Abstract of the Work
There have been notable droughts in Ethiopia throughout the history. About a century ago, the frequency of drought events in the country used to be once every 10-15 years. Nowadays, the event is becoming more frequent, once every five years or even less causing drastic impacts on agricultural outputs and massive livestock deaths. In order to minimize the negative impacts associated with droughts, it is necessary to develop proper drought management strategies including forecasting and early warning systems. This calls for the paradigm shift in the country’s drought management policy from the customary crisis management approach to more proactive, risk management approach that would place greater emphasis on preparedness planning and mitigation actions. The objectives of this study are to describe and forecast droughts in the Awash River Basin, Ethiopia, based on meteorological and hydrological variables on the basis of which appropriate agricultural water management strategies are proposed for a large irrigation estate in the basin. Further, a relationship is developed between meteorological and hydrological drought events. Impacts of future climate change scenarios on the proposed water management strategies are also investigated. To gather baseline information regarding socioeconomic impacts of drought and its mitigation strategies adopted by the farmers in the area, a questionnaire-based survey is conducted in the basin.

Farmers engaged in agriculture, both with and without irrigation, are considered in the field survey conducted in the Upper Awash River Basin to obtain firsthand information on socioeconomic impacts of drought and its mitigation strategies. A total of 173 household farmers are interviewed. The survey results suggest that drought prevails in the area, on average, once every two years and causes damages, both to crops and livestock. Consequently, under such drought conditions, the farming communities have adopted various coping strategies and important among them are: sale of labor and sale of livestock and their products. The survey results also reveal that the available water resource in the Awash River for the different uses is affected during the dry seasons and drought periods.
Drought characteristics in the Awash River Basin, Ethiopia, are described using two methods: Standardized Precipitation Index (SPI), a measure of meteorological drought, and the theory of runs, a measure of hydrological droughts. The SPI method is used to generate monthly spatial patterns of various categories of drought on a basin level at different temporal scales (3, 6, and 12 month). The study reveals that Middle and Lower Awash Basins are the most vulnerable areas to drought conditions. In this regard, the feasibility of rainfed agriculture in the basin for some selected crops is assessed based on the available meteorological data with the aid of ArcView/GIS. It is found that growing cotton crop in the basin should be considered only under irrigated condition for optimum yield. The second method of drought characterization, the theory of runs, is used to monitor and measure drought events in terms of streamflow in the Awash River system.

The results based on the drought intensity shows that the severest drought events occurred at Melka Sedi stream gauging station during the periods May/1988 to June/1988 and April/1998 to May/1998. The study also established relationships between the meteorological and hydrological drought events (in terms of their respective duration, magnitude and intensity) which can be used to plan for an ensuing hydrological drought event. The results show that there is an average lag time of 7 months, with a variation of 3 to 13 months, between the occurrences of the two events in the Awash River Basin.

A non-linear streamflow forecasting model is developed using Artificial Neural Network (ANN) modeling technique for the Melka Sedi stream gauging station with adequate lead times. This gauging station is located above a weir that diverts water to a large estate irrigation scheme, Middle Awash Agricultural Development Enterprise (MAADE), for which water management strategies are proposed. On the basis of the model-forecasted streamflow time series and irrigation water and minimum flow requirements, the study proposed appropriate agricultural water management strategies for the irrigation scheme, MAADE. These proposed strategies are evaluated based on different scenarios of abstraction demand which are formulated based on a range of possibilities of developing agricultural fields in the MAADE. An appropriate scenario of agricultural development is decided on the basis of the residual flows in the river vis-à-vis the trigger/threshold value established for Melka Sedi stream gauging station. It is found that for a reliable supply of water to the scheme throughout the growing season, a 1-24% reduction (depending on the scenarios considered) in the cultivated area of the scheme is necessary.

Impacts of future climate change scenarios on Awash River flow at the Melka Sedi stream gauging station and on the proposed agricultural water management strategies in the MAADE are also investigated. Results from two CGCM2 climate change scenarios (A2 and B2) show that climate change has no significant effect on Awash River water resources under scenario A2 whereas a slight increase in the streamflow is expected under climate change scenario B2 when compared to no climate change scenario. Consequently, it is found that future climate change under these two scenarios do not have effect on the proposed water management strategies for MAADE.
**Keywords (minimum 5; maximum 10)**
Drought forecasting, Spatial analysis of drought, Awash River Basin, SPI, ANN, the theory of runs, Ethiopia

**Bibliographic data**


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