Statement of Teaching Interests

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I am broadly interested in agricultural sciences with particular emphasis on decision support systems such as crop modeling, remote sensing and geographical information systems. In particular, my future education interests are adopt the use of technological facilities to researchers and especially students. As a graduated in interdisciplinary fields namely undergraduate agricultural engineering, master environmental engineering and doctorate in geographic information systems, The use of technological decision support systems and early warning systems in environmental problems and safe food production has become very important in the world (Shelia et al., 2019). My research agenda focuses on the question of how to use these decision support systems effectively to teaching relevant students.

Dissertation Research – Using Crop models and Remote sensing systems

With the developed computer technology, it is also possible to use technological tools such as Crop Simulation Models (CSM), Remote Sensing (RS) and Geographic Information Systems (GIS). This provides important data for healthy monitoring and evaluation of production on a point and area basis. Thus, it is provided to make more accurate decisions with reliable results for the management of agricultural areas at local, regional, national and even global scale. Crop Simulation Models, also referred to as crop growth, crop development, crop simulation and crop climate, are allow analysis practices such as yield and risk estimates of the plant's growth and development as a function of soil and climate, plant characteristics and management practices (Jones et al., 2003). In addition, there may be healthy assessment and solution methods for the agricultural condition of the region related to obtaining indices from different reflection rates to determine information about plants in larger agricultural areas by remote sensing (Alganci, Ozdogan, Sertel, & Ormeci, 2014) . Finally, GIS are specified as the information system that collects stores and analyzes information and obtained from all these regional location-based processes, and finally provides them with mapping (Yomralıoğlu, 2009). In agricultural applications, various methods are used to understand the relationship between input data such as fertilization and irrigation and yield output information such as product and biomass. Models can simulate the environmental components that the plant interacts with at all stages of the growing process based on mathematical background.

In my dissertation research named “Wheat yield estimation using DSSAT crop simulation model and indices obtained from remote sensing: islahiye and nurdagi case” I I obtained important findings about my agricultural research region.

The study area is İslahiye and Nurdagi agricultural plains in a fertile valley, the region has favorable climate, and first class agricultural soil for agricultural production and it is possible to grow high quality economic products with planned agricultural production. Among the eighteen wheat fields in the 2016-2017 growing season, high yielding fields such as Yelliburun well location village field, in front of Yelliburun village field, Mali Akınyolu village field and Selver village field were used for model calibration. Moreover, medium yielding fields such as Sakçagözü village field, Bizim Akınyolu village field, Çetin Akınyolu village field and Gözlühöyük village field were used for model performance testing.

Among the data, minimum and maximum temperature, average rainfall, relative humidity and solar radiation were used as climate data. As soil data, that is one of the most important components, general soil information, soil surface information and soil layer parameters such as structure, texture, pH, organic matter and nitrogen content were used. As maintenance data, another data group,

included information such as planting date, planting method, planting depth, number of plants per m^2, fertilization/irrigation/harvest amounts and dates. Finally, as the observed and measured data in the actual field collected for comparison with the model estimation results, the above ground crop weight, stem and leaf weight, sibling number, yield, biomass, anthesis and physiological maturity time, leaf area index were collected. The plant phenology and development (P1V and P1D), then growth (P5, PHINT) and finally yield (G1, G2, G3) parameters were calibrated. The performance of the model was evaluated using RMSE and % error between observed and simulated values. In order to determine the effects of climate change in the region, they were examined in the RCP 4.5 and 8.5 scenarios of three global climate models for mid-century (2036- 2065) and end-century (2066-2095). According to previous climate change forecasts, global temperature will increase by 2.5 ° C in 2050. The increase in temperatures predicts that it may reduce future agricultural productivity, especially in semi-arid regions in Turkey.

Apart from all these, another technological tool used in agricultural field is remote sensing systems. It plays a role as an important data source in the production of different spatial - temporal resolution information with the images obtained from agricultural fields. By using radiation reflected from the canopy of plants, regional yield values can also be determined by calculating the vegetation indices such as land classification and NDVI. The fields obtained from the Farmer Registration System in the Nurdagi and İslahiye plains were used for yield estimation. In addition, data such as parcel area, crop species, planting and harvest dates and yield values were also used. Moreover, 13 Landsat-8 images from 17 November 2016 to 29 June 2017 were used. Eight machine-learning algorithms were used for spatial distribution of wheat. NDVI values were calculated at 16-day intervals for each field throughout the season, and the yield prediction model was developed with the Bootstrapping method. The LASSO regression model was also successfully used for regional yield estimates. Significant values were obtained in all analysis results.

Regarding the genetic coefficients for the Golia cultivar, the days for the optimum vernalization (P1V) were slightly higher, while the photoperiodic requirement (PID) and the thermal time (P5) causing the grain filling were slightly higher. While G1 and G2 were found to be balancing each other, G3 coefficient was found to normal value as a parameter related to biomass production and plant height. At the end of the calibration, the measured and simulated values of the maximum LAI were close to each other with -5.26 % error and 0.21 root mean square error, while yield was below the measured value with -11.32 % error and 586 kg / ha RMSE. It showed a close agreement with -9.56 % error and 896 kg/ha RMSE in above ground plant weight. According to the results of climate change projection in Turkey's southeast, in the mid-century (2065), maximum temperature will increase from 1.6 °C (RCP 4.5) to 2.3 °C (8.5 RCP); minimum temperature will increase from 0.6 °C (RCP 4.5) to 1.9 °C (RCP 8.5). In the end-century (2095), maximum temperature will increase from 2 °C (RCP 4.5) to 4 °C (RCP 8.5), minimum temperature will increase from 1 °C (RCP 4.5) to 3.4 °C (RCP 8.5). In the future temperature increase, wheat yield will decrease in İslahiye with 16.3 % by the mid-century and with16.8 % by the end- century. In Nurdagi, the model showed that it will decrease with 13.4 % in the mid-century and 14.4 % at the end-century.

Another regional yield analysis study, the results of NDVI indices obtained from satellite images showed a close agreement between the observed and predicted yields for both regions. In Nurdagi (2013-2017), it was recorded as the root mean square error value which is higher with 145 kg/ha for 5 years, while in Islahiye it was recorded with a root mean square error of approximately 70 kg/ha. In the Nurdagi region, the error between observed and estimated yield ranged from 1.96 % to 10.61 % for 5 years. However, the error in the Islahiye region ranged from 0.81 % to 7.65 %.

As a result, the calibrated DSSAT model CERES-Wheat module and also NDVI values estimated the regional yield are useful methods. This method can also be used easily for other regions and crops of Turkey.

Future Research Directions- New Projects

In parallel with the developing technology, I would like to work to adopt the importance of decision support systems such as GIS and Remote Sensing to students and relevant stakeholders. Moreover, I think there are many projects to be done in understanding, using, and expanding the studies in this field.

Selected References

Alganci, U., Ozdogan, M., Sertel, E., & Ormeci, C. (2014). Estimating maize and cotton yield in southeastern Turkey with integrated use of satellite images, meteorological data and digital photographs. *Field Crops Research*, *157*, 8–19. doi:10.1016/j.fcr.2013.12.006

Jones, J. W., Hoogenboom, G., Porter, C. H., Boote, K. J., Batchelor, W. D., Hunt, L. A., … Ritchie, J. T. (2003). *The DSSAT cropping system model*. *European Journal of Agronomy* (Vol. 18). Elsevier. doi:10.1016/S1161-0301(02)00107-7

Shelia, V., Hansen, J., Sharda, V., Porter, C., Aggarwal, P., Wilkerson, C. J., & Hoogenboom, G. (2019). A Multi-scale and Multi-model Gridded Framework for Forecasting Crop Production, Risk Analysis, and Climate Change Impact Studies. *Environmental Modelling & Software*, *115*(February), 144–154. doi:10.1016/J.ENVSOFT.2019.02.006

Yomralıoğlu, T. (2009). *Coğrafi Bilgi Sistemleri, temel kavramlar ve uygulamalar* (5.). Trabzon.