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Extended Abstracts

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Groundwater and dependent ecosystems

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Interactions of surface and ground waters

title: **Estimation of ratio of water taken by shelterbelts to total evapotranspiration**

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Capitalizing on ecological knowladge that ecosystems perform various functions like altering intensity of water balance components, influencing on water chemistry, modifying microclimatic conditions, sustaining biodiversity and so on, the concept of ecosystem services was developed. Using the classification of ecosystem services distinguished by the world Millennium Ecosystem Assessment (MEA 2005), the following groups of services have been distinguished:

- Basic services, pre-conditioning the existence of ecosystems through the distribution of energy streams into the production of plant biomass, evapotranspiration, warming up air and soil, permanent turnover of the matter and water in particular, and the course of soil-forming processes;
- Productive services, which condition the production of food of plant origin, wood, fibres, herbs and animal production;
- Regulatory services, which stimulate natural self-purification processes of soil, water, air, modify climate, restrict erosion, flatten flood waves, maintain biological diversity, etc.;
- Cultural (social) services, which favour economic, tourism, landscape aesthetics, education, natural inheritance, etc.

A few of the most important for human well-being are regulatory services connected with water cycling in agricultural landscape and provisioning services ensuring indispensable clean water supplies. Long term studies carried out by Institute for Agricultural and Forest Environment proved that one of the best tool for counteract negative effects of intensive agriculture is increasing of landscape structure mainly by introducing nets of shelterbelt which very effectively control and limit spreading of non-point pollution, especially chemical compounds of fertilizers and means of plant protection. Efficiency of reduction of chemical compound concentration in ground water depends on quantity of water taken by shelterbelts from saturated zone of soil. Not all transpired water used for Evapotranspiration is taken from ground water; partly is taken from unsaturated zone. The special model for estimation the ratio of water taken from saturated zone to total water used for evapotranspiration was elaborated by authors (Fig. 1.).

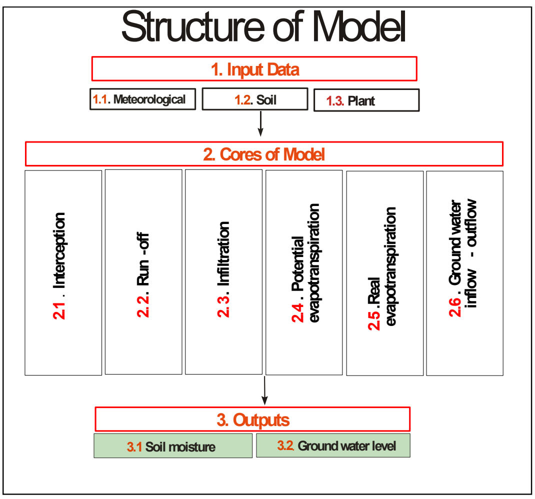


Figure 1.

The field experiment for estimation of all mathematical function need for applying the model was carried out during three years. Whole catchment can be covered by regular grid net or can be divided into quasi-homogeneous units. In the last case, land-use is the main criterion of this division. Moisture condition of the habitat is an additional criterion. Each of the plots is differentiated into levels that are homogeneous as regards soil. Regular grid net is better when rather small area is analysed. Dealing with regular grid net in very mosaic landscape composed of small fields is unusable. The model is designed to estimate:

1. Real evapotranspiration of different ecosystems on the basis of calculation of all components of developed water balance; any vertical and horizontal water fluxes
2. Proportion of water uptaken by plants from saturated zone to total water uptaken by plants.

Time resolution is one day for calculation.

The results of the experiment showed that the shelterbelt ewapotranspiration during growth period was by 40% higher then evapotranspiration of adjoining agroecosystems and the ratio of uptaken by plants from saturated zone to total water uptaken by plants is function of real evapotranspiration of shelterbelt and depth of ground water level (Fig. 2).

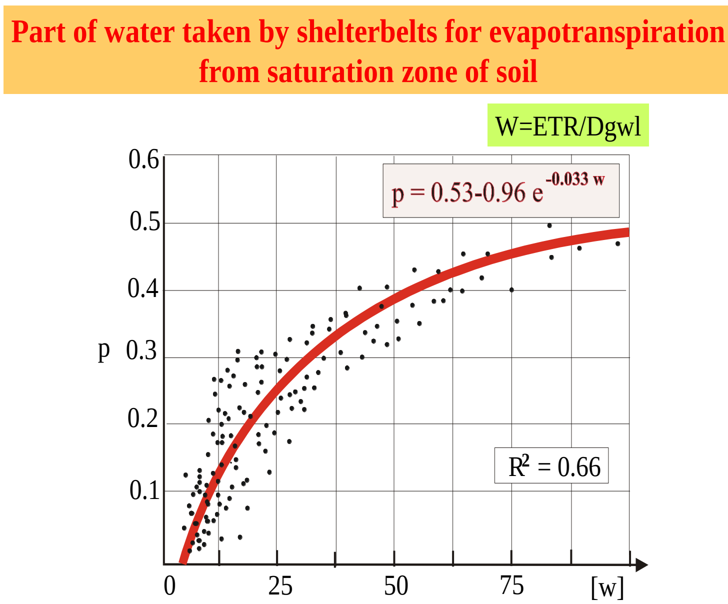
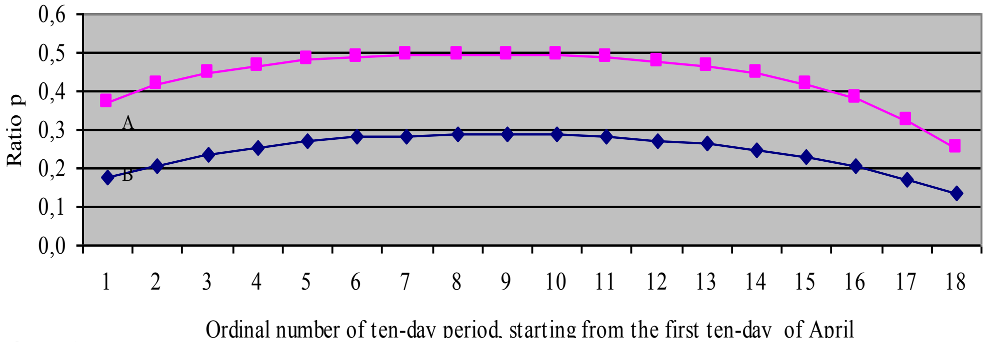


Figure 2.

Share of ground water in evapotranspiration related to weather conditions and depth of ground water level. Maximal value of this ratio reach about 50% in warm weather and shallow ground water level, while in cold weather and deep ground water level this ratio is about 30% (Fig. 3).


0,6
0,5
0,4
0,3
0,2
0,1
0,0
Ratio p
A
B
1
2
3
4
5
6
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14
15
16
17
18
Ordinal number of ten-day period, starting from the first ten-day of April

Figure 3.

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