Danube S3 Cluster Project
Transnational Cluster Cooperation active on Agro-food, based on Smart Specialization Approach in the Danube region

Precision beekeeping and sustainable agriculture

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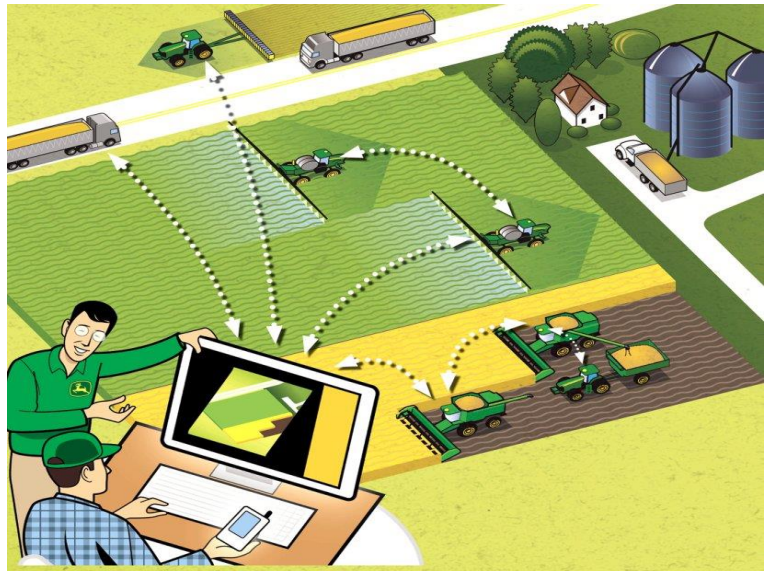
Beekeeping in Bulgaria and information technologies

- Beekeeping in Bulgaria is the agriculture sector providing the largest alternative employment in depopulated rural areas.
- The favourable climatic conditions, are a prerequisite for its successful development.

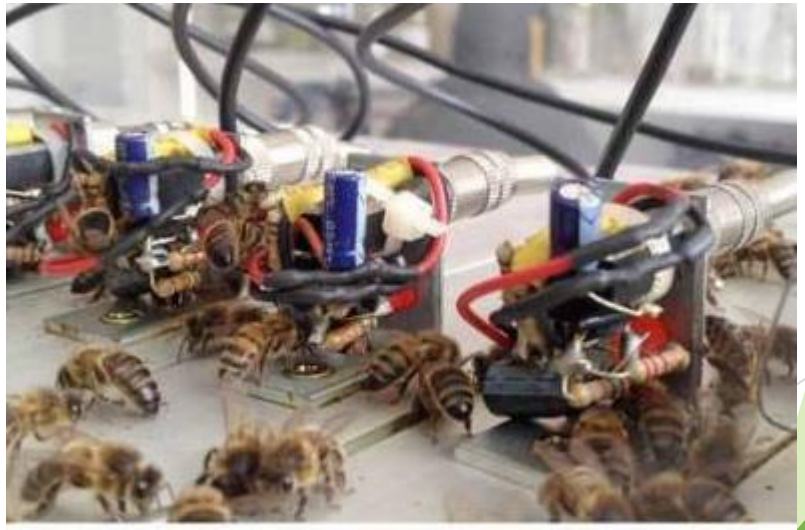



With climate change in recent years, there has been a change in the behavior of bee families in Bulgaria and elsewhere, which has a bearing on the quantity of bee products.(Some of these changes are related to the increase in winter mortality, increased propensity for swarming, aggressive behavior, attack by enemies, and etc)

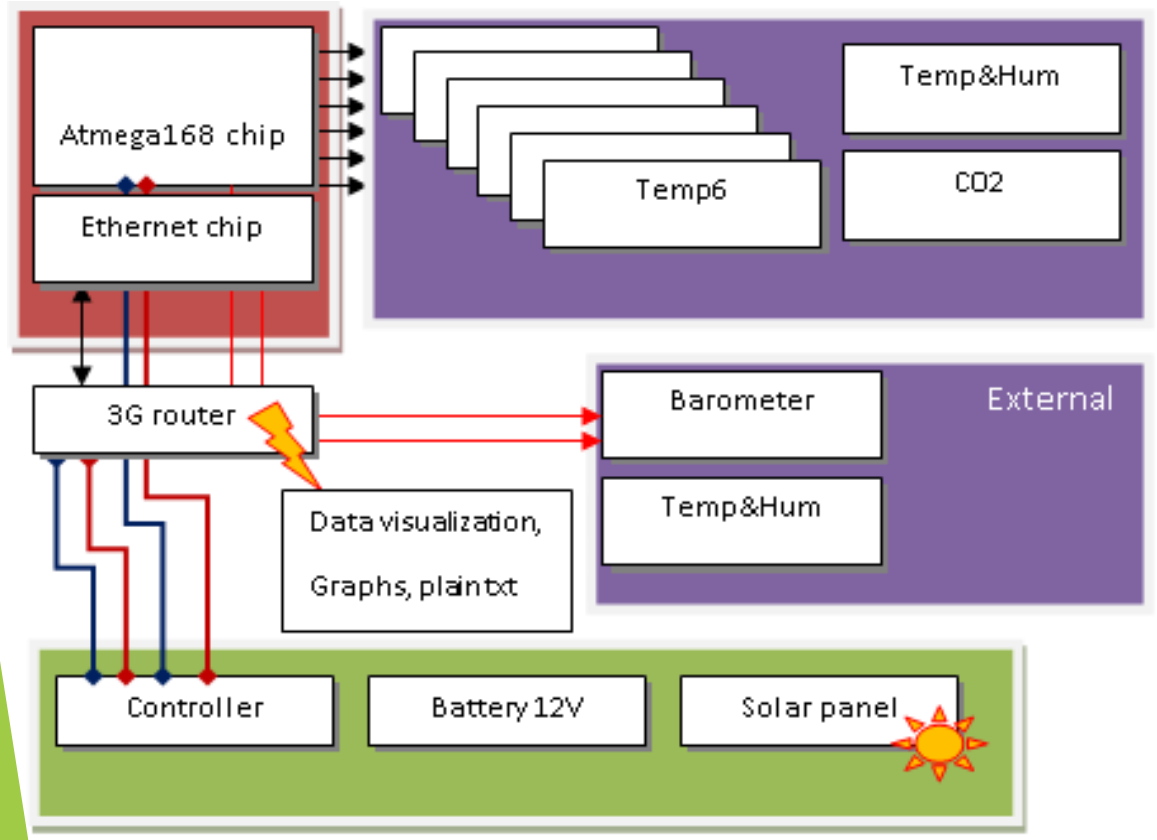
- Nowadays with the advent of the information technologies in the agriculture it is provided individual supervision of the biological units and the agricultural sites with a main purpose control of their development. Similar control of the single agricultural sites, is based on the interdisciplinary area, named precision agriculture.



- In the field of bee-keeping, one of the main questions is the search of adequate solutions to be followed the healthy condition of the bee hives, swarming and other biological activities, which provide for the production of the bee products in interrelationship with the conditions of the environment, influencing on the colony.
- One of these decisions is the adapting of the approach for precision agriculture towards the bee-keeping grounding on the measurements in the bee hives and outside it during the whole year.



- Research team of the University of Rousse “Angel Kunchev” has been created a prototype of measuring system measuring the microclimate of the beehive and outside it.

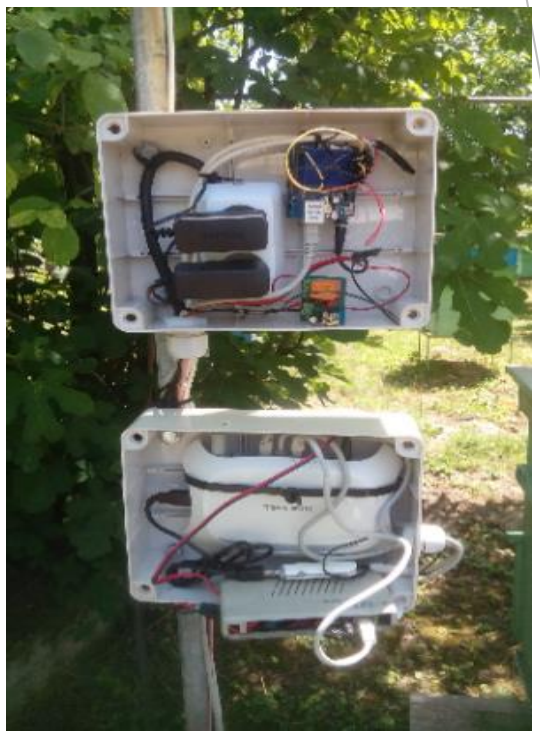


Functional diagram of a meteorological station for measuring the microclimate in the bee colony and beyond

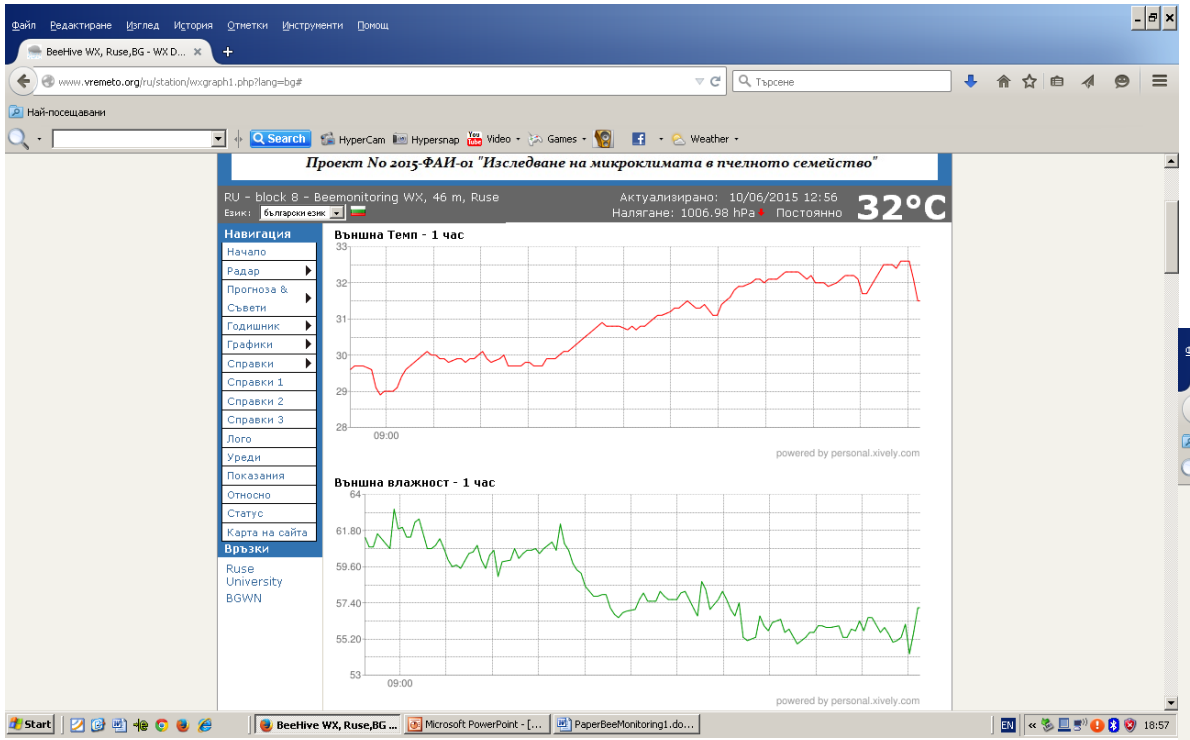
The measurement system comprises of :

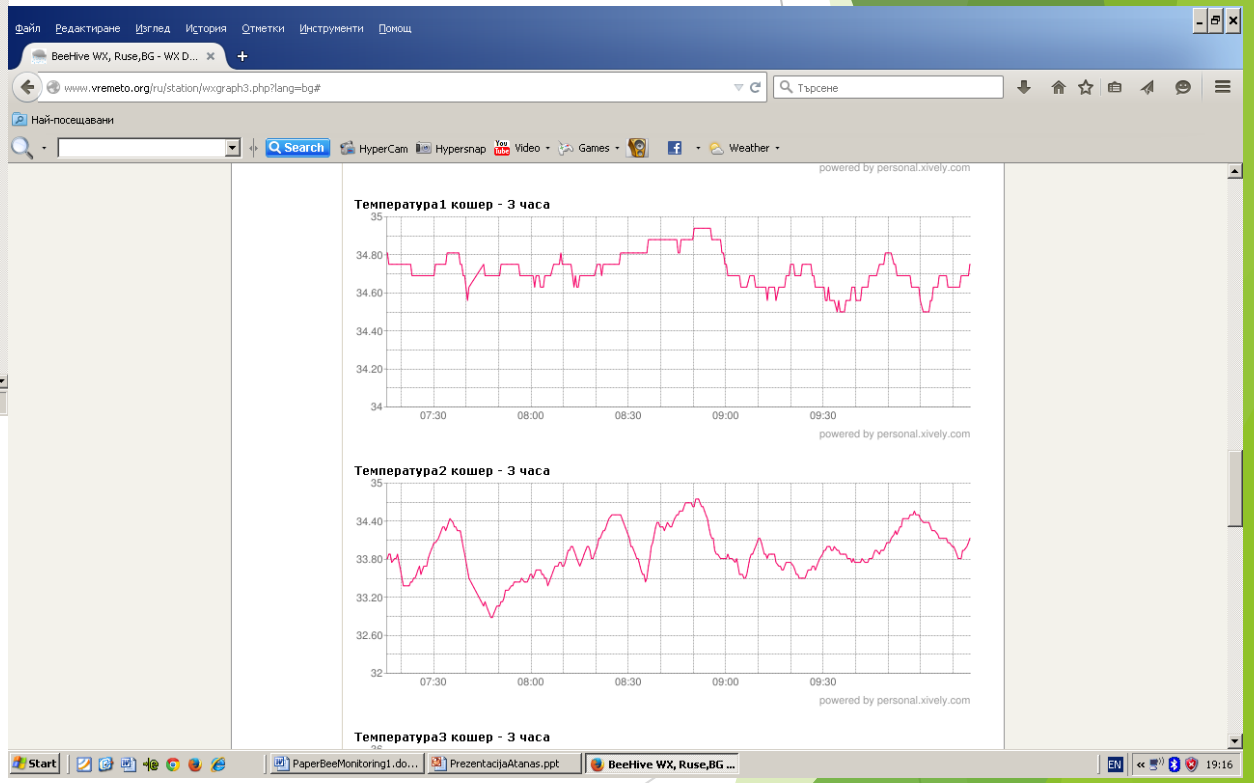
1) the hardware configuration including electrical module, LAN module, temperature sensor - DS18B20, combined sensor of the temperature and the humidity (temp/ humidity) DHT22, sensor for CO2 sensor MG811, 3G router/ AP access point + antenna 5dB, solar panel 50W+35W, control panel 6.6A + adapter 12/5V, accumulator 100Ah; 3 m aluminum mast 2) software configuration using generally accessible applications, as CarterLake.org and PHP conversion by Saratoga-Weather.org, TNET Weather [Kevin Reed], Long Beach WA [Mike Challis], Saratoga-Weather.org, AJAX TNET Weather common PHP site design. [Ken True].





Meteorological station for measuring the microclimate in the bee colony and beyond

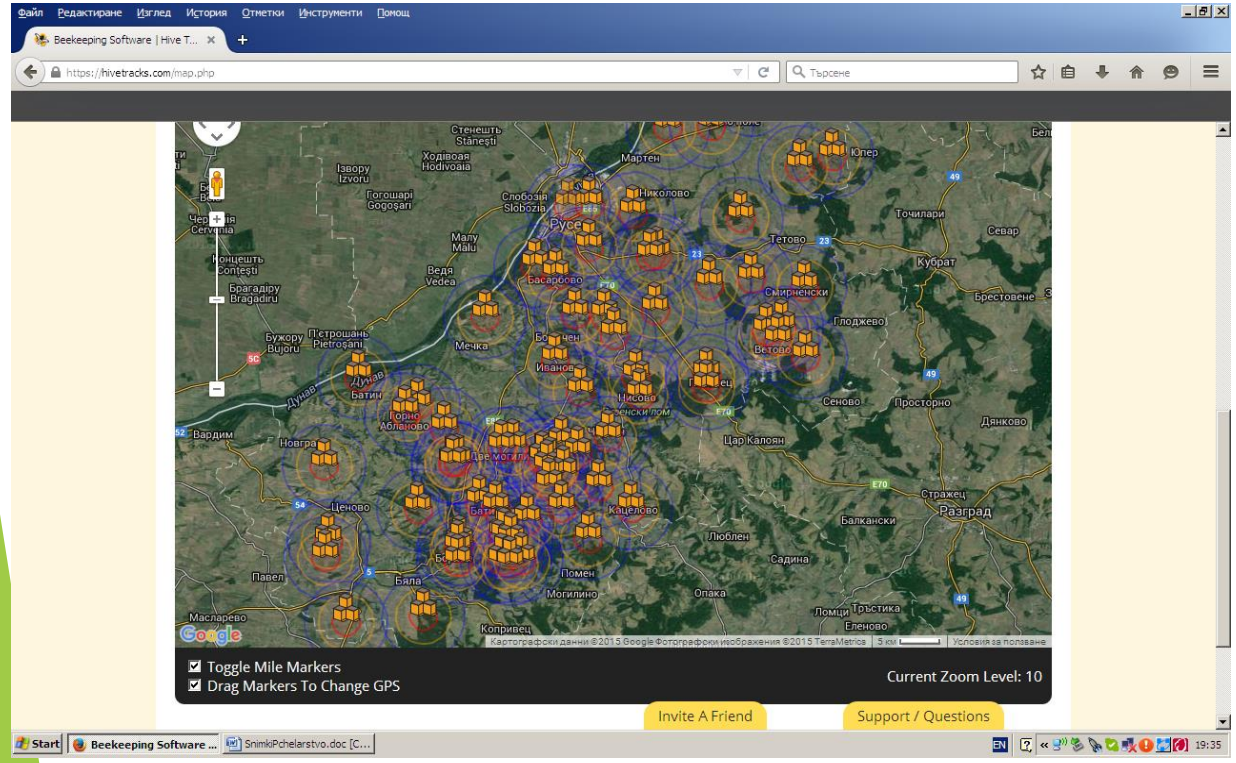


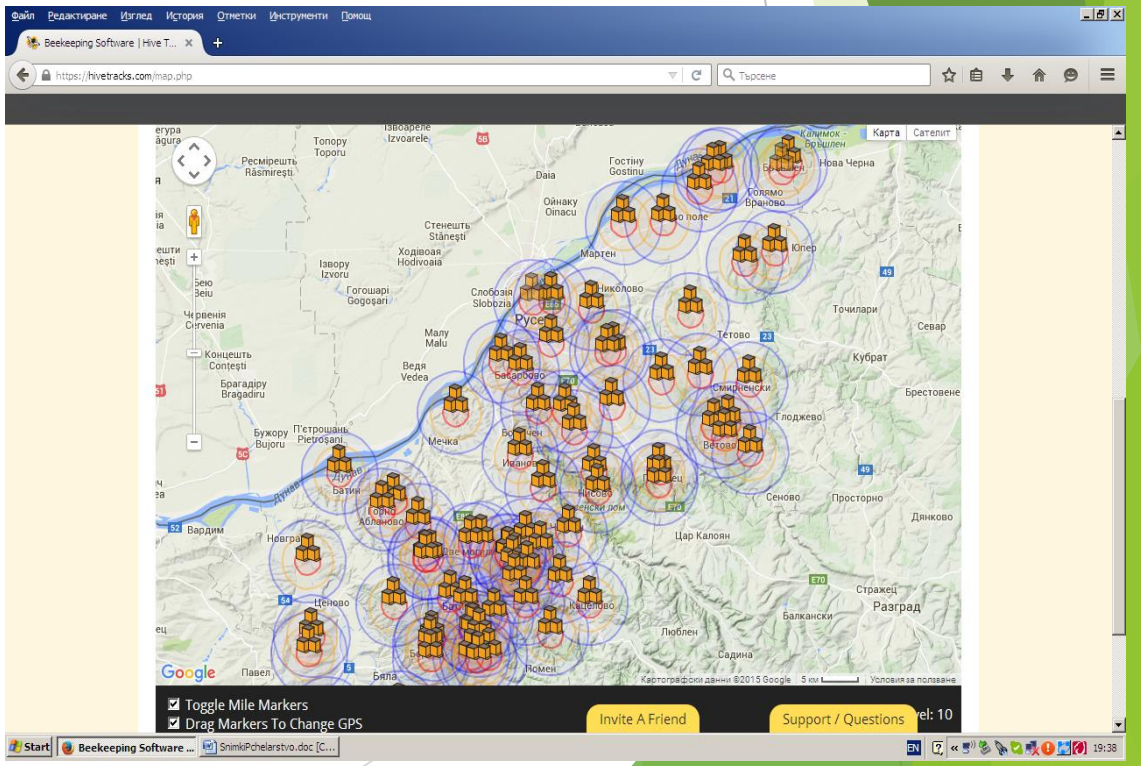


Visualization of the measurements in real time

- The rapid increase in the number of bee colonies and their improper location in areas rich of flowering vegetation has led to their overpopulation and reduced honey yields per beehives.
- Finding suitable places for apiaries is a very difficult task for all beekeepers.
- The choice of suitable places depends on a complex of interrelated factors such as: sufficient flowering vegetation, easy access to the place by the beekeeper, spatial distance between the apiaries and etc.
- On the other hand, the correct location of the bee colonies is of great importance for the good pollination of the agricultural crops and the increase of the yields obtained by them.

After a survey conducted among beekeepers from different regions of the Ruse region it was found that there was a progressive increase in the number of bee colonies. This condition may lead to competition in terms of limited resources.





- The researchers from University of Ruse develop multicriteria mathematical model for optimal location of honey bee determination of the optimal honeybee colony's location.

The objective of the function is to maximize the number of colonies to be relocated, taking into account the beekeeper's preferences in first case and in the second case with the higher priority is the complete feeding of the bee colonies to minimize overpopulation.

Objective Functions: $Max\ f_1(X) = \sum_{i=1}^{m} w_i X_i \ \ and\ Min\ f_2(E) = \sum_{i=1}^{m} E_i$

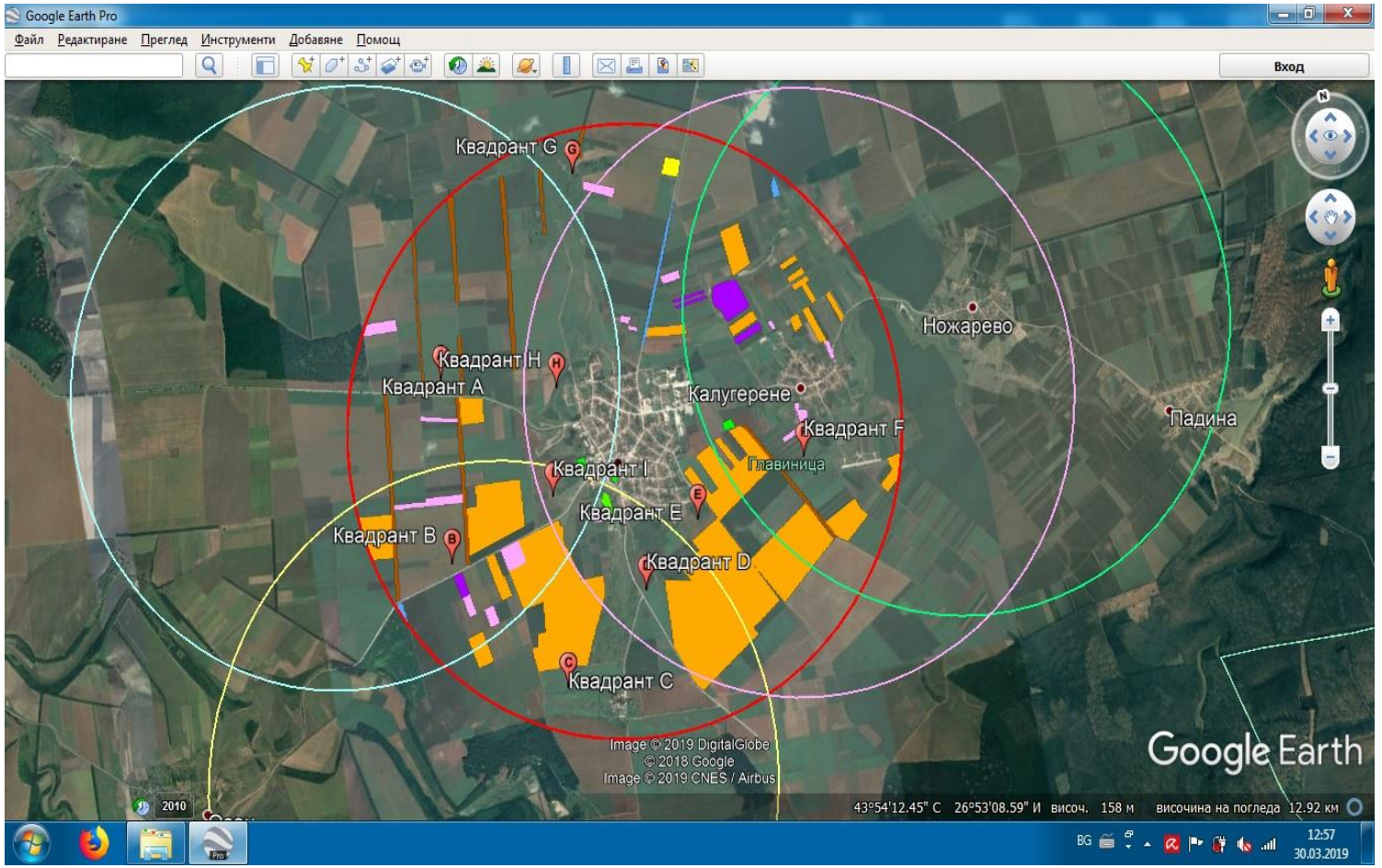
subject to

Constraint 1) $\sum_{\substack{j=1 \\ j \in C_i}}^{p} x_{ij} - X_i = 0 \quad \forall\, i = \overline{1,m}$

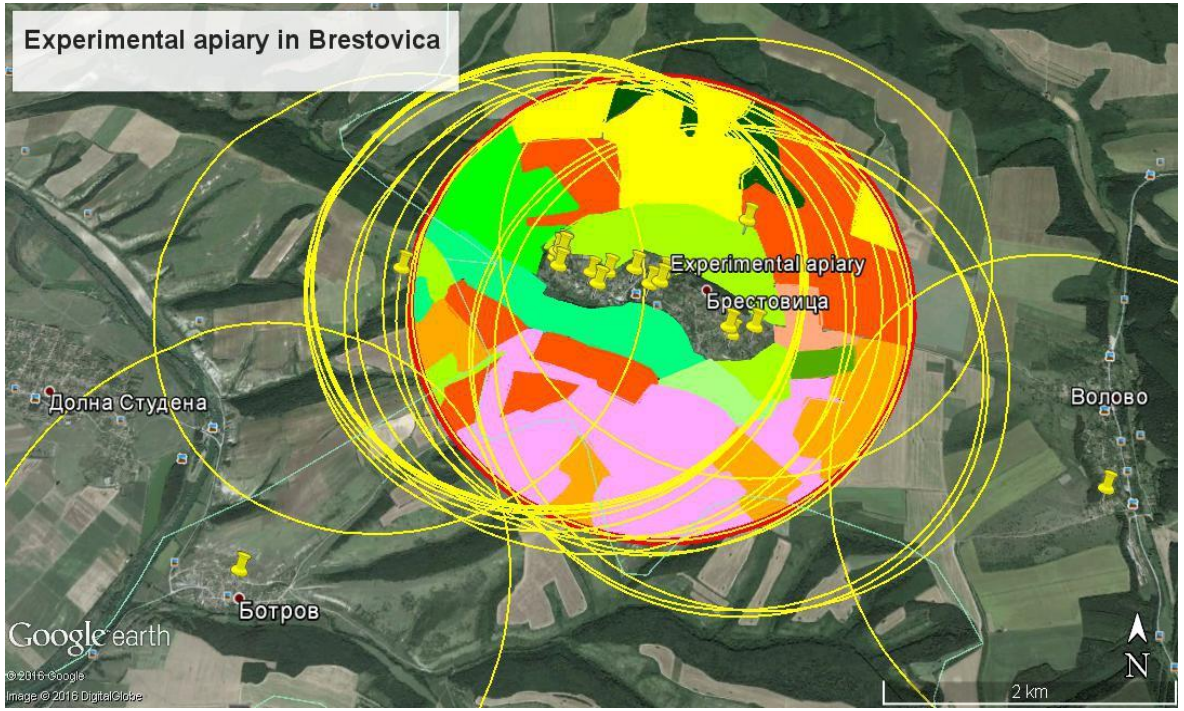
Constraint 2) $\sum_{\substack{i=1 \\ i \in F_j}}^{m} x_{ij} - Y_j \leq 0 \quad \forall\, j = \overline{1,p}$

Constraint 3) $\sum_{k=1}^{n} z_{ki} - E_i - X_i = 0 \quad \forall\, i = \overline{1,m}$

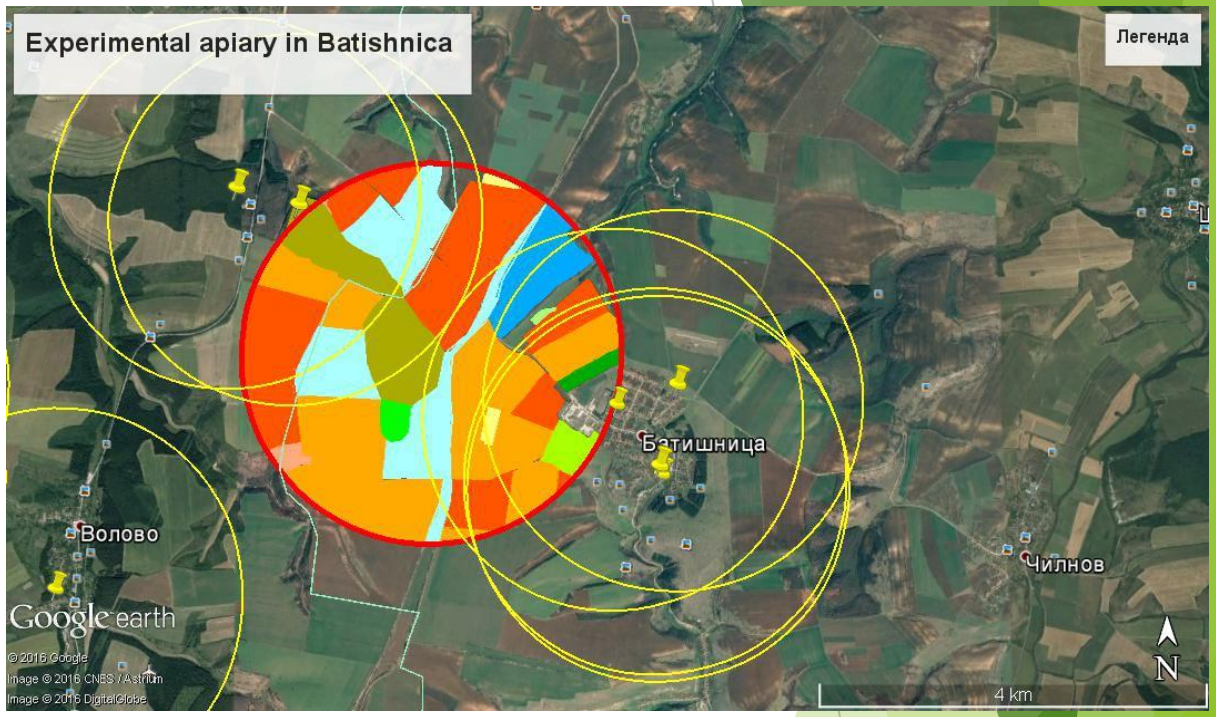
Constraint 4) $\sum_{i=1}^{m} z_{ki} \leq \mathrm{b}_k \quad \forall\, k = \overline{1,n}$



Experimental apiary in Glavenica geo-referenced image



Experimental apiary in Brestovica geo-referenced image



Experimental apiary in Batishnica geo-referenced image

Thank you for your attention!