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The Thesis Submitted for the Degree of Ph.D in the field of Agronomy Science

Sustainability assessment and land suitability determination focusing on the maintain the water benefit; case study on Ghaenat

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The importance and necessity of planning the cropping pattern of rainfed and irrigated crops in each region can be attributed to the need for optimal use of water resources and rainfall and provide solutions to increase production efficiency in non-irrigated and irrigated land; Therefore, in this study, using multi-objective nonlinear programming with the aim of maximizing the net benefit and minimizing the virtual water footprint, green, blue, grey and white water, the optimal cultivation model of crops in the regions of Ghaenat and Zirkoh has been proposed. The results showed that a large amount of water resources in this area are used to produce crops such as cotton. In all the studied crops, blue water footprint was more than other components of water footprint, which shows the reliance of crop production on surface and groundwater resources. The results also showed that the area under cultivation of jujube, watermelon, barley and saffron in the multi-objective model of Ghaenat irrigated crops and the area under cultivation of sugar beet, watermelon, pistachio and saffron increased compared to the current pattern of irrigated crops in Zirkoh. A 50% reduction in the cultivation of cotton, alfalfa, watermelon in Ghaenat and cotton, wheat and barley in Zirkoh in the multi-objective cropping pattern were other important factors in the analysis of the results. The results also showed that the area devoted to melon cultivation in the rainfed lands of Ghaenat increased more than 2 times and in the rain areas of Zirkoh more than 11 times under the multi-objective model compared to the current cultivation pattern. Therefore, by determining the optimal cropping pattern, the environmental effects of the agricultural sector on water resources can be reduced, so that by implementing this model, while maintaining the current income in the region, virtual water will decrease by 26%, blue water footprint will decrease by 5%, grey water footprint will decrease by 23%, white water footprint will amount to 368779 m3 ton-1 and green water footprint will decrease 1898384 m3 ton-1 compared to the current situation. According to the results of this study, it is necessary to pay attention to the objectives of reducing the water footprint, especially the amount of the green water footprint in optimizing the crop model in rainfed areas, also because of the advantages and the positive effects of the multi-objective model on the current model, in particular the reduction of water pollutants. The effective role of green water in the preservation of water resources and underground aquifers is recommended to replace the multipurpose model in the region. It also showed that the farmlands of Ghaenat and Zirkoh counties in all rainfed and irrigated crops such as wheat, sugar beet, alfalfa, watermelon and melon belong to two sensitive and semi-sensitive classes, while in barley, cotton, potatoes, barberry, saffron and jujube farmlands in these two counties have been classified into three categories: very sensitive, sensitive and semi-sensitive. The evaluations showed that the cultivation of plants such as barberry, jujube and saffron was the most desirable, so that the most sensitive areas for growing these crops were 23,331, 17,063 and 9,392 ha respectively.

Keywords: Land Suitability, Demand Assessment, Water footprint, Virtual water, Water accounting