



73RD INTERNATIONAL EXECUTIVE COUNCIL MEETING



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3rd OCT - 10th OCT 2022
ADELAIDE | SOUTH AUSTRALIA



**CATCHMENT BASED WATER-ENERGY-FOOD NEXUS
ASSESSMENT: EXAMPLE OF CROCODILE RIVER
CATCHMENT, MPUMALANGA, SOUTH AFRICA**
Sue Walker, Inga Jacobs-Mata, Nwabisa Masekwana,
Bhekiwe Fakudze and Tendai Sawunyama



INTERNATIONAL WORKSHOP ON “THE WATER ENERGY FOOD NEXUS: IMPLEMENTATION AND EXAMPLES OF APPLICATIONS”

04 October 2022: 08:45-10:30 and 11:15 to 13:00 Hours
Adelaide, Australia

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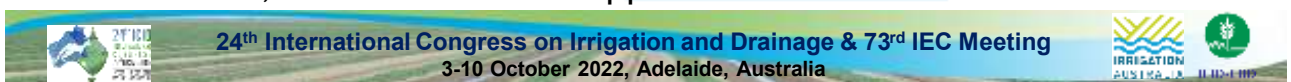
Introduction

- ❑ Climate change, population growth, & increasing urbanization are global pressures on natural resources, especially water - But need local action.
- ❑ Therefore, ongoing challenge to manage water allocation in a balanced and equitable manner in the future.
- ❑ South Africa is semi-arid with an average rainfall of 450mm per annum.
- ❑ A sustainable scientific method of allocation needs to be formulated to assist water managers with difficult decisions and planning.
- ❑ Water - Energy - Food (WEF) nexus integrated approach, use a transdisciplinary system-based methodology for resource management, development & utilisation to yield coordinated, inclusive & equitable planning, management & development.
- ❑ Climate change affects all 3 sectors so WEF nexus is important tool to blend interventions & adaptation opportunities while building resilience in communities.
- ❑ Only a few studies conducted @ local scale - catchment or municipality level.



Methods

- ❑ Multidisciplinary team - combination of social & physical scientific mixed methods used (Mohtar & Daher, 2019).
- ❑ Include collection, analysis & interpretation of both quantitative and qualitative data.
- ❑ WEF nexus analyses mostly focused on using: (Albrecht et al., 2018)
 - Quantitative approaches nearly 75%,
 - Social science methods approx. 25%,
 - Most confined to disciplinary silos,
 - Diverse disciplines only 25%,
 - **Using both quantitative & qualitative approaches < 20%**
- ❑ Therefore, this is our chosen approach ...



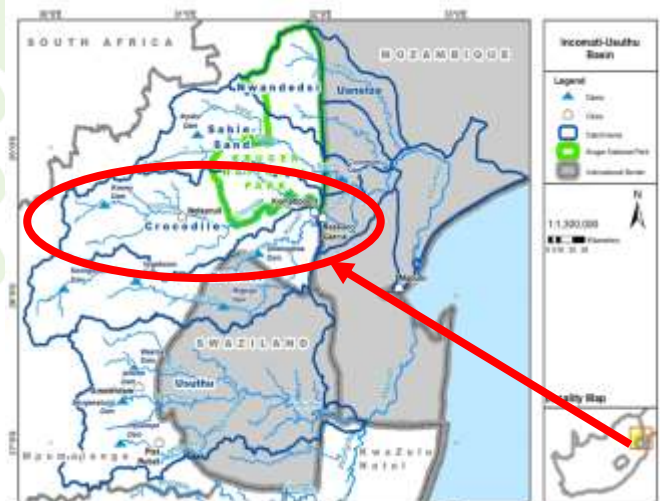
Methods

- **Combine** quantitative analysis of water use for energy & food, with engagements with role-players & decision makers in each sector.
- **Evaluation and comparison** of WEF nexus tools & frameworks.
- Focus on application at catchment and municipality level.
- Highlight relevant **indicators** for each sector:
 - with their necessary inputs for successful application
 - considering usability of expected outputs
 - in **Crocodile sub-catchment of Inkomati-Usuthu Water Management Area**



Methods

- Applied to Crocodile sub-catchment of Inkomati-Usuthu Water Management Area (WMA).
- Indicators for each sector with necessary inputs for application & usability of expected outputs
- Masekwana et al. (2022) shows preliminary results.



WEF Nexus Tools and Frameworks

- different users have different specific questions / uses e.g. management
- different levels of detail & information
- operate within different constraints - time, finances, infrastructure & human resources and policies.
- applied at a variety of scales, both temporal and spatial scales:
 - local / urban scale to national, regional & continental scales
 - time scales from daily thru weekly / monthly to seasonal, annual / decadal
- outputs used for management decisions, or for medium term planning activities, or for tactical seasonal or strategic long-term planning.

Method & Purpose	Scale	Type	Task	Authors
Analytical Livelihoods Framework ALF - Trade-off analysis	Multi-scale	Integrate	Knowledge	Mabhaudhi 2019; Nhamo 2019; Mpandeli 2018
Biophysical & Economic Model Systems Crop, economy - land use & water quality	Multi-scale	Indicators	Knowledge	FAO, 2014; Giampietro 2009
CLEWs - climate, land, E&W - Evaluate climate impact on resources supply	Multi-scale	Integrate	Implement & Manage	Ferroukhi 2015; Mpandeli 2018
MuSIASEM - Multi-Scale Integrated Assess Society & Ecosystem Metabolism - relate socio-economy & ecology	Region / national	Integrate	Govern	Giampietro 2009
Water footprints - WEF nexus Ecological footprint, diet/food, virtual water trade & governance	Multi-scale	Footprint	Govern & Inform	Van der Laan 2019 & 21; Zhang 2018
WEF Nexus Tool 2.0 Quantitative assessment & forecast	National	Simulate	Govern & Manage	Daher & Mohtar, 2015; Brouwer 2018
NexSym Framework Define & quantify WEF interconnection	National	Quant. analysis	Govern	Martinez-Hernandez 2017; Nhamo et 2020



WEF Nexus Tools and Frameworks

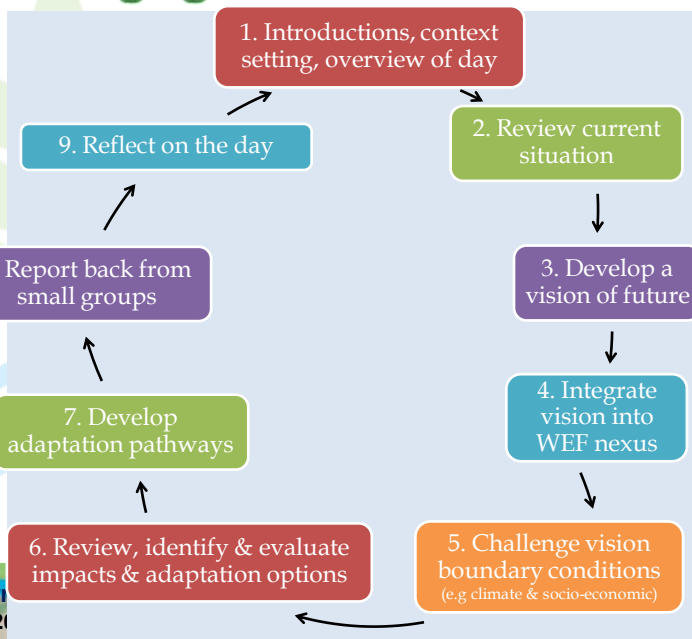
- most useful at this stage:
 - ALF framework,
 - WEF nexus Tool 2.0 and
 - Water footprint approach
- collect a comprehensive set of data across full WEF scope for selected area.
 - challenging task as data / info across sectors is not aligned to same spatial scale
 - search national databases, contact sector reps, &
 - using simplified assumptions

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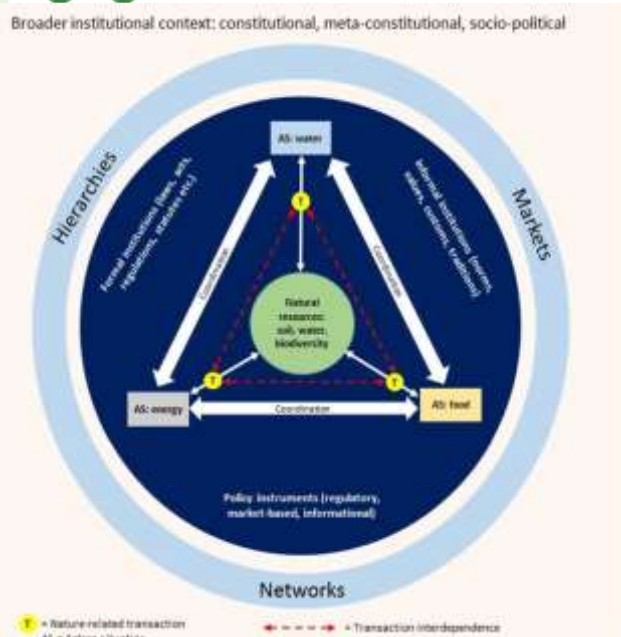
Stakeholder Engagements

- ▣ theoretical qualitative methodology
 - via Network of Adjacent Action Situations (NAAS) (McGinnis, 2011)
- ▣ participative process:
 - Multi-stakeholder workshop - **PSD Participatory Scenario Development**,
 - Present @ 3 Catchment Forum meetings in Inkomati-Usuthu WMA,
 - 15 semi-structured interviews, &
 - 2 FDGs Focus Group Discussions.



Stakeholder Engagements

- ▣ Need trade-offs among policy goals of different sectors.
- ▣ Address policy coherence or expect increased pressure on fragile resource systems.
- ▣ Conceptual framework governance structure of WEF nexus shows linkages from natural resource base to 3 sectors as Action Situations (AS).



Stakeholder Engagements

- Wide range of issues influence decision-making:
 - global competitiveness in agriculture,
 - political interference in municipal and administrative functions,
 - low maintenance of infrastructure and other resource limitations,
 - general limited capacity & awareness.
- Stakeholder engagement decision-making considered critically important in WMA
 - with feedback loops, and
 - processes for community validation

Scenarios

- Business as Usual;
- Climate Change (i.e. hotter, drier, floods);
- Socio-economic Change (global competition, inequality, sustainable access, support from industry);
- Political &/or Policy Change (lack of commitment from government, change in political power).



Conclusions

- WEF nexus tools can be applied at a catchment level in Mpumalanga province of South Africa - ALF, WEF nexus Tool 2.0 & water footprint.
- Difficult to source data @ spatial & time scales => need more work.
- Multi-stakeholder workshop on participatory scenario development gave insights into challenges of both public & private sectors to balance trade-offs in allocation of water to municipal, agriculture & energy sectors.
- Four Future Scenarios developed & unpacked for sectors – namely
 - 1=business as usual, 2=climate change, 3=political/policy changes, 4=socio-economic changes.
- Work continuing on integrating main aspects (modelling & stakeholders) into practical applications for catchment water allocation.
- Urgent challenge to better manage 3 resources of water, energy & food.





Team



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- ▣ Prof Sue Walker: Agricultural Research Council – Natural Resources & Engineering, Pretoria, (walkers@arc.agric.za) & University of the Free State, Bloemfontein, South Africa.
- ▣ Dr Inga Jacobs-Mata: International Water Management Institute
- ▣ Ms Nwabisa Masekwana: ARC-NRE & University of Pretoria
- ▣ Ms Bhekiwe Fakudze: IWMI & University of Pretoria
- ▣ Dr Tendai Sawunyama: Inkomati-Usuthu Catchment Management Agency



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