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Changes in catchment hydrological connectivity under different post farmland abandonment scenarios

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Farmland abandonment has been one of the major changes in many Mediterranean mountainous areas throughout the 20th century. Large areas of former agricultural land have undergone natural revegetation. In other cases, extensive afforestation programs have been conducted to reduce land degradation following farmland abandonment. On terraced landscapes, the lack of maintenance may cause failures in the terrace risers, resulting in new sediment sources on the hillslopes. The heterogeneity of landscapes present in mountainous regions of the Mediterranean increases the uncertainty in forecasting changes in water resources and soil conservation after farmland abandonment. This study describes the evolution of land use in three small headwater catchments in northern Spain, representing different farmland abandonment scenarios (natural revegetation, afforestation and terraced fields), and examines its implications on catchment hydrological connectivity. It also analyses the hydrological responses of the three abandoned scenarios to similar rainfall events, and compares them to that of natural forested areas. Vegetation tended to increase in the three catchments, but there were important differences in the characteristics of the current land cover. Arnás, the catchment left to a process of natural revegetation, contained a mosaic of shrubs (64%) and forest (27%) at different stages of succession, largely conditioned by the topography and soil properties. The Araguás_afforestation sub-catchment was extensively afforested in the 1960s, with 75% of its surface currently covered by forest, most of it planted artificially. In the Munilla catchment, occupied by terraced fields, vegetation recovery was partly restrained by the introduction of cattle and 80% of the total area was covered by sparse shrubs. Land abandonment resulted in a general reduction in computed hydrological connectivity (Borselli's index – updated version) in the three studied catchments, except in localized areas close to the main channel, new forest roads and trails, and upstream of terrace wall collapses, all areas of increased hydrological connectivity. The decrease in hydrological connectivity was much lower in Munilla, characterized by an absence of dense vegetation and still dominated by a terraced topography. The hydrological responses of these catchments differed significantly, showing the influence of not only vegetation cover but of the properties of soil remaining after previous agricultural activities. In this study, the parametrization of the hydrological index (IC) was greatly determined by the land cover and extension of the stream layer. Our results suggest, however, that soils characteristics play an essential role in the hydrological behavior of the studied environments. Thus, alternative methods for evaluating hydrological connectivity are required, which should include soil properties (e.g. permeability) or the assessments of IC for different targets (e.g., ephemeral gullies, sinks or springs).

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