

Test-bed "Varbitsa watershed" Eastern Rhodopes, Bulgaria

I.Ts. Marinov¹, T. Lubenov², E. Velizarova¹, S. Todorov³, L. Krastev³ K. Hristov⁴

¹Forest Research Institute, Bulgarian Academy of Sciences, Sofia; ²Solar Terrestrial Influences Laboratory - Bulgarian Academy of Sciences, Sofia; ³State Forestry Agency, Sofia; ⁴Region Forestry Board - Kardzhaly

Main characteristics of the river Varbitsa watershed

Location - in the central part of Eastern Rhodopes.
Total area - 1207,2 km².
Varbitsa river is right tributary of Arda river
Altitude of Varbitsa watershed varies from 220 to 1440 m

- ✓ Varbitsa is **strongly torrential** river.
- ✓ It flows in thinly populated region, economically poorly developed and with insufficiently developed infrastructure.

Damages from floods of Varbitsa river for the period 1990 - 2001:

- ✓ 29 swellings
- ✓ 92 residential buildings flooded and damaged
- ✓ 30 supporting walls, 17 bridges and 6 drain-pipes destroyed
- ✓ 54 roads, a dam lake embankment dam wall and the piers of 6 bridges damaged
- ✓ military equipment damaged and destroyed
- ✓ production of 73 private farms destroyed
- ✓ 15 people died



Situation of the Varbitsa river watershed

Mean annual water flow (station Dzhebel) for the period 1961-1998, (m³/s)

- for the upper course - 0,333
- for the middle course - 7,267
- for the lower course - 16,58

- ✓ The water flow module is 14,43 l/s.km².
- ✓ The low water level is during the period August - October, with maximal frequency in September.
- ✓ The module of suspended sediment load for the period 1960-2000 for station Dzhebel is 435 t/an.km².



"Flooded" bridge over Plazishte river - the road to village Varhari

For the purposes of this work, 9 risky segments with the following watersheds were determined:

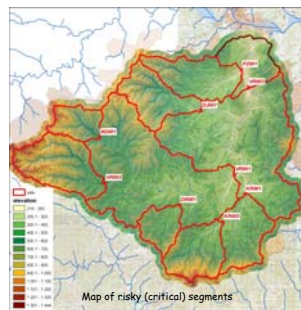
1. Varbitsa river above Zlatograd (VR003);
2. Varbitsa river above pump station Fotinovo (VR001);
3. Varbitsa river (almost entire watershed) (VR002);
4. Nedelinska river above town Nedelino (ND001);
5. Drangovska river (DR001);
6. Kirkovska river above village Kirkovo (KRO02);
7. Kirkovska river (the entire watershed) (KRO01);
8. Джебелска река (DJ001);
9. Plazishte river (PZ001).

Risky objects (segments) are determined in such a way on the basis of obtained information about registered events (torrential floods) and damages (flooded objects, emergency switch off of machinery and data about caused losses).

There is no special method to determine these segments. Losses caused in past events are accepted as basis.

After restoration activities particular segment could be excluded from the list of risky (critical) objects.

In many of these objects it is necessary to carry out restoration activities several times, which considerably raises their costs in the region.



Map of risky (critical) segments



Slopes in many of Varbitsa river tributaries are not entirely protected by vegetation

INFERENCE

- ✓ The basic factors, influencing on the risk of floods in Varbitsa river watershed area were analysed. These are **intensive precipitations**, strongly **rough relief**, poor soils with small depth and poor condition of the vegetation.
- ✓ For the purposes of the investigation were determined **9 risky areas**.
- ✓ The **watersheds above each risky segment are mapped** and on the basis of the obtained data for the territories, the possibility for a risk is determined and basic factors are analysed.
- ✓ The frequency, category, intensity and range of risk of floods in the watershed are determined.
- ✓ Most risky, according to frequency of swelling and caused damages, is the watershed of Kirkovska river (two risky segments) followed by the Drangovska river watershed and the upper part of the Varbitsa river watershed area (above the pump stations near Fotinovo).
- ✓ The necessity of building of hydrometric station in Kirkovska river is well-grounded. A system for early warning of the population is necessary, as well as monitoring network for precise outlining and analysis of factors for floods in risky areas.



Varbitsa river "takes away" part of the agricultural lands



Part of the dikes on Dzhebel'ska river are destroyed



Kirkovska river



Varbitsa river



Damages, caused by Varbitsa flooding river