Estimation of Irrigation Water Requirement in Zohrabi Canal Command Area, Khulm Watershed, Afghanistan

○Ezatullah Rabanizada* , Hiroaki Somura**

Introduction

Total annual water capacity of Afghanistan is 75 billion cubic meters and the cultivable area has been estimated approximately 7.7 million hectares (ha), which is 12% of the total area. A land use survey was conducted on the 1990s, and reported that about 3.2 million ha was irrigated and other lands remain bare (FAO and ICARDA 2008). As Afghanistan is located in the arid and semi-arid region, agriculture relies heavily on irrigation. As the majority of the population is small-scale farmers, they have to irrigate their fields to produce crops. However, their irrigation allocation method has a systematic problem. Afghanistan's current method for water distribution is a traditional irrigation practice which has been set since over 300 years ago, and the amount of water is determined according to land size. Each farmer can irrigate their land in limited hours by way of a circulation schedule between the water users, but the crop types and variation of water regime are not considered. In traditional allocation system, Mirab (water master), who is selected by water users, has responsibility to control irrigation hours according to their land size. Therefore, when Mirab releases water from the main canal to secondary canals, the upstream command area receives much water than necessary because it doesn't be considered the actual crop water requirement. In this case, enough irrigation water couldn't reach to downstream area, particularly during summer, crops cannot complete their vegetation growth because of deficit of irrigation water. Canal water decreases during summer but the amount of irrigation for the upstream area doesn't vary so much. Hence, some parts of arable lands in downstream are left without cultivation. In order to enhance the irrigation efficiency and irrigate more arable lands, the aims of this study are 1) to evaluate a traditional water allocation method of Afghanistan, and 2) to find ways to optimize the use of water in the command area level.

Study Area and Methodology

The study area is Zohrabi canal command area with 671.2 ha, which is located in Khulm watershed of Afghanistan (Fig.1). The canal water inflows from Khulm-Aybak River. The area located between 36°43′N and 68°03′E, and the altitude is 1000 meters above mean sea level. The average annual rainfall is 262 mm, and potential evapotranspiration is 1100mm. Temperature varies during a year from -5 to 37ºC.

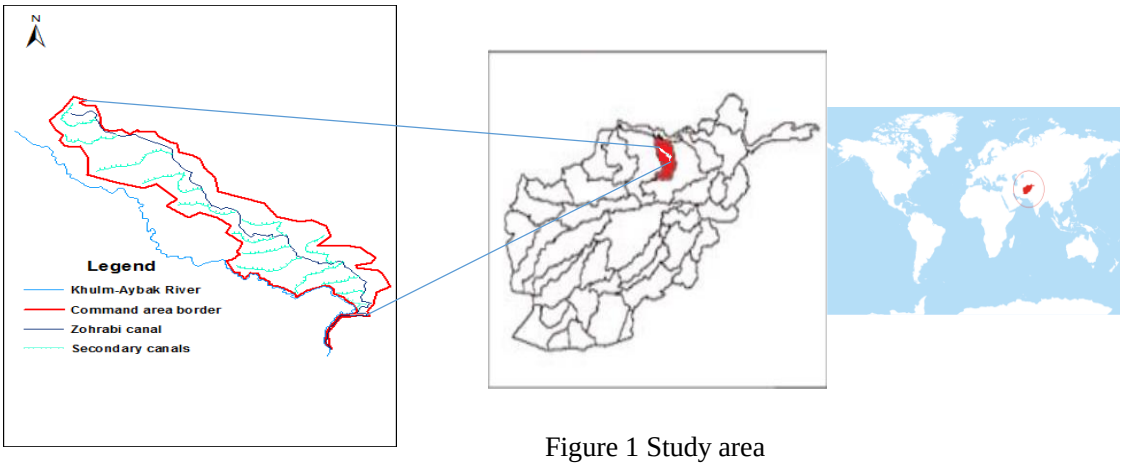

Figure 1 Study area

*Shimane University, Graduate School of Life and Environmental Science, **Shimane University, Faculty of Life and Environmental Science

Keywords: Command area, Water requirement, Traditional water distribution

The meteorological data (rainfall, temperature, wind speed, solar radiation, and humidity) and crop characteristics were used in CROPWAT application for estimating crop water requirement. Also, for calculating canal convenience water losses, the inflow-outflow method was used. The land cover map which is prepared by FAO and Ministry of Agriculture, Irrigation and Livestock of Afghanistan was used for grasping area crop acreage. Water discharge, soil moisture through moisture meter, percolation rate, crop types, current traditional water distribution method, and Mirab (water master) information were obtained from our field investigation. The geographical coordination points of the canal, block and study area boundary were obtained using the walkthrough method with ArcGIS software.

Results

A calculation of water requirement in seven main crops (winter wheat, almond, maize, peach, tomato, potato, and alfalfa) showed that winter wheat was the highest water-consuming crop in the area with 522mm of annual water requirement, and maize is the lowest crop with 321 mm water requirement (Fig.2). The average daily canal water discharge for one month from the end of August to September 2015 was estimated as 1.42×10^6 m^3/month (Fig.3), and water demand for the seven major crops during the same period was estimated as 1.75×10^6 m^3/month. Also, from the field survey, the average values of water conveyance loss were estimated to be 26 % in the main canal and 13 % in secondary canals. From these analyses, it was revealed that 8.9×10^5 m^3 of water was deficient in Zohrabi command area during that period. According to the net irrigation water requirement estimation, when compared with irrigation water supplies at 14 blocks, it was indicated that the first head 5 blocks and 3 middle blocks received excess water, but 2 middle blocks and 4 tail blocks were under deficient water condition. Also, it was found that more than 50 % of the arable lands were located in the water shortage blocks.

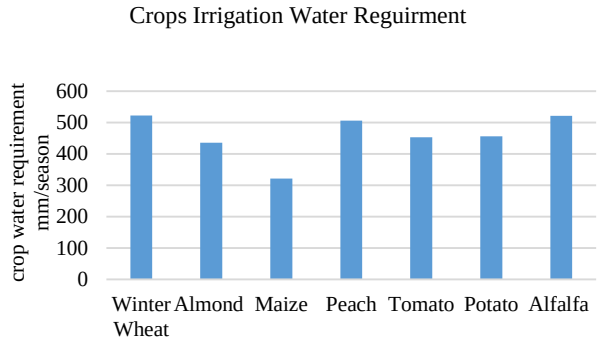

Figure 2 growth crop water requirement

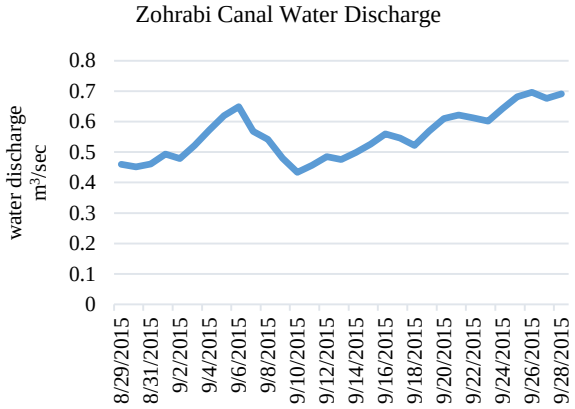

Figure 3 main canal water discharge

Discussion and Future Scope

In addition to the current traditional allocation system in Zohrabi command area, evapotranspiration, percolation and conveyance losses are also higher primary factors for a large amount of water losses. Effective and efficient usage of the available water resources to meet the irrigation demand, irrigation scheduling plays a key role. Confidently, after analyzing water requirement during the entire growth period of all crops, annual water discharge, soil moisture analysis, soil samples analysis (texture and water holding capacity), we will define and propose alternative irrigation way to maximize cultivation area.

Reference

Anderson, I.M. Irrigation Systems, Water Management, Livestock, and the Opium Economy. Kabul: Afghanistan Research and Evaluation Unit, 2006.

Allen E.A., (1998), “Crop Evapotranspiration: Guidelines for computing crop water requirement “, FAO Irrigation and Drainage paper 56, Rome.