Water and Agriculture – A Concept Note

Contributing to the "***Characterization of current agriculture activities, future potential irrigation developments and food security face to climate variability in Zambezi River Basin***"

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1. Introduction and Background

The agricultural sector contributes significantly to the socio-economic development of the riparian countries to the Zambezi Basin, and to the livelihoods of 24 of the 30 million people who live in the basin (IFRC, 2009). Agriculture is practised under diverse biophysical and socio-economic conditions, policy and legal domains, and heterogeneous farming types and systems with different technologies used for abstracting and distributing water. For example, crops are grown under rain fed and irrigated conditions as well as in wetlands and flood plains. Linkages to markets also differ between and among different farming systems: there are large scale farms which are well linked to markets, and smallholder farms that are subsistence-oriented.

Water is a critical input into existing and future agricultural production across all the farming types and systems that are found in the basin. Water must be used sustainably if agriculture is to enhance economic growth and reduce poverty, as well as continue to make a contribution to agriculture-based livelihoods (World Bank, 2010). The most significant challenge in the basin is physical availability of water, in terms of its spatial and temporal distribution. Climate variability and climate change are likely to make water resource availability less certain in terms of amount and frequency, which will negatively affect agriculture and other socio-economic activities (Cervigni *et al*, 2015). A related challenge is the lack of adequate water infrastructure in terms of its coverage as well as its suitability for the projected new climate conditions. Poor water quality is also another issue, due to weak regulation of socio-economic activities, which results in discharge of poor standard effluent into water bodies. This is indicative of serious environmental problems in the basin, which include land and water degradation mainly due to agriculture, mining, industry and increasing urbanisation.

1.1 Agricultural water management

It is estimated that 75% of the people who live in the rural areas of the basin are generally food insecure (World Bank, 2010). Addressing such levels of food insecurity, and other problems in the agricultural sector, depends on finding ways and means to practice agricultural water management properly. Agricultural water management (AWM) can be defined as deliberate human actions designed to optimize availability and utilization of water, which can include direct rain as well as water supplied from surface and underground sources, for agricultural purposes (Mati, 2007). In broad terms AWM therefore refers to the management of all the water in agriculture (field crops, tree crops and livestock) in a continuum from rainfed systems to irrigated agriculture, and includes the capture, storage and drainage of any water used for agricultural production (Merrey *et al*., 2006). Within the context of integrated water resources management (IWRM), AWM is also taken as part and parcel of nested and diverse agroecosystem systems made up of biophysical and social environmental

dimensions (Molden *at al*, 2007). Thus, strictly speaking, the objective of agricultural water management should be to ensure that water and irrigation management take into account environmental, economic and social factors, hence the emphasis on sustainable agricultural water management.

Arising from sustainable agricultural water management is the concept of sustainable agricultural intensification (SAI), also termed sustainable intensification of agricultural production (SIA) which derives from the need to intensify production (e.g., producing more with less water and land) in a sustainable manner using an agro-ecological approach and through socio-economics and institutions, and all key stakeholders should be involved from the beginning of any interventions using participatory approaches. According to Conway (2014), SAI provides a means for tackling hunger, malnutrition and poverty while at the same time protecting and improving the environmental base. Successful SAI requires human ingenuity, creativity and innovation, given the severe resource constraints and global warming (Conway, 2014) faced by mankind. The key tenets of SAI are intensify production, follow an agro-ecological approach and have all stakeholders participating.

1.2 **Agriculture and national economies**

Data shows that agriculture accounts for at least a fifth to the Gross Domestic Product (GDP) in half of the riparian countries (see Table 1) with Tanzania recording the highest followed by Malawi. On the other hand Botswana, whose economy is based on mineral resources, has the lowest contribution at 2%. The economy of Angola has a similar structure to that of Botswana. The contribution of agriculture to GDP, however, will change if adequate investments in water infrastructure are made. Agriculture also supports the livelihoods of millions of people who reside in the basin. Of the 30 million people in the basin, almost 75% of that number lives in the rural areas and are dependent on agriculture.

Table 1: Contribution of agriculture to the Gross Domestic Product (GDP) of the riparian countries of the Zambezi River

Country	Contribution of agriculture to GDP (%)
Angola	8.9
Botswana	2
Malawi	35.5
Mozambique	21.7
Namibia	11.3
Tanzania	45.3
Zambia	16.1
Zimbabwe	21.9

Source: Euroconsult *et al* (2008)

Only 3% of the 5.4 million cultivated annually is irrigated, and this area under irrigation is expected to increase by 2025, subject to investment plans and availability of resources. More than 90% of the cultivated area in the basin is rain and flood dependent.

2. <u>The Research Problem</u>

Before one can look at sustainable AWM and its associated SAI, it is imperative that one takes stock of conditions obtaining in the basin. There is a need to understand the dimension of the two key inputs of water and land into agriculture. Questions that arise include; how much land is available in the basin and of that how much is suited to agriculture and is being used thus, what typologies of agricultural practices exist in the basin and what are the key factors driving these, how much water is

available in the basin and of that how much is allocated or available for agriculture, how much irrigation is taking place in the basin and what is the potential for further expansion with what water resources, what are the levels of agricultural water productivity in the basin, what options exist to improve agricultural water management, can there be trade-offs between rain fed and irrigated agriculture, and can the basin be eventually food secure? Within the context of the Water-Energy-Food-Ecosystem (WEFE) nexus, the questions are, can this be used as an approach or tool to better manage resources in the basin for sustainable energy and food production?

The above set of questions highlight the need for significant baseline research on issues to do with water, land and agriculture in the basin. Once this is established, analyses are then undertaken on what the key issues in water and agriculture and assessment done on agricultural productivity, water productivity, WEFE nexus (water and land) indicators and recommendations amd for the basin leadership and policy people.

2.1 **Research objectives**

The research objectives are:

- To analyse the baseline conditions on agriculture (including livestock and fisheries) by gathering and processing data and by-products (land use and coverage, local practices, seasonal patterns) at ZRB scale;
- To perform agriculture assessment (crops water demand, productivity and potential impact of irrigation expansion) and scenario based management practices.

These objectives can further be broken into component parts for ease of research.

3. Research Methodology

The research methodology is going to be in the form of work packages (WPs) that focus on activities to be done and the expected outcomes.

3.1 Work Package 1 – Review of existing literature and practices on agriculture and water in the Zanbezi River Basin.

This work package proposes to review all pertinent literature on the ZRB with respect agriculture and water issues and then specifically on agricultural water management aspects. The WP in itself will follow a two-pronged approach, first, a review to put into context the water and agriculture issues in ZRB in terms of generalities such as quantities, distribution, quality, usage, commitments and future development. This work will form the base upon which the rest of the other work is to be build. Naturally, this work will be done in close linkage with other groups working on hydrology and surface and ground water resources in the basin

A second part of this work package is to review existing dominant agricultural practices in the basin. The focus of the review will be on agricultural practices that include rain fed agriculture, irrigated agriculture, flood farming and dambos, fisheries, livestock farming and any other agricultural related livelihood strategies. The intention of this aspect of the study is to document the types and spread of the different agricultural practices and get an understanding of their drivers, the qualitative impact on food security and cash generation.

Approach: The above reviews will take the form of desktop studies using a range of data and information sources that will include, but not limited to; internet searches, national datasets, SADC databases, ZAMCOM reports, reports from international financial institutions (e.g. IFAD, WB, IMF),

research articles, consultancy reports, NGO reports, university research dissertations, and related materials.

Output: The main output of this WP is a report that contextualises issues in terms of the agricultural baseline conditions. Of importance

3.2 Work Package 2 – Current and future agricultural water demand assessment

This work package follows on from WP 1 as it will be based on the baseline data and information generated. The main thrust of this work is to undertake assessment of various agricultural practices in terms of; water use, water demand, water productivity, expected extra water demanded for proposed irrigation expansion, impacts on water quality.

Approach: These assessments will be undertaken using traditional approaches as well as modelling with tools such as AquaCrop, incorporating climate change/variability aspects. Because of the wide scope of the work, the research might deliberately take a case study approach and focus analysis on specific agricultural practices, for example, conservation agriculture in Malawi, irrigated agriculture in Zimbabwe and flood farming in Zambia. The focus will deliberately be on irrigated agriculture and conservation agricultural practices. The idea is this would allow the generation of useful and applicable information for the various countries in the basin.

Another angle to this assessment will be to bring into the mix the water-energy-food-ecosystem nexus (WEFE) approach in the analysis. The WEFE nexus will be applied as tool in integrated management of water and land for energy and food production in an ecosystem sustainable manner, given the various challenges and risks faced in the basin. Expected outputs of such endeavours will include the determination of the WEFE index for water and land in agriculture to allow comparison and advice of the best way to deploy the limited resources for optimal outcomes in the basin in general, or as case studies.

Output: The main output from this work package is going to be a report on agricultural assessment in general and specific cases in the basin.

3.3 Work Package 3 – Guidelines and training material on water usage in irrigated agriculture and conservation agricultural practices.

The work package will apply data and information from WP1 and WP2 and will consist of focused guidelines on various aspects of irrigated agriculture and conservation agriculture. The first part will focus on determining appropriate guidelines and assessing their feasibility in the basin countries. The guidelines will be guided by an assessment of any guidelines developed and used in the basin and their success. Of importance is to identify drivers of success and maximise on these in the development of the guidelines. The guidelines will be specific to the activities under consideration.

4. Work plan

Gantt chart

No.	Activity	Q4 2017	Q1 2018	Q2 2018	Q3 2018	Q4 2018
1	Concept note					
2.0	WP1 a – Water and agriculture in ZRB					
	WP1 b – Review of agricultural activities in ZRB					
3.0	WP2 – Current and future agricultural water demand assessment					
4.0	WP3 – Guidelines and training material on water usage in irrigated agriculture and conservation agricultural practices					
5.0	Final project report					

5. <u>References</u>

Manzungu & Senzanje and Mutiro – book chapter

World Bank/IWMI book

Euroconsult report

SADC databases