Climate Change Impact and its Mitigation Assessment the Case of Afar Water Spreading Weirs, Ethiopia

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Introduction and background

- According to CSA's estimate for 2021, majority of Ethiopia's people (78%) live in rural areas, more than a fourth of them in the lowlands. The Afar Region located in northeastern Ethiopia (Figure 1) is one of these lowland areas of the country. The region's variable rainfall regularly leads to droughts and flooding, which frequently jeopardize agricultural production and the life of animal herds on which people's livelihoods depend. With changing climates and more frequent extreme events being expected in the Ethiopian highlands, flooding in Afar may lead to further catastrophic damages in the already fragile ecosystem because of land degradation. The agropastoral areas are the most affected.

Water Spreading Weirs (WSW):- response to mitigate the current climate change impact by restoring the environment, increasing productivity, and improving livelihoods. WSW is used to spread flood out of the concentrated flow into the plain to reduce the velocity and distribute flood to the wider plains and create opportunities to grow forage/crops while preventing the potentially disastrous effects of flood on soils, vegetation, and livelihoods.

Figure 2 Map of WSW locations

Data layer	Data Source	Spatial resolution	Temporal resolution
Net primary production (NPP)	WaPOR	100m	10 days
Actual evapotranspiration and interception (AETI)	WaPOR	100m	10 days
Reference Evapotranspiration (RET)	WaPOR	20km	10 days
Precipitation (P)	WaPOR (CHIRPS)	5km	10 days/daily
Normalized difference vegetation index (NDVI)	Landsat 8	30m	16 days

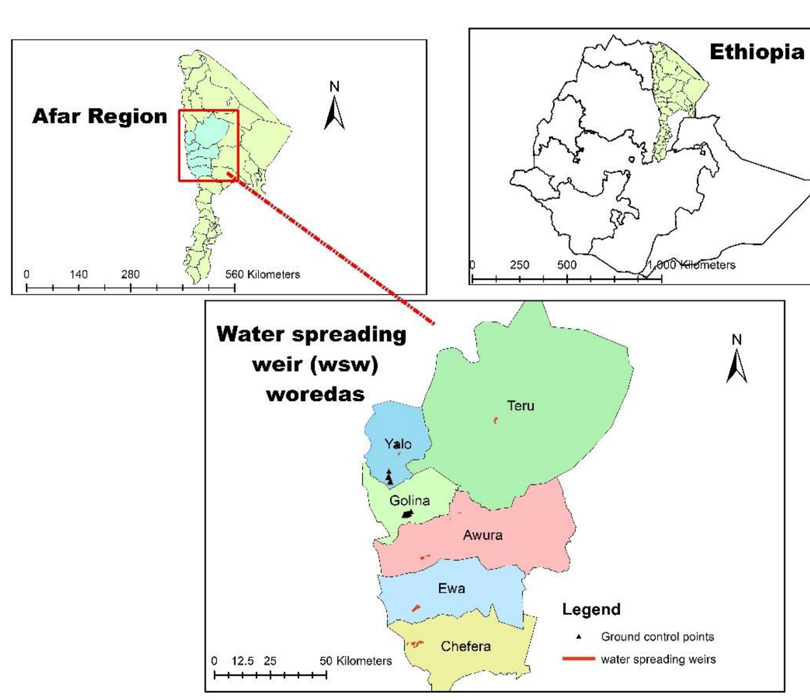


Figure 1 Map of WSW locations

- The dominant part of the region is characterized by low rainfall of less than 300 mm (53% of the region) and average temperature exceeding 27.5 0C.
- Pastoral and Agro-pastoral modes of life. Crop production is practiced through irrigation and river water abstraction.

Objectives

- To delineate the potential area affected by Water Spreading Weirs.
- To evaluate the impact of Water Spreading Wiers by using different WaPOR data and Satellite images.

Methodology and Data

Potential impact area delineation

- To assess the impact of the WSW, the potential rehabilitated area was delineated.
- WaPOR data analysis was conducted over the identified areas. To estimate the potential rehabilitated area, the 30m spatial resolution of Landsat 8 images was pan-sharpened to 15m spatial resolution. Then the 15m spatial resolution NDVI values were estimated for September of the years 2013 to 2020.
- The average value of the NDVI before the WSW was constructed and the average after the construction was estimated. After the values of the NDVI were separated into two datasets (before and after WSW construction). Finally, the raster was binarized. All values greater than the mean would be identified as rehabilitated areas.

Computing seasonal values

- After the potential rehabilitated areas were identified, the decadal values of NPP and AETI were acquired from the WaPOR portal and converted to seasonal values for these areas. This computation was done directly through the WaPOR portal which takes the mean value of all pixels within the delineated shapefile.
- The area has two rainy seasons; season 1(February to May) and season 2(June to December).

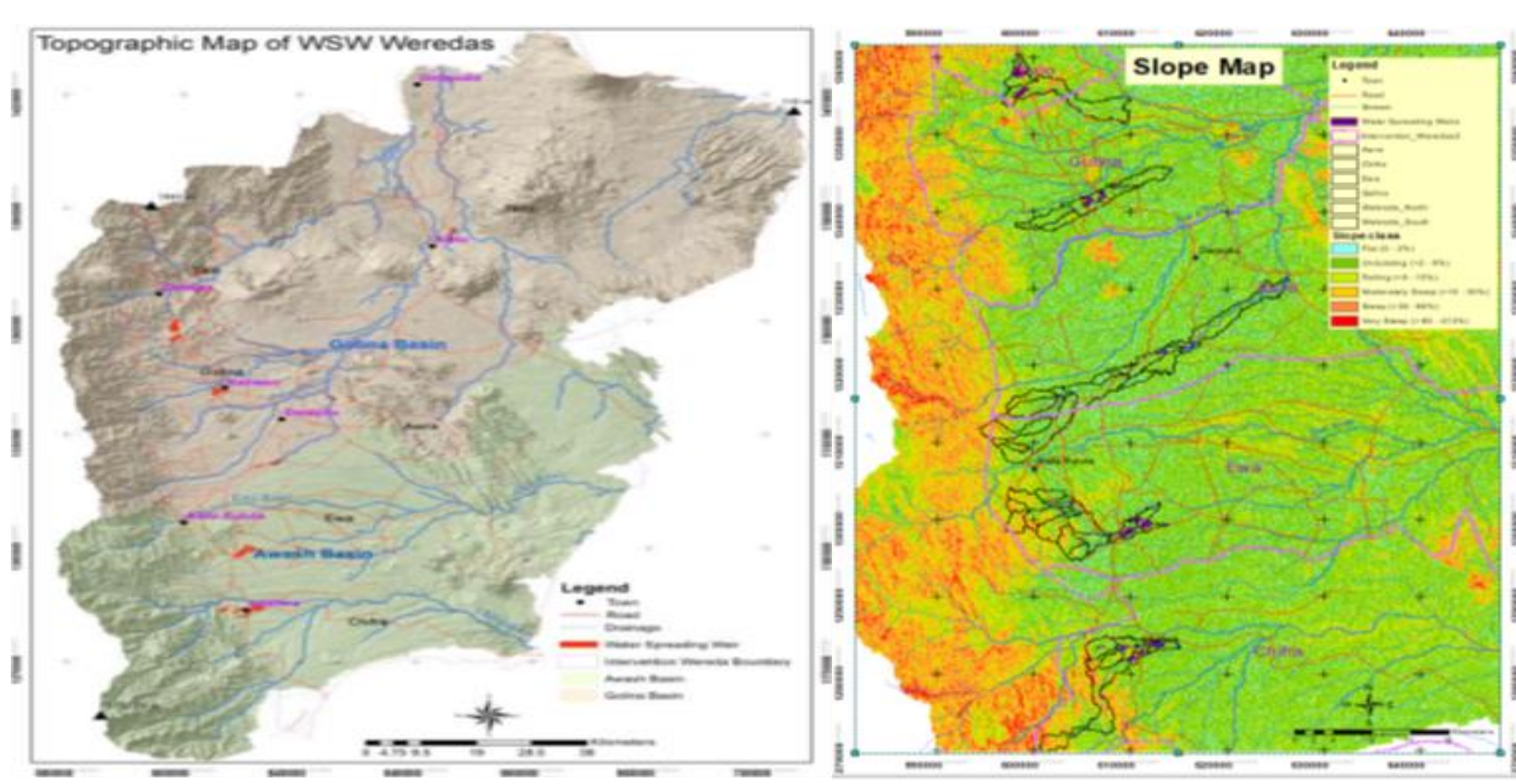
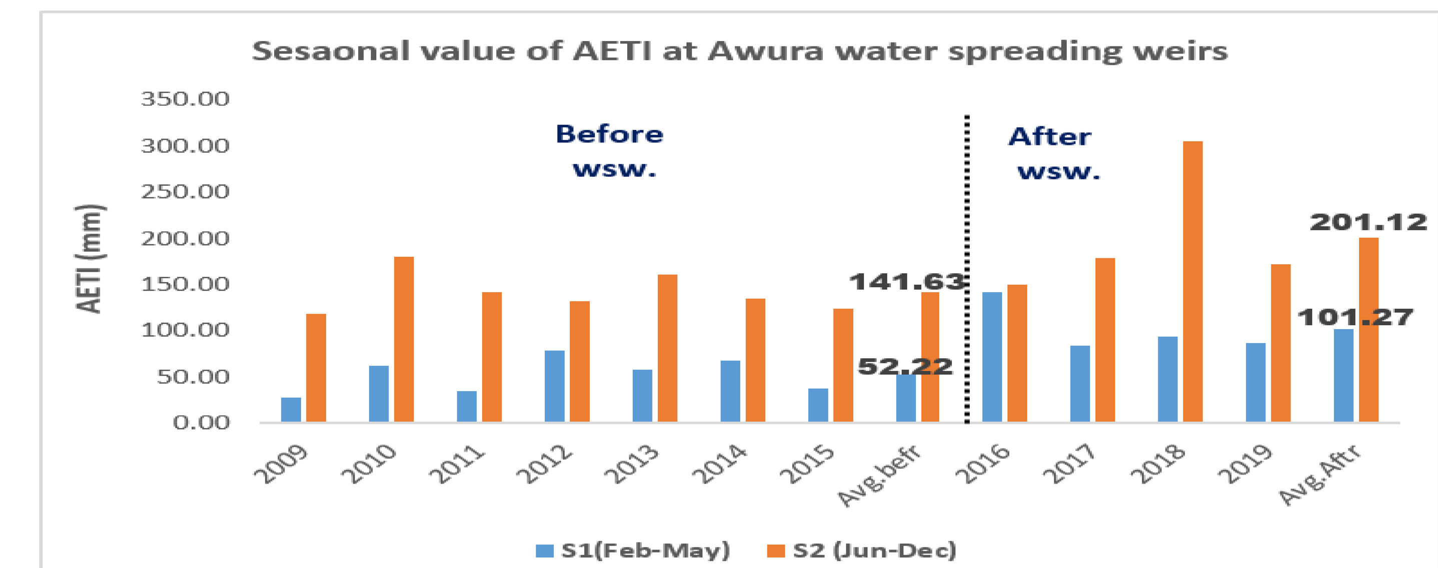


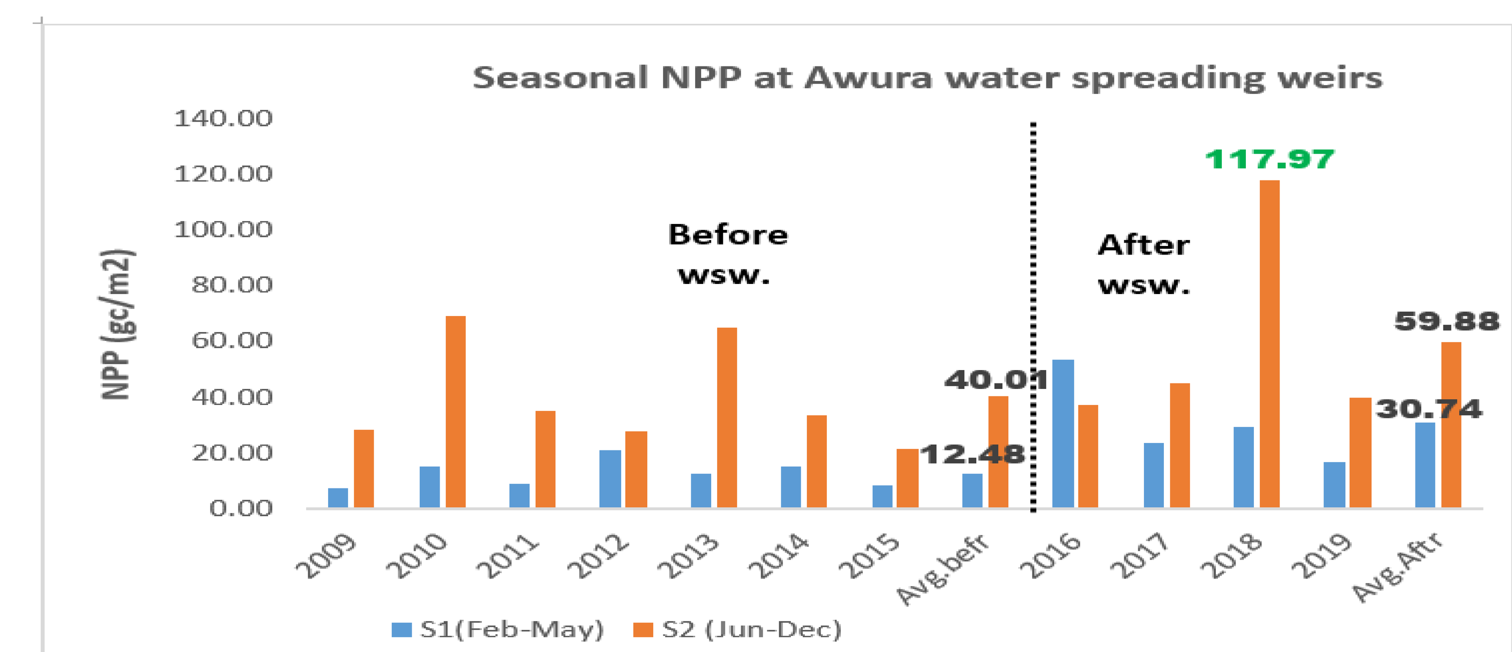
Figure 3 Topographic (a) and slope (b) map of the study areas Geological and structural map of the study area showing the closeness of the WSW sites to the escarpment zone.

Result and discussion

Table 2: Total area delineated as rehabilitated area		
S/N	woreda	Delineated area (ha)
1	Awura	5404
2	Chefera	3046
3	Ewa	60.7
4	Golina	262.6
5	Yalo	8507.4



As observed from the graph the value of seasonal actual evapotranspiration and interception were increased after the construction of water spreading weirs (after the year of 2016). In both rainy seasons, the average seasonal value of AETI was shown incremental.



The average value of net primary production were shown incremental after the construction of water spreading weirs at Awura. Of course, the maximum NPP was observed in 2010 and 2013 even before the construction of water-spreading weirs.

Conclusion

The results observed from the WaPOR analysis of AETI and NPP showed an increase in almost at all water-spreading weir structures after the year of 2016. On the other hand the value of seasonal rainfall increased at all water-spreading weirs after the year of 2016. So, it is difficult to conclude that the incremental of NPP and AETI were due to the construction of water spreading weirs since there were also huge changes in rainfall during the construction of water spreading weirs.

Reference

FAO (2018). WaPOR Database Methodology: Level 1. Remote Sensing for Water Productivity Technical Report: Methodology Series, Rome, FAO. 72 pages. Licence: CC BY-NC-SA 3.0 IGO.

Feyisa, G.L. Meilby, H., Fensholt, R., Proud, S. R. (2014). Automated Water Extraction Index: a new technique for surface water mapping using Landsat imagery. *Remote Sensing of Environment*,