Effect of afforestation and soil conservation on runoff and suspended sediment in a semiarid region, Bikhra Basin, Israel

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Afforestation has been carried out in the semiarid northern Negev of Israel. It's objectives are to reduce soil loss and afford a Savanna-type environment for pasture and tourism. Afforestation activities have included not only tree planting, protection and initial watering, but also a variety of soil preparatory measures with deployment of runoff reducing and soil conservation techniques. These are dominated by (though are not exclusive to) contour-aligned deep plowing, creating micro-watersheds locally termed 'Schich'.

The response of these loess-clad areas to the land use change was investigated by comparing three small (0.5-2 km^2) catchments: non-afforested (though overgrazed), newly afforested and an older afforested catchment. The comparison consisted of monitoring rainfall depth and intensity, runoff and suspended sediment concentration. Runoff was monitored with two large crump weirs and a triangular flume. Suspended sediment concentration was monitored by automatic pump samplers as well as by a self-activating turbidity sensor capable of monitoring concentrations above 120,000 mg/l. To ascertain rates of soil erosion and the extent of soil conservation we have undertaken a variety of turbidity calibration methods. These include standard laboratory, on-site and dynamic calibration. These are compared as well as the response types of sediment-laden runoff to rainfall events.

Evidently the forested basin generates no runoff except during the most intense rainstorms. The newly afforested and soil-conserved area generates considerably less runoff than the untreated basin (Fig. 1), although some runoff that is generated flows to the channel and is laden with much sediment due to soil disturbance as a result of site preparation. Suspended sediment concentrations are high in the unforested area, where runoff is often quickly generated in response to rainfall.

The presently-adopted means of afforestation attain objectives of decreasing runoff and soil loss. However, these involve a massive environmental and landscape change. An alternative approach is to stabilize channels by ensuring decreased gullying. We have analyzed the extent of gullying of 1st and 2nd order channels with respect to landscape characteristics: slope and contributing area. The latter two parameters, which have been identified on a GIS platform (ARCMAP), are shown to determine the extent of gullying as determined by the presence of stabilizing endemic bush vegetation.

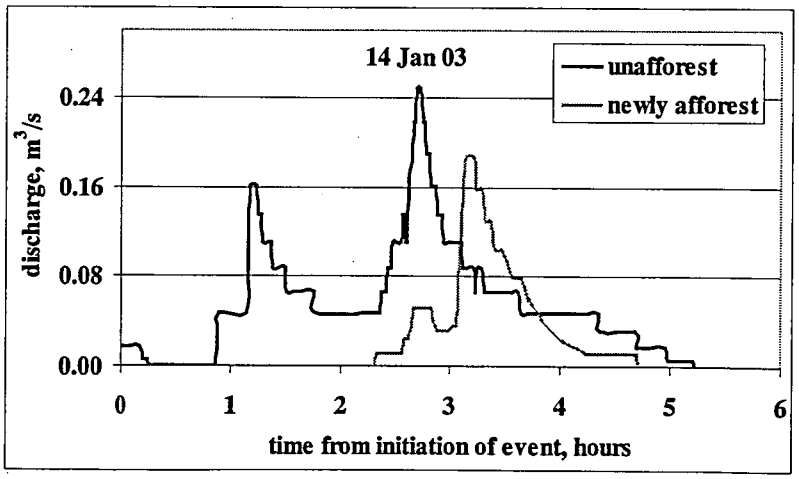

Figure 1. Outflow hydrographs from unafforested (though overgrazed) and newly afforested basins in the semiarid Northern Negev, Israel. Overall (1) no generation of runoff in some instances, (2) longer lag time, (3) lower peak discharge and (4) runoff volume are generated in the newly afforested basin.