Hydro-Ecological functioning and management of the Cubango-Okavango River Basin

Fonctionnement hydro-écologique et gestion du bassin du fleuve Cubango-Okavango

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RÉSUMÉ

Le delta de l'Okavango, d'une superficie de 12000 km2, est le terminus principal d'un bassin hydrologique endoréique plus large (300.000 km2) entre l'Angola, la Namibie et le Botswana, en Afrique australe, le bassin hydrographique Cubango-Okavango (CORB). Les précipitations saisonnières dans le bassin versant angolais fournissent un flux annuel fortement pulsé dans le système qui se caractérise par de faibles gradients et des taux de transit lents, se terminant dans le delta où 97% de l'afflux est évapotranspiré. Le Delta n'est pas transformé par l'activité anthropique et il est la base d'une industrie florissante d'écotourisme. Il y a d'importants besoins en matière de développement dans le CORB, qui inclut certaines des zones les plus touchées par la pauvreté des trois états du bassin. En prévision de la nécessité d'une action coordonnée en faveur de ce développement et pour assurer sa durabilité, la Commission tripartite permanente du bassin de l'Okavango (OKACOM) a été créée en 1994. L'OKACOM a supervisé la mise en œuvre d'une évaluation diagnostique transfrontalière, des plans d'action nationaux et un plan d'action stratégique pour l'ensemble du CORB. Elle est actuellement engagée, à travers deux projets majeurs, dans la mise en œuvre des actions recommandées dans ce processus de planification, notamment l'établissement d'un réseau de surveillance hydrométéorologique et de contrôle de la qualité de l'eau. Les défis permanents consistent à trouver des points d'entrée institutionnels appropriés et à obtenir une reconnaissance et un soutien suffisants de la part des gouvernements des états du bassin, y compris un financement à long terme (au lieu du simple financement par projet).

ABSTRACT

The 12000km^2 Okavango Delta is the main terminus of a larger (~300,000km^2) endorheic river basin which links Angola, Namibia and Botswana, in southern Africa the Cubango-Okavango River Basin (CORB). Seasonal rainfall in the Angolan catchment provides a strongly pulsed annual flow in the system which is characterized by low gradients, and slow transit rates, ending in the Delta where 97% of inflow is evapo-transpired. The Delta is untransformed by anthropogenic activity, and supports a thriving ecotourism industry. There are strong pressures for development in the CORB, which represents some of the most poverty-ridden areas of the 3 Basin States. In anticipation of the need for coordinated action on this development, and to ensure sustainability, the Permanent Tri-partite Commission on the Okavango Basin (OKACOM) was formed in 1994. OKACOM has overseen the implementation of a trans-boundary diagnostic assessment, national action plans, and a strategic action plan for the whole CORB. It is currently engaged, through two major projects, in implementing recommended actions from this planning process, including (significantly) establishing a hydro-meteorological and water-quality monitoring network. Consistent challenges have been finding appropriate institutional entry points, and getting sufficient recognition and support from Basin State governments, including long-term (as opposed to project-based) funding.

KEYWORDS

Endorheic, Floodplain, Pulsed, Trans-boundary, Un-transformed

1 INTRODUCTION

The iconic 12,000km^2 Okavango Delta wetland system in Botswana, a World Heritage Site, receives a pulsed seasonal inflow of 10km^3/year, from 120,000 km^2 of sub-humid and semiarid rangeland in the Cuito-Cubango province of Angola. Local rainfall on the Delta itself provides an extra 5km^3, but potential evapotranspiration exceeds rain by a factor of 3. The terminal Delta of this endorheic system is comparatively well-studied, but *little is known or documented about the large catchment area upstream, without which there would be no Delta*.

As a result of its location, and the socio-economic history of the area, the Cubango-Okavango River Basin (CORB) is characterised by an extremely low human footprint, and can thus provide us with many insights on how tropical wetland systems function prior to anthropogenic transformations and a baseline on which to base sustainable development. Here I will talk about our current understanding of the major hydro-ecological processes in the Cubango-Okavango River Basin (CORB), and our attempts to ensure that development within the CORB is sustainable, yet lifts the Basin's inhabitants out of poverty.

2 BACKGROUND

Almost the entire basin is underlain by quartzitic aeolian sands, with the exception of the uplands in the extreme north-west, where crystalline basement rocks are found. There is a pronounced gradient in mean annual rainfall from NW to SE: the upper catchment receives around 1200mm/annum, while the distal Delta receives 460mm/annum. The interaction between groundwater storage and surface water flows explains much of the hydrological behaviour of the Delta. Upstream, rainfall infiltrates to an unconfined shallow aquifer in the catchment and slow discharge from this groundwater augments late wet season and dry season stream flows; storage also carries over from year to year. In the Delta, surface water recharges the shallow aquifer during inundation and buffers the system across consecutive years; it is depleted by ET through plants and soil, and again, storage carries over from year to year.

Another result of the CORB geology is the purity of the water. The quartz-dominated basin sediments generate very few weathering products. Aside from the lack of suspended sediments, a simple example is nitrogen. Water in the catchment is sufficiently low in N that the seepage bogs have high abundances of carnivorous plants like *Drosera*. Even after 97% of total input to the CORB is lost to evaporation and transpiration (mainly in the Delta), conductivities of outflowing water are <150 mS/cm. Mass balance calculations thus point to deposition of dissolved material within the downstream Delta in the order of 360,000 tons/year. Yet the biologically active surface of the Delta remains fresh; there is little evidence of the accumulation of salts that is obviously occurring. The concentrated brine formed under island centres sinks episodically under density-driven flow.

Our work in the Delta has shown that hydroperiod is a strong driver of plant species composition in seasonal floodplains, and the high level of variation in volume and timing of the floodpulse is critical in the maintenance of both the aquatic and terrestrial biota. Hydrological variation occurs on 3 different scales: multi-decadal, inter-annual and seasonal. A given patch of floodplain seldom is inundated to the same depth for the same duration from year to year, effectively maintaining the vegetation in a highly productive early succession state. These findings probably apply equally to the river-floodplain systems of the middle reaches. In the upper catchment, rapid change in land cover is occurring: forests are being harvested for charcoal to fuel cities and land is being cleared for subsistence agriculture. We have not yet been able to quantify the effects of these changes on river flows or water quality.

3 EVOLUTION OF MANAGEMENT

Against this backdrop of fundamental ecological processes, the relatively pristine Okavango Basin is facing a number of threats to ecological integrity: climate change will increase potential evapotranspiration (PET), but its effects on rainfall are ambiguous; the need for socio-economic development in the Basin is pressing, and conspicuous choices for drivers of this growth are based on use of the water for irrigated agriculture, and for hydropower; with both of these activities, and with land cover change, the volume, timing, nutrient and sediment content of inflowing water will inevitably change.

A tri-partite commission on the river basin "The Permanent Okavango River Basin Commission" (OKACOM) was established in 1994, in order "to promote coordinated and environmentally

sustainable regional water resources development, while addressing the legitimate social and economic needs of each of the riparian states", and "to anticipate and reduce those unintended, unacceptable and often unnecessary impacts that occur due to uncoordinated resources development" (http://www.okacom.org/okacom-commission).

The 1994 OKACOM Agreement gives it legal responsibility to:

- Determine the long term safe yield of the river basin
- Estimate reasonable demand from the consumers
- Prepare criteria for conservation, equitable allocation and sustainable utilisation of water
- Conduct investigations related to water infrastructure
- Recommend pollution prevention measures
- Develop measures for the alleviation of short term difficulties, such as temporary droughts

The early stages (the first 8 years) of the Commission's life were characterized by development in fits and starts: civil war in Angola restricted activities in that part of the CORB, and funding streams came in the form of time-bound projects. Signing of a peace accord in Angola in 2002 meant that OKACOM could move forward with work in the Basin. The Global Environment Facility had stepped in with funding to support a Transboundary Diagnostic Analysis (TDA), and USAID came forward with a programme of interventions and administrative support, the Integrated River Basin Management project, that was to take the institution to a whole new level of functionality.

In 2011 OKACOM completed an analysis of available knowledge about how the river system functions: the ***Cubango-Okavango TDA***. The analysis developed water-use scenarios to estimate the ecological, social and macro-economic outcomes of possible developments. The analysis has been used to develop a framework for livelihood strategies and conservation interventions – a ***Strategic Action Programme*** (SAP) – that will inform and support the planners in each member state in dealing with transboundary issues, and facilitate joint investment in the basin.

Currently OKACOM is seeking ways to implement the SAP for the Basin, and has two major projects underway working towards this. The first aims to construct a Basin Management and Development Framework underpinned by Integrated Water Resources Management principles, with pilot projects to demonstrate socio-economic development and foster environmentally conscious livelihoods. The second essentially focuses on the more technical aspects to facilitate the first: a) the development of a CORB Decision Support System, with its associated data collection, assimilation and analysis; b) these data are to be generated from a basin-wide monitoring network currently under development; c) improved land use planning, including addressing livelihood issues that lead to environmental degradation.

4 MAJOR CHALLENGES

1) Angolans, Batswana and Namibians living in the CORB are among the poorest in the region
2) War and economic/development imperatives have resulted in very big disparities in available bio-physical data to inform management
3) Language and institutional differences between member states
4) A lack of sense of urgency in national governments resulting in relatively weak commitment to the RBO process.
5) How to ensure and maintain genuine government commitment to the complicated process of making decisions based on "best-guess" science with a relatively high level of uncertainty
6) How to engender a transparent, open negotiation process between sovereign states with rather different management and development goals