NDVI IMAGERY IN POLLINATION AREAS DETECTING FOR MIGRATORY APIARY SCHEDULE

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ABSTRACT

The decline in the honeybee population is a worldwide problem concerning farmers and scientists as a significant threat to the agriculture. These flying insects are the best-known pollinators around the world and the work done by them is a critical step in the life-cycle of the plants. To use that small workforce as most effective as possible, the beekeepers have created migratory apiaries and travel with them thousands of kilometers to the areas rich in the nectar-secreting flowers. However, high-decible traffic sounds and vibrations during the transportation are not natural for bees and have unfavorable impact on their health. When facing the risk of a collapse of the colony, it is especially crucial to avoid any negative influence on the bees. In the case of travelling, this might be achieved by optimizing the migratory apiary route and schedule to decrease the time the bees spend on the way.

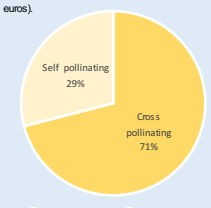
In our work, we exploit remote sensing techniques to acquire more information to improve the scheduling of migratory apiaries. In particular, we compute normalized difference vegetation index (NDVI), well established in the agriculture to determine plants condition. The initial results of our work are based on SentiNel Application Platform (SNAP) and Sentinel NDVI imagery to detect the areas of interest, where migratory apiaries could be sent. The goal is to detect the optimal apiary transfer time, based on plants vegetation state.

For the future work, it is planned to use the optimization algorithms, such as Dijkstra's algorithm, to connect the identified areas of interest and schedule the best migration.

INTRODUCTION

The European Food Safety Authority reports that over the past 10 to 15 years, beekeepers have been reporting unusual weakening of bee numbers and colony losses, particularly in Western European countries including Belgium, France, Germany, Italy, the Netherlands, Switzerland, Spain and the UK. The Food and Agriculture Organization of the United Nations (FAO) estimates that **out of the 100 crop species (that provide 90% of food worldwide) 71 are pollinated by bees**. Only in Europe the growth of over 4000 vegetables depends on the essential work of pollinators, as Greenpeace reports. Beyond the value of pollination for maintaining biodiversity, the European annual cash value of pollination has been estimated at over 22 billions of euros (in global it is hundreds of euros).

According to Polish Ministry of Agriculture and Rural Development expertise, pollinators, like honeybee (*Apis mellifera*), have positive influence even on self-pollinating plans. They can increase harvested crops by **30% in the case of sunflower and even 80% for red clover**, as reported.



The negative effects of decreasing number of bees and colony losses include mainly:

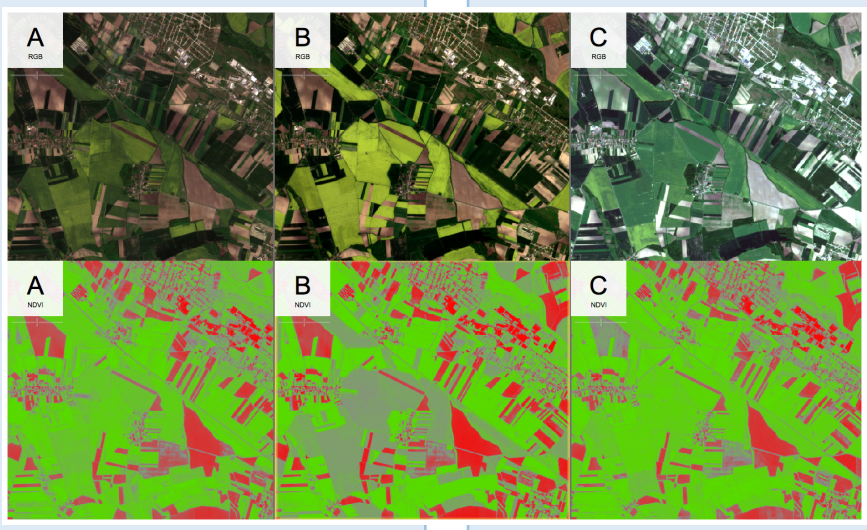
- decrease in the amount of food,
- decrease in the amount of honey, higher price of healthy food (vegetables and fruits) and food at all.

The above effects have negative impact on the environment, economy and eventually can affect human health. The higher costs of food, the higher poverty and hunger.

OBJECTIVE

The main objective is to help beekeepers to manage their apiaries and furthermore help them to increase the apiculture industry in Poland and Europe.

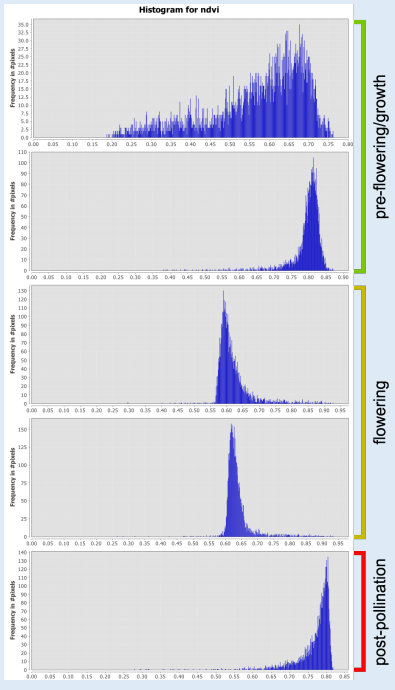
We want to achieve that by creating a remote sensing system for scheduling the routes for migratory apiaries to detect the optimal apiary transfer time, based on plants vegetation state. Our nearest milestone is to finish first part of the system with manual selecting crop species (e.g. colza) and detect the ready-for-pollinating vegetation state based on satellite imagery.



METHODS

First of all analysis of available satellite imagery has been made (Table 1). Sentinel data have been chosen for the researches, because of temporal, spatial and spectral resolution compared to price. Resolutions of Sentinel-2 MSI missions sensors, especially spatial resolution, are enough to provide valuable research results for big areas of one crop species.

As a second step data was downloaded and locations of significant colza fields was determined. Three vegetation stages of colza was defined – pre-flowers / growth, flowering and post-pollination. SentiNel Application Platform (SNAP) was used to process images and Normalized Difference Vegetation Index (NDVI) was calculated.



RESULTS

Although researches are in the very first stage, current results are promising. Colza was selected as a base example for researches, because it is one of the easiest species to locate on the map. Histogram of colza NDVI shows that values of vegetation index are diversified during growth stage - from 0,20 to 0,75. At the end of pre-flowering state NDVI characteristic changed and histogram peak was between 0,75 and 0,85. During flowering stage NDVI values was between 0,55 and 0,65 and in post-pollution state it came back to 0,75-0,85.

That behavior of NDVI characteristic confirms it is possible to detect flowerings stage and the places where migratory apiaries should be send by beekeepers, what is the main objective of the project.

DISCUSSION

No doubts there are couple of risk points in the project. Resolutions of Sentinel-2 MSI missions sensors, especially spatial resolution, are enough to provide valuable research results, but may be insufficient for smaller areas of interest, what is essential in business case. Irregular temporal resolution does not guarantee correct detection of flowering stage.

CONCLUSIONS

Consultations and workshops were held with beekeepers and farmers for deep understanding of field of interest in agriculture and apiculture industry and that approach will be continued.

For the future work AI is planned to be used for detecting areas of interest and optimization algorithm to schedule best migration path.

MAJOR REFERENCES

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