Study on the necessity of Irrigation development and management in food-insecure and semi-arid regions

Summary

The entitled thesis discusses about the necessity of Irrigation development in the food self-insecure regions of Ethiopia and Irrigation management in the semi-arid region of China. The researches were conducted at two specific sites: in Ilalla, Ethiopia and Luohui irrigation scheme, China. The main aim of the first case study was to relate food self-insecurity and water resources potential in Ethiopia while the main aim of the second case study was to investigate the types of salinization processes in Luohui irrigation scheme, which are causing for land degradation in the area.

Case study part I:

Interpretations were made on recorded droughts, meteorology, and crop production data in order to relate the drought (food shortage) events, rainfed agriculture and available natural water resources in Ethiopia. From the results of this particular research, it was possible to understand that recurrent droughts occurred in Ethiopia from 1543 to 2002 with a mean interval of 20.85 years. Moreover, the mean intervals for five consecutive drought years had declined from 62.2 years (in 1543 through 1876) to 4.8 years (in 1983 through 2002). Of all these droughts, the major droughts were occurred in 1973, 1985, and 2002 followed by loss of 0.2 million people in 1973 and 1 million people in 1985. And about 15 million people were exposed to critical food shortage in the latest drought of 2002. Spatially, the eastern half of the country was widely covered by the drought in 2002 as compared to the droughts in 1973 and 1985, which were mainly limited to two northern regions of Tigray and Wollo. Under the prevalence of recurrent and expanding droughts, the high dependence of most of the population (more than 85%) on rainfed crop production (99%) has been one of the most attributors to food insecurity and famine in Ethiopia. Because it was investigated that the effective rainfall (*Erf*) was less than the crop water requirements (Et_c) of most of the commonly cultivated crops and vegetables (bean, barley, wheat, maize, cabbage, onion and potato) in Ilalla area throughout most of the years. The annual national production of cereals per capita also decreased from 0.18 in 1961 to 0.12 metric tons per head in 2002. Thus, rainfed agriculture is incapable of shouldering the growing food demand of the people and the food shortage in the future will be worse in the absence of appropriate

measures. To avoid annual dependence of the country on foreign food aid and solve the shortage of food and famine in Ethiopia on sustainable basis, it is recommended to develop the unutilized water resources and land resources by implementing well planned irrigation schemes through the support of international community in terms of capital and technical advisory as the country has 95% unutilized water resources and 95.4% land resources suitable for irrigation. Specifically, the country needs to develop 30, 50, and 75 % of the potential irrigable land in 2006 to 2010, 2011 to 2015, and 2016 to 2020, respectively, in order to approach the growing food demand of the country and improve the energy intake of the people. Besides, promoting microcatchment water harvesting technologies are recommended in Ilalla area and other areas as higher yield was obtained as *Erf* becomes less than Et_c and as compared to the reverse case (*Erf* more than Et_c).

Case study part II:

The main objectives of the second research were to identify and classify the types of salinization processes in Luohui irrigation scheme, China. For these purposes, groundwater salinity and soil salinity were measured at field and analyzed in laboratory. The obtained main findings of this research were: 1) salinization due to capillary water rise with indicators of: higher salinity (up to 21 dSm^{-1}) within 0 to 3 meters of shallow groundwater depth, relatively higher correlation coefficients between water salinity and soil salinity for 0 to 3 meters shallower groundwater depth as compared to more than 3 meters depth, dominant (63%) coverage of loam textured soil and little average annual rainfall (513.6 mm) in contrast to about threefold average annual evaporation (1689.3 mm); 2) salinization due to use of saline irrigation water with indicators of: agreements between water salinity and soil salinity for some of the irrigation wells (34, 64, and 41) and reduction of potential production of salt-sensitive crops to 0 % ; 3) salinization due to dumping and compacting dug soil of well sinking in the field with indicators of: agreements between higher pore water salinity of surface soil (EC_p) and moisture content (MC) at specific spots nearby the groundwater wells (specifically in the eastern direction of well 30' and in the northern direction of well 51) and local information; and 4) salinization due to variation in surface topography and drainage with indicators of: increasing concentration of salinity (from about 2 to 6 dSm^{-1} of water salinity (EC_w) and from 3 to 6.5 of sodium adsorption ratio (SAR)) along the downstream direction of the drainage line as well as higher salinity (up to 8.4 dSm^{-1}) in poor drained area. To improve the salinization problem in the case study

area, lowering groundwater depth, controlling dumping dug soil, and managing use of water from wells. Besides, further and detail studies of salinization and sodification in specific parts (central, northern, and northeastern parts of the irrigation scheme) are recommended.