

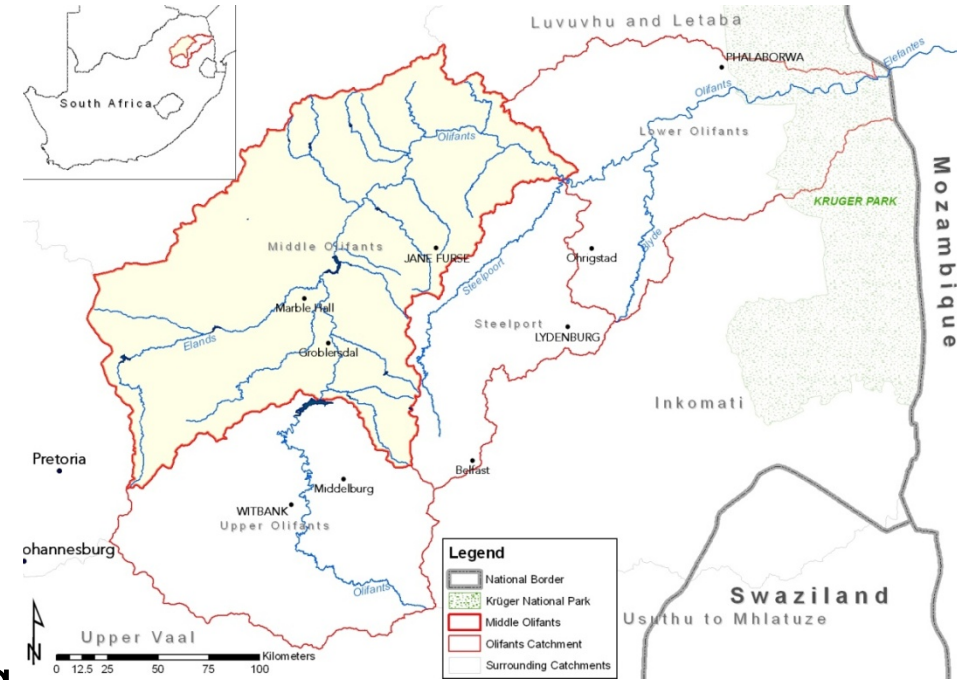
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Interlinked Hydrological and Economic Modeling to Support Integrated Water Resources Management

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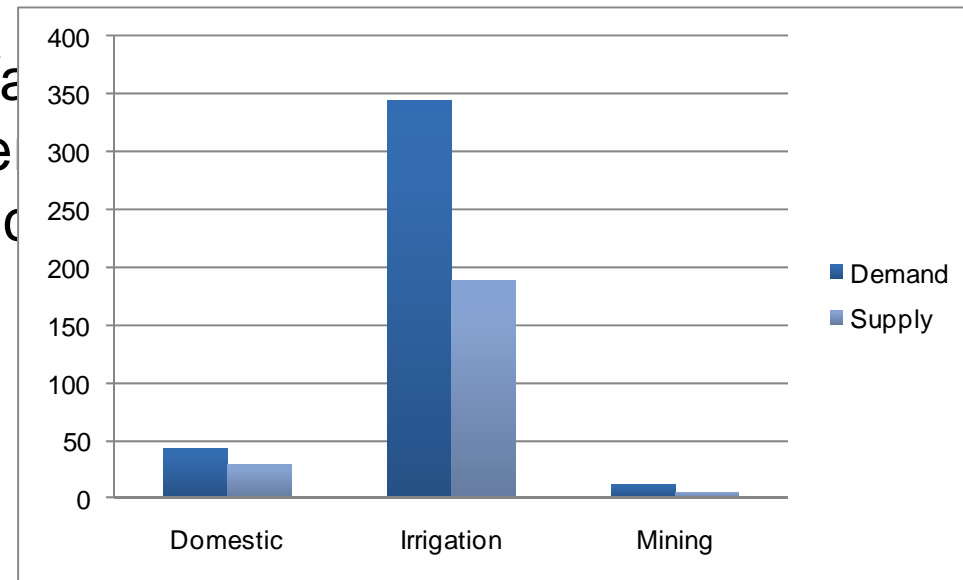
Project Region – The Middle Olifants River Basin

- North-east of Johannesburg/Pretoria
- In the provinces of Mpumalanga and Limpopo
- Eventually, the Olifants River flows through the Krüger National Park and Mozambique into the Indian Ocean.
- Characterized by highly developed irrigation, a dynamic growth in the mining sector, and over 1.5 m inhabitants, mostly rural settlements
- Numerous competing water user groups
- Quantity and Quality problems arise due to over-allocation, mining (active, abandoned and defunct mines), agricultural practice and wastewater treatment plants out of operation.



Water Situation in the Middle Olifants River Basin

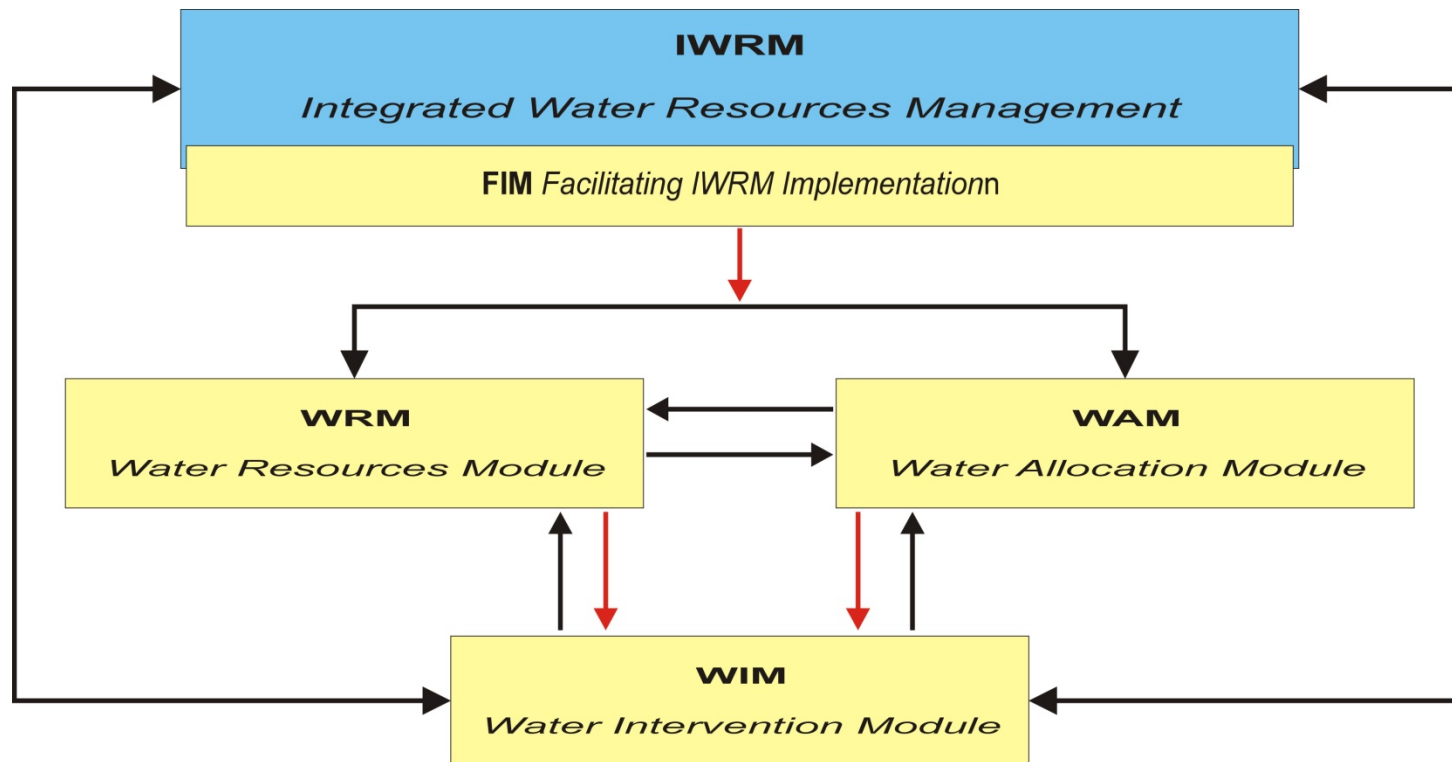
- There are three major water user groups in the Middle Olifants
 - domestic sector,
 - mining sector, and
 - irrigation sector (more than 86 % of total water use)
- Water for the human and ecological reserves is not provided with priority
- Total demand (approx. 400 m m³/a) equals abstraction, therefore water resources are over-exploited (deficit about 100 m m³/a)
- All users have to live with frequent supply shortages, leading to production downfall, especially in dry periods



- Global Water Partnership:
Integrated Water Resources Management (IWRM) is a process of promoting the coordinated management of water, land and related resources, in order to maximize the resultant economic and social welfare without compromising the sustainability of eco-systems.
- South African National Water Act (from 1998):
All water users should use water productively and in a sustainable manner for social and economic activities; in a manner that promotes growth, development and prosperity of all people to achieve social justice and equity.

Interlinked Modeling to Support IWRM in the Middle Olifants

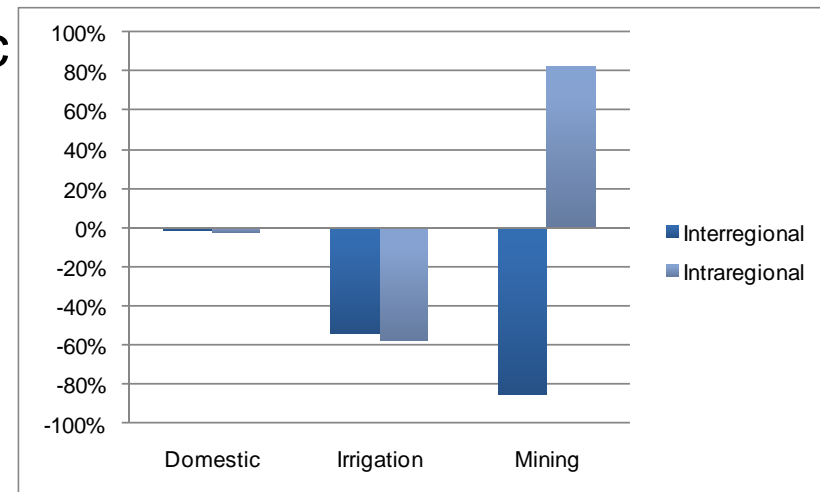
- The IWRM model that was developed for the Middle Olifants combines technical data with institutional regulations and with economic criteria.
- Consequently, the model was based on three modules:



- The Water Resources Module
 - analyses the different types of water demand,
 - computes the water balance for each sub-catchment of the project region, i.e. water availability, water use and water transfer to the next sub-catchment, and
 - considers the institutional regulations
- The Water Allocation Module (developed by ZEF)
 - contains in-depth information on the productivity of each of the water users, and
 - using the output of WRM, computes the best allocation for each sub-catchment
- The Water Intervention Module (WIM) runs scenario analyses of planned and unplanned measures to enhance water supply and sanitation

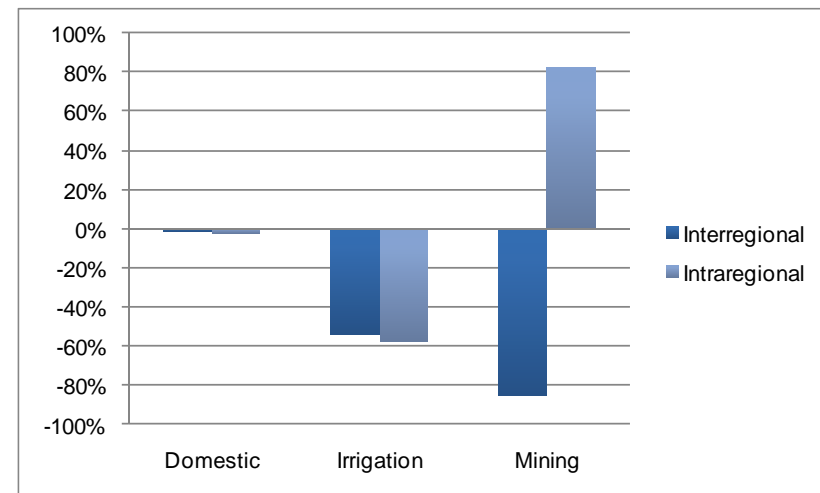
Model Results 1/3

- Overall demand would have to be cut by more than 38 % to gain social equity and ecologic sustainability (acc. to NWA)
- Consequently, water supply for irrigation would need to be reduced by ca. 213 m m³/a
- But, the amount of water that would have to be re-allocated from irrigation to mining was found to be lower than expected, due to the high level of irrigation technology
- No significant re-allocation from the domestic sector (- 0.11 m m³/a)



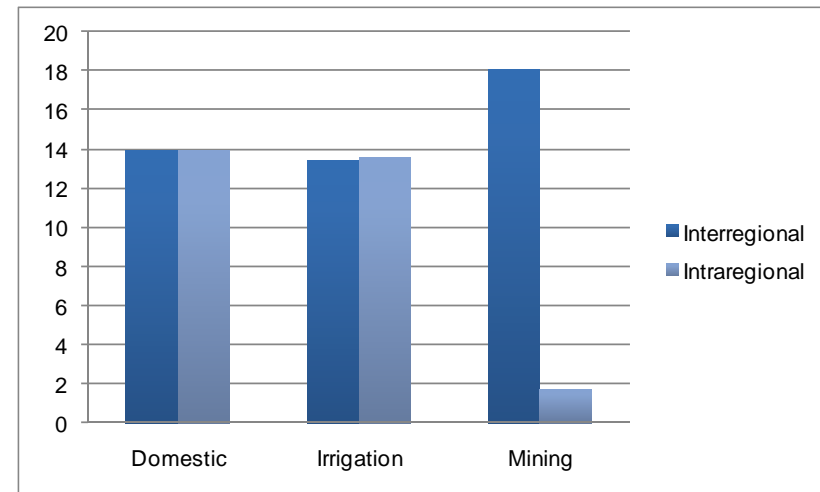
Model Results 2/3

- For the mining sector, the picture is somewhat different
- The model results show that the mining sector could almost double its water use if intraregional trade was possible (+82%)
- Though in case of interregional trade the sector would have to reduce its consumption by 85%
- The ratio behind these figures is as follows:
 - The increase in water supply with intraregional trade is mostly due to one sub-catchment that currently does not get as much water as it was entitled, and there are almost no other economic activities besides mining
 - On the other hand, in the Middle Olifants, there are users with higher water productivity than in the mining sector



Model Results 3/3

- Average benefits (ZAR/m³) for the mining sector are higher with interregional trade than with intraregional trade
- Because: water is not a major determinant for the productivity of the mines. Therefore, if water supply was reduced, average benefit would increase. The same effect can be witnessed when drip irrigation is applied in agriculture
→ a lot of water is currently wasted in the mining sector !



Implications for IWRM in the Middle Olifants River Basin

- Interlinked hydrological and economic modeling supports protecting the available resources by showing how to allocate them more efficiently
- However, the model results should be used cautiously
- One also needs to look behind the figures to find other ways to improve the water balance (which is when IWRM actually begins):
 - 55% of South Africa's wastewater treatment plants, especially smaller ones, do not meet effluent standards. Balancing the water situation could also be accomplished if water facilities were operated (and maintained) in a more sustainable way or if wastewater treatment capacities were enhanced significantly.
 - Non-revenue water for South Africa varies between 45 and 71%.
- In other words: It is not mainly natural characteristics but also lacking management know-how which creates the huge deficit in the region

Next Research Initiatives

- Integrated water resources management is more than just analysing water availability and water demand. Regional economics, efficiency of water use, the operational state of water assets etc. need to be considered, too
- Therefore a combination of multiple tools to improve the situation is needed
- This also requires local stewardship and improved ownership of water
- Future research will therefore have to analyse methods and concepts that are adapted to the local conditions in order to improve the attitude towards water management in general and the management of water facilities and assets in particular

- IEEM is involved in three IWRM research projects funded by BMBF
 - South Africa
 - Vietnam
 - Iran
- The insight gained from these projects shows that
 - Compared to Vietnam, data availability is better in South Africa and more reliable
 - Compared to Iran, participation is more open
 - But in all regions, there is a deficit with cost transparency

Thank you for your attention !



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