Afar Water Spreading Weirs, Ethiopia - Analysis Report

This analysis was done to better understand the effectiveness of flood water spreading weirs (WSWs) in Afar in Ethiopia. These relatively simple structures spread flood water to the surrounding land, which is used for flood based farming, groundwater recharge, local forestry or rangeland improvement. The WSWs are often implemented in a series (cascade) on an ephemeral river emanating from the highlands. The concept is gaining popularity – with Kreditanstalt fur Wiederaufbau and Productive Safety Net Program interested to adopt the concept too and WSWs being constructed in different Sahel countries as a resilience measure. At the same time much is unknown: how effective are the WSWs in diverting flood water and how much more biomass do they sustain? Are they causing an increase in invasive species, especially prosopis juliflora?

1. Name of the area and location

The water spreading weirs (WSW) are constructed in Afar region, in six woredas (Awra, Chifra, Ewa, Gulina, Teru and Yalo). In these six woredas nine cascades of WSWs have been constructed. The results of the analyses with use of WaPOR data for the Woredas Teru and Chifra are shown below.

2. Analysis

Analyses done

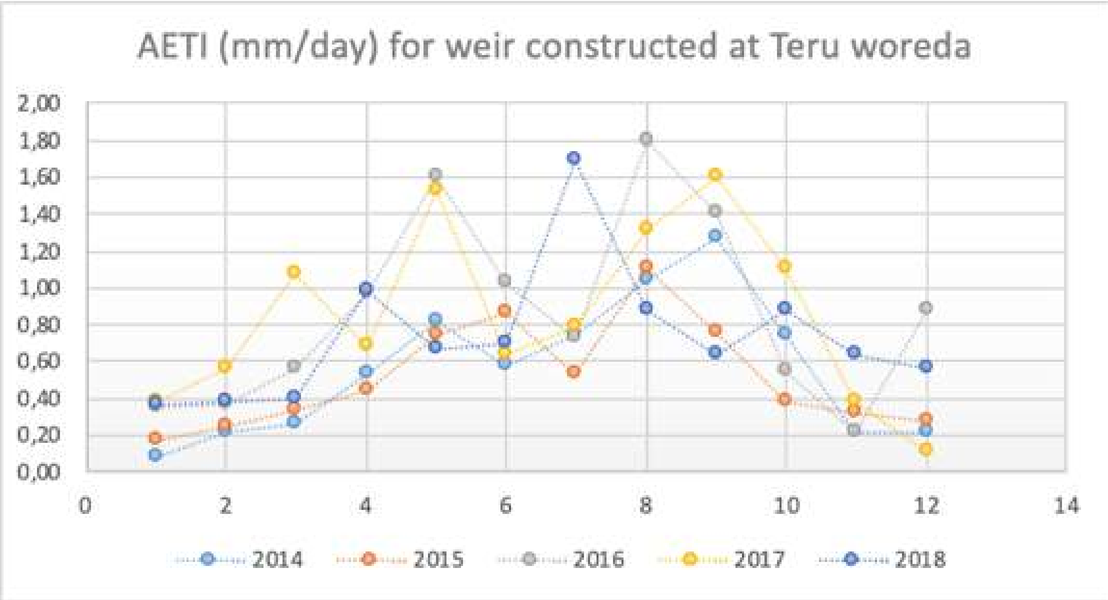
- Impact of the nine WSW cascades: Net Primary Production (NPP) dekadal timeseries over up- and downstream areas (2009-2019)
- Impact of the nine WSW cascades: AETI dekadal timeseries over up- and downstream areas (2009-2019)
- Analysis of flood AETI and NPP peaks before and after system development

Analyses to be conducted

- Comparison NPP and AETI with precipitation data (from WaPOR)
- Definition of command areas based on regular seasonal cultivation
- Filter out natural vegetation (prosopis juliflora)
- Assessment of total (additional) volume of water diverted- including comparison between the different WSWs locations
- Approximation of groundwater recharge
- Additional CO_2 capture
- Resilience analysis – change in risk of drought and reduction in bio-mass before and after WSW development
- Cultivated area temporal and spatial trend

3. OUTCOMES

Below, the preliminary outcomes of the analysis are visualized for two of the nine cascades. The daily average AETI and NPP per month for various years are shown for the Woredas Teru and Chifra. The WSWs were constructed and became operational in 2015, and some a little later. The influence of the WSWs therefore become visible after 2015.



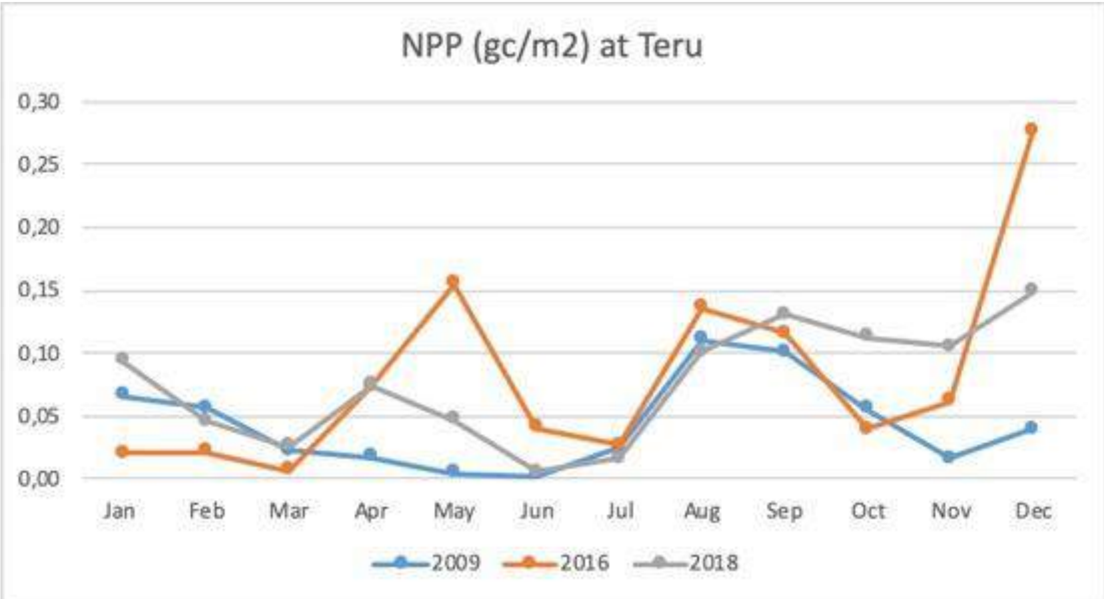
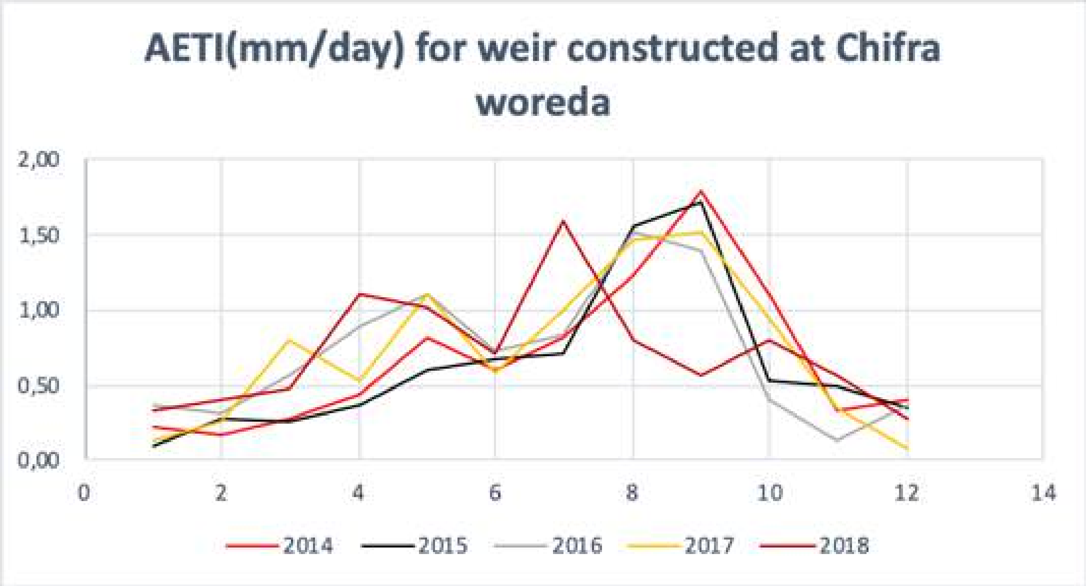


Figure 1: These two graphs show the NPP and AET for Teru WSW, over the year. After the construction of the WSWs the AETI in month 4-5 and month 7-9 increased (the minor and major flooding season respectively). In 2016 and 2018 there was a remarkable impact on NPP in Month 10-12 (the impact of the main flooding season diversion presumably) and for 2016 for the month 5-6 (impact of the minor season). In 2018 this latter impact was noticeable for the minor season.



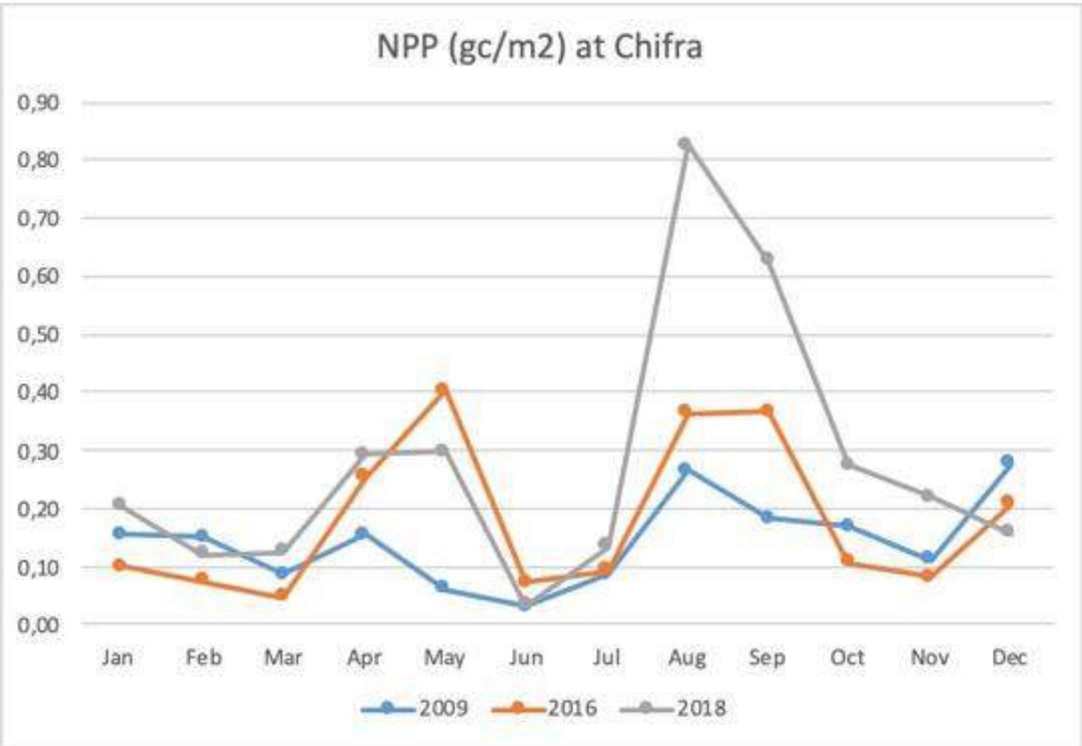


Figure 2

Figure 2: These two graphs show the NPP and AET for Chifra WSW, over the year. After the construction of the WSWs the AETI in month 2-4 and month 7-9 increased. The early flood season coming earlier in Chifra than in Teru. The increase in biomass occur sooner after the flood peaks in Chifra than in Teru. This may be related to the flood water use in Chifra, where it is applied on the grazing areas, whereas in Teru moisture storage in the soil is common to support sorghum production after the intensely hit summer season.

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4. Main findings

- The AETI during the two flood seasons after the weir construction show higher values in most years, compared to the AETI in the flood seasons prior to the weir construction. This could suggest that the WSWs have led to significant changes. However, the next step in the analysis is to compare it so more years and with the catchment precipitation, to assess the impact of environmental fluctuations to these AETI values.
- Similarly there is a significant change in NPP before and after the completion of the WSWs. These higher NPP values give signs of optimism, but have to be further analyzed similarly as the AETI.
- The NPP peaks six-eight weeks after the AETI peak – as may be expected
- The increase in NPP appears more than the increase in AETI. This suggests that with more reliable flood based irrigation crop production 'jumps', which may be because soil moisture is securely beyond the wilting point and crops are not stressed (related may be also to late season capillary rise)
- The different cascades perform differently. This may be related to several factors, but one is the man use of the diverted flood water.
- We do not know the impact on natural biomass – this we still need to assess

5. With whom are we talking

The analysis was undertaken with the GIZ SDR program (Strengthening Drought Resilience), that have a direct interest in the results and are making validation data available. There is wider interest in WSWs within Ethiopia: apart from KfW and PSNP, from IFAD, African Development Bank and Ministry of Agriculture. The interest concerns two questions: are WSWs effective (and do they not have negative side impacts) and what can we learn from siting and designing the WSWs.