Okavango Basin – Physicogeographical setting

The Okavango Basin

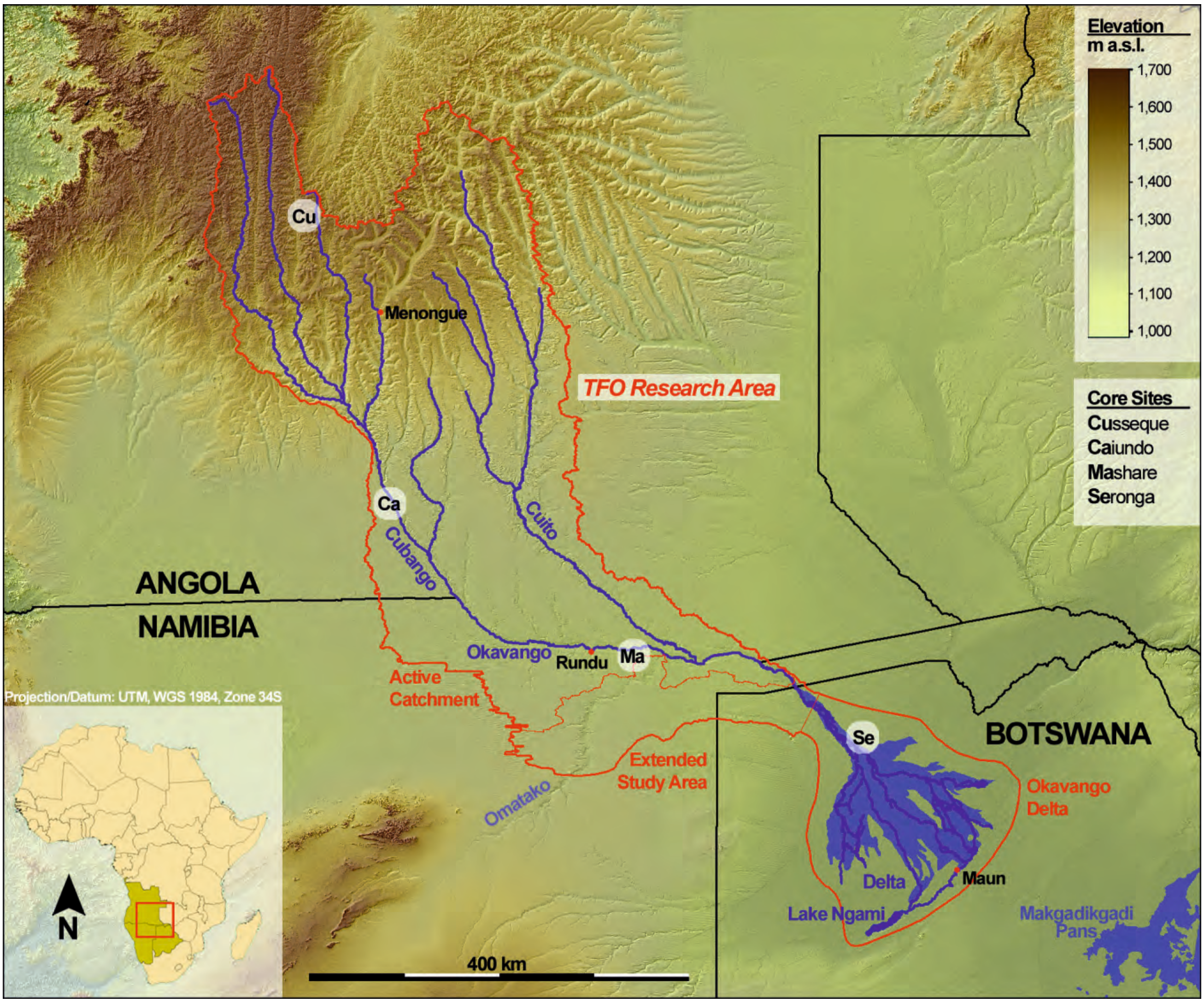

Fig. 1: Map of the Future Okavango Research Area (FORA) in southern Africa (data source: SRTM, Jarvis et al. 2008).

The Okavango Basin is situated in southern Africa within the three countries Angola, Namibia and Botswana. It can be subdivided into three prevalent landscape units: the Angolan highlands in the north, the lowlands to the south, and the Okavango Delta in Botswana.

The highlands reach altitudes of 1,600 to 1,800 m a.s.l., and constitute the largest part of the hydrologically active catchment of the river system. The geomorphological situation is the result of upheaval and faulting processes during the overthrust of the Precambrian continental lithosphere of the Congo Craton over the Kalahari Craton in the early Paleocene (Grünert 2003). The landscape descends towards the lowlands of the Kalahari in the south-east: an extensive, slightly undulating plain with significantly lower relief intensity.

The Kalahari is a vast sand body with hardly any surface water. Its basal structure is a peneplain developed on ancient Gondwanan rocks, upon which terrestrial cretaceous sediments accumulated. Although in places the Kalahari sand is most probably of alluvial origin, it was largely deposited after aeolian transport under desert conditions. The characteristic longitudinal paleodunes of the north-western Kalahari can extend up to several hundred kilometres. They formed about 20,000 years ago under cooler and drier conditions and became stabilized about 5,000 years ago (Grünert 2003).

The Okavango Delta, situated in the lowlands of north-west Botswana, makes up the southernmost part of the research area. It is an indistinctive depression confined within extensions of the East African Rift Valley system (UNESCO). North of the Delta, the so-called Panhandle forms a broad floodplain of about 120 km in length and 12 km width (Mendelsohn & el Obeid 2004).

The climate in the Okavango Basin is characterized by a rainfall gradient with annual precipitation of up to 1,400 mm in the humid Angolan highlands, where about 95% of the runoff is generated. In the semi-arid southern part, precipitation rates are relatively low, reaching 478 mm for the

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core site Seronga (Weber 2013 b), but also show a high interannual variability. The mean annual temperature is about 20 °C and increases towards the south with decreasing cloud cover. Accordingly, potential evapotranspiration increases to the south with highest rates in the summer (Mendelsohn & el Obeid 2004).

The Okavango's main tributaries, Cubango and Cuito Rivers, receive most of the runoff in the upper parts of the Basin. Unlike the rather straight flowing Cubango, the Cuito River meanders significantly through its floodplains once it reaches the lowlands. For 400 km the Okavango forms the border between Namibia and Angola. After crossing Namibia's Kavango East Region, the river enters Botswana and flows through the Panhandle with its seasonally inundated (flood-)plains and extended permanent wetlands. Finally the Okavango reaches the alluvial fan of the Delta area.

Large areas of this wetland, with its numerous islands, get flooded each year. Two-thirds of the total area of seasonally inundated swamp (around 9,000 km²) are permanently flooded (Mendelsohn et al. 2010). The annual inflow into the Delta, with highest peaks in April and May, ranges between 9 and 42 x 10^6 m³ (Steudel et al. 2013) of which 97% is lost to evapotranspiration. Another 3% spills from the Delta to Lake Ngami or through the Thamalakane River to the Makgadikgadi Pans in years of high water levels (UNESCO 2010).

The vegetation cover in the Basin is dominated by woodlands, grasslands, savannas and shrublands. A corresponding vegetation zonation follows the climatic gradient from the humid Miombo Woodlands dominated by *Brachystegia* species in the highlands, through *Baikiaea-Burkea* Woodlands in the lowlands, to the more open Thornbush Savannahs in the Kalahari.

The Future Okavango Research Area (FORA)

The Future Okavango Project (TFO) has delineated a research area which comprises the active catchment, the Delta and an extended research area between them which consists of parts of the Omatako catchment, including the socioeconomically important Kavango regions in Namibia. In this sense, the research area differs from the Okavango Basin used, for example, by the OKACOM, which corresponds to the entire river basin in a comprehensive sense. The FORA is defined in the following way:

a) Active Catchment: The Active Catchment represents the actual catchment as the state of the art delineated watershed area above the Mohembo gauging station, which is the link to the Delta. The ephemeral Omatako River, which originates in Namibia and joins the Cubango River near Rundu, as well as other non-active areas of the Makgadikgadi Pan (Kalahari Basin) are excluded. However, the definition of the active catchment is close to many already existing ones (e.g. OKACOM, Okavango Research Institute)

b) Extended Study Area: The Extended Study Area covers wider parts of the northern Kavango region. Within the TFO project this region is considered to be important due to resource use in the hinterland. The region corresponds to the lower parts of the Omatako catchment and follows at its southern boundary the contour line of 1,000 to 1,200 m a.s.l.

c) Okavango Delta: The Okavango Delta merges areas of commonly used definitions of the Delta, i.e. of the Environmental Information Service of Namibia and by Mendelsohn & el Obeid (2004). The delineation is adapted to the requirements of the TFO partners, for example including the Lake Ngami and areas north of the Delta defined as grazing hinterland of the core site Seronga. Thus, the Delta as used in FORA is not defined according to eco-hydrological aspects sensu stricto.

The total area of the FORA is 228,106 km² whereas the active catchment accounts for 170,029 km², the extended study area for 18,601 km² and the Delta for 39,476 km².

The Core Sites

Four areas within the FORA were selected as core research sites of 100 km² each: Cusseque (northernmost) and Caiundo in Angola, Mashare at the Namibian-Angolan border, and Seronga (southernmost) at the Panhandle in Botswana (Fig. 2). The core sites, from the Angolan highlands to the Delta, represent a physico-ecological gradient with increasing annual mean temperature and decreasing precipitation (Weber 2013 a). Accordingly, the relief intensity decreases steadily, from high mountainous areas to undulating landscapes in the central parts of the FORA and flat sandfields in the south (Fig. 3) (Groengroeft et al. 2013 a-d).

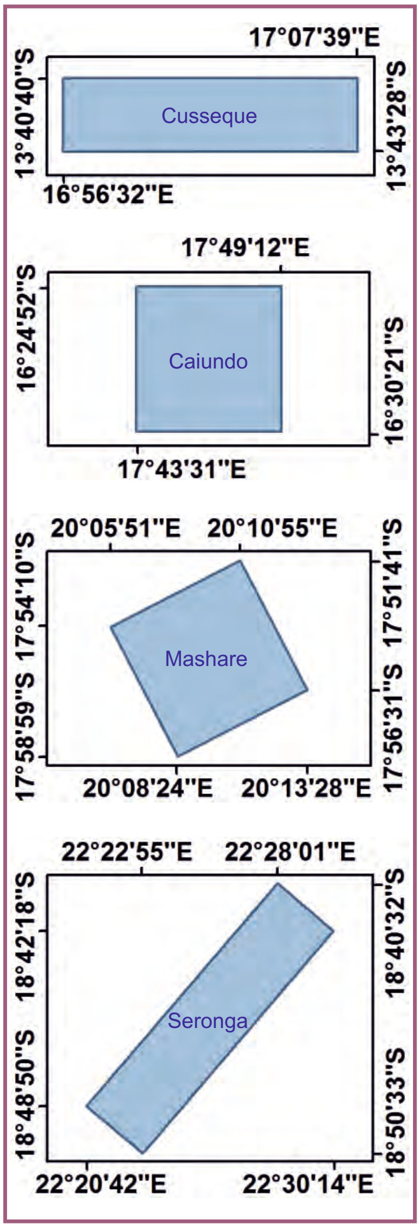

Fig. 2: Coordinates of the core sites. Projection/Datum: UTM, WGS 1984, Zone 33S (Cusseque, Caiundo), Zone 34S (Mashare, Seronga). For kmz files of core sites and FORA see Electronic Appendix.

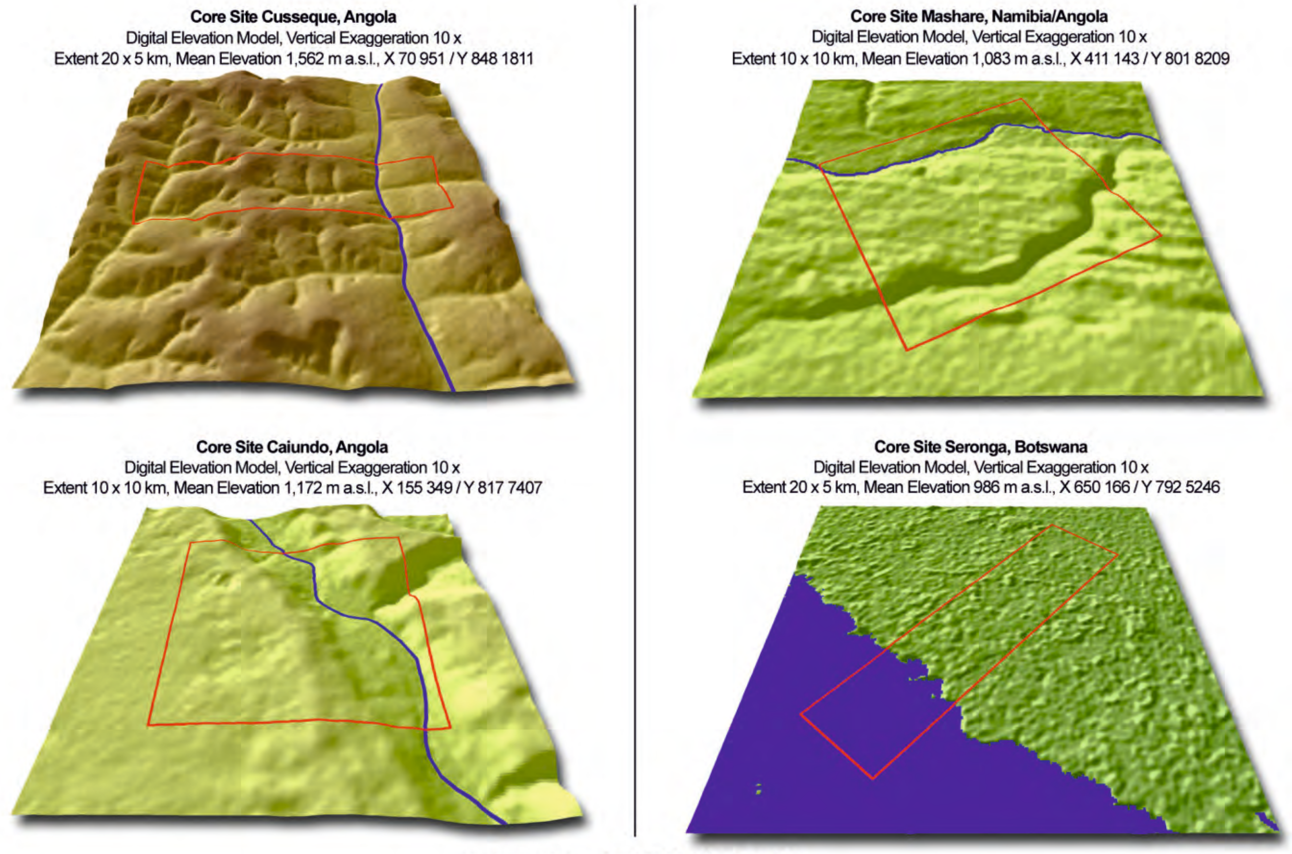

Fig. 3: Digital Elevation Models of the four core sites (data source: SRTM, Jarvis et al., 2008).

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