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Model-based Impact Assessment of an Integrated Water Management Strategy on Ecosystem Services relevant to Food Security in Namibia

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North-central Namibia is characterized by seasonal alterations of drought and heavy rainfall, mostly saline groundwater resources and a lack of perennial rivers. Water scarcity poses a great challenge for freshwater supply, harvest and food security against the background of high population growth and climate change. CuveWaters project aims at poverty reduction and livelihood improvement on a long term basis by introducing a multi-resource-mix as part of an integrated water resources management (IWRM) approach. Herein, creating water buffers by rainwater harvesting (RWH) and subsurface water storage as well as reuse of treated wastewater facilitates micro-scale gardening activities. This link constitutes a major component of a sustainable adaptation strategy by contributing to the conservation and improvement of basic food and freshwater resources in order to reduce drought vulnerability.

This paper presents main findings of an impact assessment carried out on the effect of integrated water resources management on ecosystem services (ESS) relevant to food security within the framework of CuveWaters project.

North-central Namibia is perceived as a social-ecological system characterized by a strong mutual dependence between natural environment and anthropogenic system. This fundamental reliance on natural resources highlights the key role of ESS in semi-arid environments to sustain human livelihoods.

Among other services, food provision was chosen for quantification as one of the most fundamental ESS in north-central Namibia. Different nutritional values were utilized as indicators to adopt a demand-supply approach (Ecosystem Service Profile) to illustrate the ability of the ecosystem to meet people's nutritional requirements. Calculations have been conducted using both Bayesian networks to incorporate uncertainty introduced by the variability of monthly precipitation and the application of plant specific water production functions.

Results show that improving the water buffer and water use efficiency by facilities of the multi-resource-mix increases the amount of water available for irrigation and thus enhances intermediate and finale ESS relevant to food supply on the household scale. Furthermore, surplus water can be purified and used as an additional drinking water resource.

The case study at hand shows that specific components of an IWRM approach can significantly increase the availability of supporting and provisioning ESS and thus reduce people's vulnerability to climate change and associated impacts. The model itself and the analytical framework as a whole can be utilized as a decision-support-tool in order to determine the optimal size of technological variables to maximize yields especially as a function of hydro-meteorological and socio-economic framework conditions.