (in **transboundary** basins) / rather **sectoral** approaches insufficient to reflect biophysical / techical - ecological - economic - socio **context (strengthen links)**
- insufficient **water treatment** facilities and their quality control (and: supply systems, waste water collecting networks)
- inappropriate **integration** of water management into urban **planning** concepts (legislation)

Water management

ZEF

Recommendations on **research** fields/topics:

- developing and operating basin-wide **discharge forecast** systems under **data-scarce conditions** (short – long time-horizonts, flood – drought)
- inventory of (transboundary) **groundwater** aquifers and their **link** to **surface** water
- understanding (quantifying – assessing - strengthening) the role of **natural ecosystems** like wetlands, lakes, rainforest (and their **service provision**) for regional water budgets
- utilizing **hydropower** potentials (in a nexus-approach)
- **transboundary** water management (data, modeling, institutions, legislation) management at different spatial and time scales (‘*water as medium for linking, not conflicting*’)

Water management

ZEF

Recommendations on research fields/topics:

- continued -

- strategies to improve **urban water supply** systems, **waste water** collection and **treatment** systems (innovative and adapted approaches and their implementation (how to create an enabling environment)
- realizing acceptable and affordable **sanitation** in rapidly growing cities (under conditions of scarce **data** and limited **planning options**)
- shaping the **interplay** between **institutional** arrangement, **legislation** and **economic** incentive systems to the **benefit** of economy, environment and – in consequence on **population** (Integrated urban water management)

Relevance for Africa:

- **water cycle** (and matter flows driven by water cycle) and ecosystems **link rural** and **urban** spaces
- **food security** in urban (and rural) settings depends largely on **healthy** ecosystems
- urbanization, industrialization, intensification in agriculture lead to severe **impacts** on **water quality** (surface and groundwater) and in turn on **ecosystems** and **population** (health)
- pollution from: **waste water** (and **solid** waste) systems (leakage), increasing traffic, mining, …
- **local** threats and their regional **accumulation** of impacts (eutrophication, algae blooms, …)

State of the art and challenges:

- insufficient (water quality) **monitoring** systems (smart & meaningful parameters for monitoring; design - operation), **analyzing capacity** and integration in matter flow **modeling** approaches
- lack of knowledge between water **quality** status (over space and time) and relevant **drivers** (land use changes, urbanization, industry,…)
- deficits in understanding the linkage between **water quality status**, **environmental** and **health impacts**
- impact of **floods** on **soil** and **groundwater** quality in terms of pollution (time-scale and rehabilitation expenditure in aquifers!)
- **seawater intrusion** in coastal aquifers (**sea level rise**; reduced groundwater recharge, increasing withdrawals)

Water and environment

ZEF

Recommendations on research fields/topics:

- **meaningful, (low-cost)** and smart **monitoring** tools and systems (depending on purpose and time-scale)
- **inventories** of **local** to **regional** pattern of **contamination** (driven by water dynamics)
- hydrological and matter flow **models** (with still robust results under data scarce conditions)
- how to **translate** monitoring results modeling findings in **guidelines, legislation** and **policies**? Which option to support resources conservation by **economic** tools (institutional frame)?
- (ground)water management in **coastal** areas
- seawater **desalinization** technologies for **utilizing** seawater as a resource

Water economics and governance

ZEF

- **Key-tools** for **implementing** water **management** strategies (integrated in overarching resource- and even spatial planning)
- **consequence**: to be considered as **cross-cutting** issues in above research domains
- **interplay** between **institutional** (re-)arrangements and **economic** tools as an important research area
- **water pricing** (balancing act: incentive versus over-burden)
- tools for enhancing water **efficiency** and effective **allocation** (especially in multi-purpose systems; equity –appropriateness – impact- scale): water (rights) trade, institutional efficeincy
- **integrating** economic tools in **multi-dimensional** assessment systems (especially needed in **endangered** regions (example: coastal areas) and for supporting **vulnerable people**)

Water – Climate nexus

ZEF

Relevance for Africa:

- hydrological / **water** management **systems** (being under the influence of meteo / climate factors) provide the base for **livelihoods** (rainfed agriculture, irrigation, ecosystem services) – yet, also **endanger** people (flood)
- hydrological systems depend on **changing** meteo/climate factors
- climate change and variability are altering the water demand- and the supply side (tendency: towards **supply – demand gaps**)
- **agricultural** production **potentials** need to be unfold (rainfed, supplemental and full irrigation) – yet, as a part of **multi-purpose** systems (drinking water, hydropower/industry, eco-services)
- infrastructures and strategies designed in the **past** and based on **sectoral** approaches need to be refined and adapted (e.g.: multi-purpose reservoirs – seasonal to annual irrigation))

Water – Climate nexus

ZEF

State of the art and challenges:

- currently **challenging** situation plus a **disadvantageous tendency** (**transboundary** basins and groundwater aquifers, ongoing land **degradation**, coastal areas endangerd by **salt intrusion**, **uncertainty** in climate modeling, **vulnerable** communities, **food insecurity**, limited (economic) resources, rather **weak governance** systems, urban- rural **disparities**)
- **migration** into urban areas creating immense problems in terms of ensuring sufficient **sanitation** / **health** infrastructure, providing **employment** options and **avoiding conflicts**
- examples on **best-practices** are scarce and approaches for transferring in different settings need to be **developed** and **up-** / **outscaled**
- ‚**stationarity**‘ of meteo-hydro series as a basic assumption needed for infrastructure design no longer a valid!

Water – Climate nexus

ZEF

Recommendations on research fields/topics (examples):

- enhance understanding of **linked** (climate plus land use changes) and **dynamic systems** (e.g. in extreme situations)
- **altered** water **demand** and – as a consequence - potential of **supplemental irrigation** as a **adaptation** strategy to be embedded in **basin-wide** and **impact-aware concepts** (efficiency, effectiveness, productivity – across the scales and disciplines and covering the full production chain (after-harvest losses! – biomass webs))
- **identifying** and **mobilizing synergisms** (conceiving ‚win-win interventions': e.g. irrigation efficiency for water plus energy saving plus lowering impact on environment)
- **compensation** of impacts by **urbanization** on the water cycle (within the cities and in upper parts of uban basins)

Water – Climate nexus

ZEF

Recommendations on research fields/topics (examples):

- continued -

- ‚**one-health** approach‘
- options to bridge / strengthen the **science – practice - policy interface** (‚follow-the-innovation approach‘)
- economic **incentive systems** embedded in appropriate **institutional frames** (‚enabling environment‘) to favor nexus approach

Example: mobilizing **practical synergisms** ('win-win') by raising irrigation efficiency **– link disciplines**

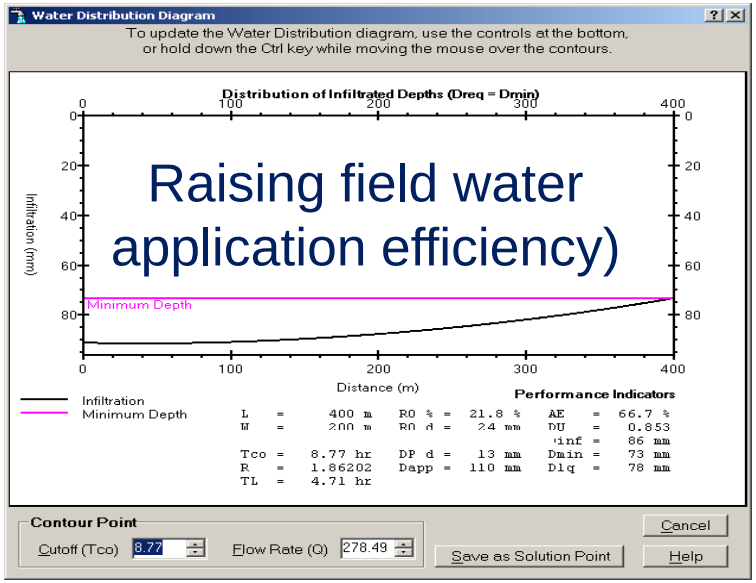
ZEF

Saving water

Lowering pressure on hydrological (matter flow) cycle

More uniform crop growth

Better use of fertilizers (leaching loss)



Prerequisite for mobilizing win-win effects: Coordination/integration of strategies/interventions

Beneficial impact on health of people handling water

Saving of energy (less water to be lifted)

Less irrigation duration (labour) needed

Reducing water conflict potential (top –tail - problem