Increasing Crop Yields and Lowering GHG Emissions by Dynamically Changing Fertilizer Input Using Cutting-edge "Smart Neural Network" Technology

Tikhonova, Darya (School: The Andrey Melnichenko Foundation: The Centre for the Development of Children's Creativity in Science and Engineering (Nevinnomyssk))
Romanenko, Kseniya (School: The Andrey Melnichenko Foundation: The Centre for the Development of Children's Creativity in Science and Engineering (Nevinnomyssk))
Shargorodskiy, Anton (School: The Andrey Melnichenko Foundation: The Centre for the Development of Children's Creativity in Science and Engineering (Nevinnomyssk))

As the world’s population grows, efficient food production with minimum environmental impact becomes more urgent. Our goal was to develop a method for proposing the correct composition of fertilizer for each stage of wheat growth — based not on traditional time-consuming and expensive laboratory tests of specimens, but on data collected inexpensively via a drone (UAV) in the field, yielding immediate results. In the course of four months, we combined regular laboratory measurements of N2, chlorophyll, N2O and CO2 for eight combinations of nitrogen fertilizers applied to winter wheat fields. Enhanced Normalized Difference Vegetation Index (ENDVI) data was collected using the UAV. At the end of the growth period, we determined crop yields and grain quality at each test plot. Next, we carried out regular measurements of N2O and CO2 around randomly selected plants to build a database of emissions vs. temperature for various nitrogen fertilizers. We conducted over 1,104 tests for GHG emissions. Based on this data, we developed a perceptron-type neural network, and trained it at every stage of plant growth. We turned it into a plugin for QGIS to provide a complete solution. Simultaneously, we solved the problem of predicting greenhouse gas (GHG) emissions. In field tests the plugin uses data from the UAV and weather forecasts to provide GHG emission estimates and an adjusted fertilization plan, taking wheat quality and yield into account. This project provides a tool that can be an important part of any sustainable agriculture strategy.

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