Water Management of On-farm irrigation for Stabilizing Agricultural Productivity

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Introduction

The history of irrigated agriculture in Afghanistan goes back to more than 4,500 years ago (an ancient settlement near Kandahar). The arable agricultural resource base of Afghanistan is about 8 million ha, which is 12 % of the total land area. There is roughly 3.9 million ha of cultivated land of which 1.3 million ha is rain-fed, and 2.6 million ha is irrigated (Asad, 2002). As the majority of the population is small-scale farmers, they have to irrigate their fields to produce the crops. Afghanistan has arid to a semi-arid climate with a high inter-annual variation of precipitation. The average precipitation in some parts of the country is only sufficient to sustain a rain-fed winter crop. The climate of Afghanistan is described by high evaporation, low relative humidity, strong solar radiation and abundant days without cloud cover (Shroder, 2014). The geography influences rainfall, area with high potential evaporation also receive the least amount of precipitation. In these locations, crops require irrigation (Bhattacharya et al. 2004). Most of the precipitation occurs as snow in the mountains and provides irrigation water during the summer for crops grown in the lowlands. Irrigation is necessary for the production of all summer crops. The main problem for farmers is to evaluate crop water requirements and low knowledge of farmers about irrigation periods. The improvement of water application efficiency is also important to achieve optimum agricultural production per unit of water. However, application efficiencies and distribution uniformities are very low due to high water losses (transmission and convince losses) and over irrigation. That provide the opportunity to water logging.

Study Area and Methodology

The tertiary canal was chosen in Mahmud Raqi, Kapisa province which is located in the north-east of Afghanistan (Fig.1). This canal water inflows from Afghan secondary canal which is the part of panjshir River. The area located between 35^0 20' N and 36^0 35' E the altitude is 1478 meters above mean sea level. The average annual rainfall is 414 mm. Temperature varies during a year from -7 to 37^0C. Current meter was used for measurement of the irrigation water inflow. Irrigation water inflow measured for summer crops for three irrigation turns with irrigation time. Soil and crop pattern were collected from the study area. Selected canal was the over-ground type, and the farmers were using traditionally built inlets for letting water into the fields.

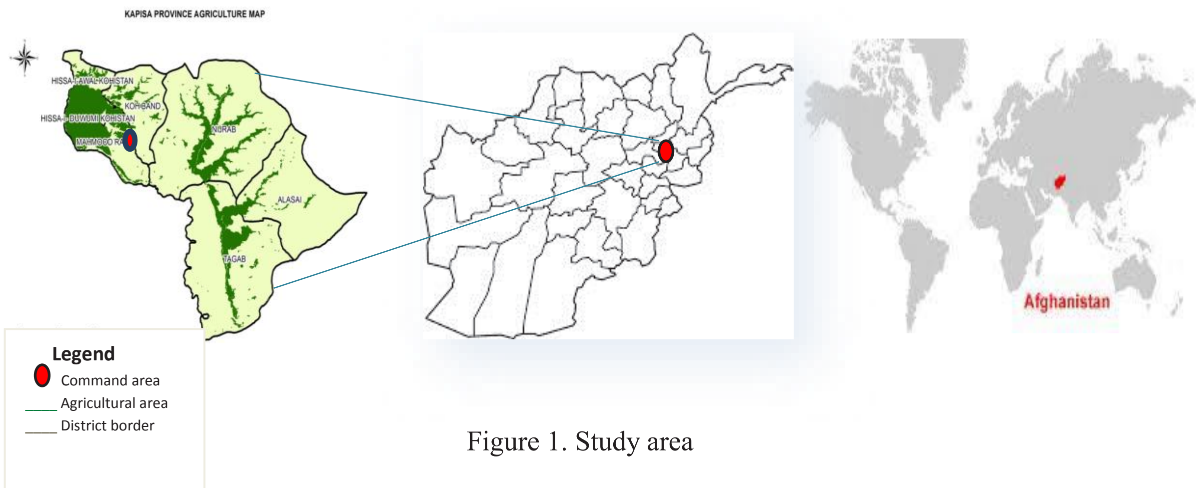

Figure 1. Study area

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Winter Wheat and Maize are dominant crops in the study area. The research need for metrological data (temperature, relative humidity, sunshine hour, and wind speed), and crops characteristics are used in CROPWAT, which was recommending by FAO's Penmen Monthiet, a method for calculation of crops water requirement. The soil sample was taken from the study area from 0-15 cm from six fields. The sample will for texture, soil moisture and water holding capacity parameters. Water distribution and crop characteristics information were obtained through farmer's interviews. The ArcGIS application is used for analysis of irrigation water distribution.

Results

From analyzing of the climatic data effective rainfall for the study area in was 175.9 mm in March and 5 mm in June, while evapotranspiration was 2.71 mm/day and 8.24 mm/day respectively. During June and July, more irrigation water needs than other months. Calculation of the crop water requirement shows that Soybean is high consuming water than winter wheat, maize and mungbean (Fig.2). Irrigation water requirement was calculated 5.6×10^3 m^3/10 days for 1st irrigation and 5.6×10^3 m^3/10 days for 2nd irrigation and 4.8×10^3 mm/10 days for 3rd irrigation (Fig.3). The canal inflow water was measured during August and September, and it was estimated 7.0×10^3 m^3 for 1st irrigation,7.4×10^3 m^3 for 2nd irrigation and 8.2×10^3 m^3 for 3rd irrigation respectively. Totally, water demand for crops in August and September 2016 was estimated as 1.57×10^4 m^3/month. The tertiary canal total water discharge during the same period was estimated 2.26×10^4 m^3/month. It shows that farmers were over irrigated the crops at the rate of 0.69×10^4 m^3 then the actual crop water need.

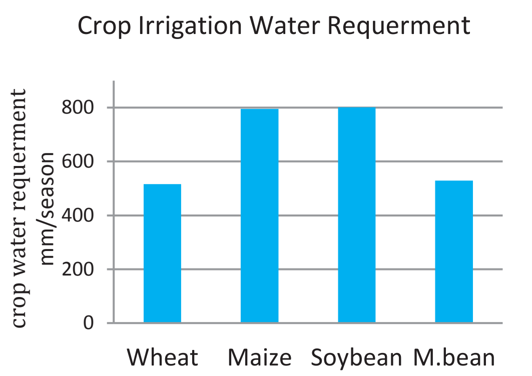

Figure 2. Seasonal crop water requirement

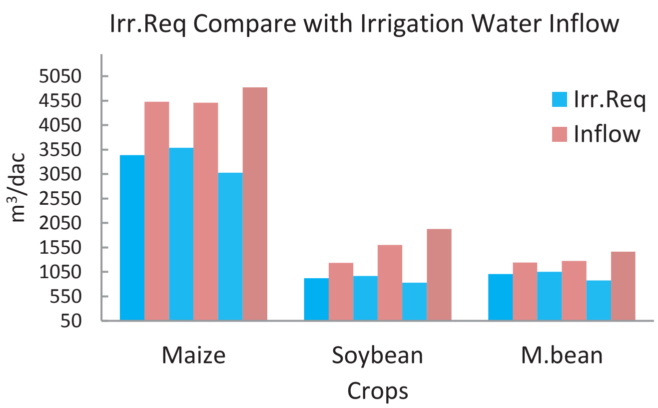

Figure 3. Monthly crop water need with supplied water

Discussion and Future possibility

Water allocation within the tertiary canal is conducted on the land size in Mahmud Raqi area as well. Evaporation and percolation losses are the basic factors for a bulky amount of water losses. Also, farmers are applying the water to the fields without irrigation planning and proper schedules. The efficient irrigation water allocation expectantly will get after analyzing of actual water requirement to meet the irrigation demand. Soil physical characteristics analysis will be classified and suggest a more effective way optimize irrigation water amount.

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