Agroforestry and water retention

Reference 7

Background and objective

Soil water infiltration influences groundwater recharge and potential top soil loss by erosion, as well as the partitioning of runoff into slow flow and quick flow. To synthesise the effect of afforestation or the use of trees in agriculture (agroforestry) on the soil infiltration capacity in the tropics.

Search strategy and selection criteria

Databases: ISI Web of Science (1986–2005), CAB abstracts (1973–2005) and BIOSIS previews (1989–2005) for publications in English and French. Search date: 30 November 2005.Search string: topic = ((hydraulic conductivit or Infiltra or permeabilit) and soil and water and (forest or afforest or reforest or deforest or agro forest or oil palm or palm oil or rubber or tree or shifting cultivat or slash burn or shifting cultivat or slash or logging or clear felling or clearing or skid or burn or hauling or woodland or savan)). From the search results, two of the authors selected articles by first excluding papers with titles that clearly did not fit the objectives because, for example, they were outside the tropics, did not measure infiltration in the field or did not involve growing trees. Then the same procedure was repeated after reading the remaining abstracts. More than 10% of the references were cross-checked for consistency independently by the two authors. The same procedure as for titles and abstracts was repeated for full papers. Studies were not used for the full meta-analysis because they were not relevant in terms of latitude, studied variables or vegetation compared. The remaining were rejected on grounds of information about and handling of design, statistics and methodology. The most common reason for exclusion from a secure metaanalysis was a non-randomized design. Rejection on the basis of statistics was usually because of the absence of complete data sets or any indication of variation within the results. All cases rejected on the basis of methodology were because only initial/unsaturated infiltration was measured. Several studies that were rejected met more that one of these criteria.

Data and analysis

The combined data from the selected studies and their respective experiments (comparisons) were analysed using the statistical software MetaWin. All statistical tests were considered significant at the 95% confidence level. They used non-parametric boot-strapping to calculate the confidence intervals (CI) for the combined response ratios. They first used fixed-effect models and tested for heterogeneity with the $x2$ -test. If heterogeneity was significant they used random-effects models instead. Given sufficient availability of data, heterogeneity was then examined using meta-regression and by categorical analysis of sub-groups.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
4	Tree plantations in tropics.	Afforestation and agroforestry. Forest was defined broadly as any area of trees with more than 10% crown coverage. Afforestation denoted plantation on open land that had been free from forest cover as a result of prolonged agricultural use, failed reforestation by active replanting or delayed natural secondary succession. This included pastures, grasslands (non-fallow and fallow) and permanent cultivation.	Deforested land including pastures, grasslands (non-fallow and fallow) and permanent cultivation.	Logarithm of ratio of the infiltration capacity in the fields before conversion, to the infiltration capacity in the fields after conversion.	100%

Results

- Infiltration increased approximately three-fold after afforestation or agroforestry.

- Plantations and agroforestry systems were not significantly different, but there was a tendency for agroforestry to exhibit less improvement than afforestation: there was a mean of 1.9 for agroforests compared to 3.8 for afforested sites.

- NA

- NA

- NA

Factors influencing effect sizes

NA

Conclusion

The meta-analysis confirms the beneficial effect of tree planting on soil infiltrability over a wide range of humidity levels.