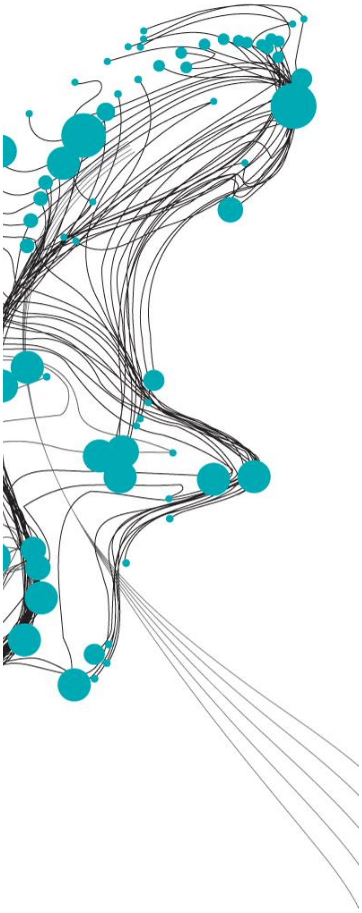
THE BLUE WATER FOOTPRINT AND LAND FOOTPRINT OF WATER STORAGE SYSTEMS



At the global level, enough freshwater is available to meet a rising demand, however, spatial and temporal variations are large, resulting in a lack of water availability. By capturing water in times of excess and releasing water in times of deficit, implementing water storages is a promising part of the solution. More knowledge is required on the quantities of the water losses occurring with different systems of storing water. The aim of this study is to estimate the differences in blue water footprints and land footprints between water storage systems consisting of multiple decentralized small-sized water storages and centralized large-sized reservoirs used for water supply.

The blue water footprint is expressed as the ratio between the evaporative water losses and the total available withdrawable water over a period of time. The land footprint is expressed as the area required for the available withdrawn water to be stored in. The footprints calculations were performed for six scenarios. Three scenarios consisting of irrigational purposed storages and three scenarios consisting of multi-purposed storages were analyzed, differing in amount of precipitation during the year from a dry to a wet year. The storage systems were based on the catchment area of the Challawa reservoir, located in Nigeria. Each storage system consists of different storage dimensions, given Table 1.

Under normal precipitation conditions, for irrigational purposed water storage systems 15% to 30% of the total seasonal water abstractions is lost through evaporation. For multi-purposed water storage systems 12% to 24% of the total annual water abstractions is lost through evaporation. For both the irrigational purposed and multi-purposed water storage systems, under normal precipitation conditions, 0.12 to 0.39 square meter is required to abstract one cubic meter of water.

It can be concluded that the, seasonal and yearly, blue water footprint and land footprint are positively correlated with the amount of storages within a storage system. The correlation is mainly caused by the differences in total surface area, resulting in higher evaporation losses for water storage systems consisting of smaller, decentralized storages than systems consisting of larger, centralized storages. As shown in Figures 1 and 2, the footprints are higher for irrigational purposed water abstractions (IRR) than for multi-purposed water abstractions (MP). In addition, the footprints are positively correlated with yearly precipitation.

Table 1. Designed water storage systems

System	Amount of storages	Inflow volume per storage ($m^3 * yr^{-1}$)	Max. surface area (m^2)	Max. depth (m)	Max. volume (m^3)	Max. total volume (m^3)
1	1	2.38E+08	2.75E+07	8.95	1.19E+08	1.19E+08
2	63	3.56E+06	5.37E+05	7.00	1.83E+06	1.19E+08
3	4,000	5.96E+04	1.12E+04	5.35	2.97E+04	1.19E+08
4	255,000	9.45E+02	3.44E+02	3.30	4.75E+02	1.21E+08

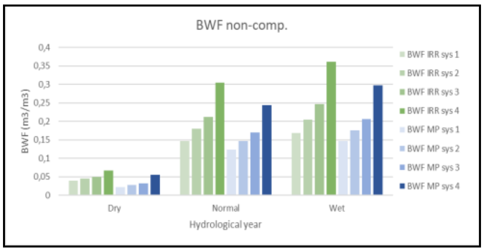


Figure 1: Blue water footprints per system per scenario

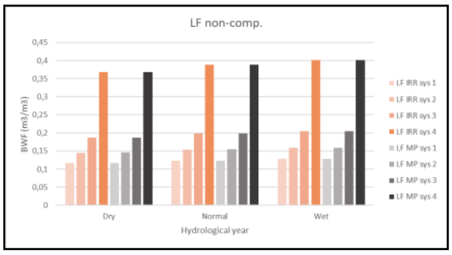


Figure 2: Land footprints per system per scenario

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