

# **ABSTRACTS**

## **10<sup>TH</sup> INTERNATIONAL SOIL CONSERVATION ORGANIZATION CONFERENCE**

**May 23-27, 1999  
West Lafayette, Indiana USA**

A-0204

Hydrological implications of planting bluegum in natural shola and grassland watersheds of Southern India. J.S.Samra, A.K.Sikka and V.N.Sharda, Central Soil & Water Conservation Research & Training Institute, Dehra Dun, India

The paper discusses the hydrological behaviour, tree growth and economic evaluation of planting *Eucalyptus globulus* (bluegum) in a natural mixed Shola and grassland forest using paired watershed technique. Shola forest portion (18.7 ha) of a watershed was replaced with bluegum in one of the two comparable watersheds of about 32 ha each during 1972 after a calibration period of 4 years (1968-71). Ten years rotation cycle was followed for harvesting and coppice regeneration. The probability calculations of rainfall, total runoff and base flow during the first (1972-81) and second (1982-91) rotations analysed higher rainfall during the first rotation as compared to the second rotation in all respects. Average annual rainfall was 1569 mm and 1309 mm during first and 2<sup>nd</sup> rotation, respectively. However, the *Eucalyptus* planted watershed produced lesser base flow and total runoff than the natural watershed and the reduction was more pronounced during the second rotation. The double mass curves also analysed similar trend. The regression equations developed during the calibration period were used to analyse the effect of bluegum plantations on water yield reductions during the two rotations. As against 16 and 15% reduction in total runoff and base flow during the first rotation, the coppiced bluegum caused higher reduction of 25.4 and 27% over the natural grassland during the second rotation. Immediately after clearfelling of bluegum in 1982, there was hydrological recovery since the computed total runoff (201.8 mm) and observed (201.1 mm) were almost same. Rapid and vigorous growth of coppice shoots in the subsequent year (1983), reduced the total runoff and base flow by 19 and 31%, respectively compared to natural grassland watershed. A similar trend was observed during 1992 after the second harvest of coppiced bluegum. From the pooled monthwise analysis, it was inferred that 68, 76 and 56% of the mean annual reduction in total runoff, surface runoff and base flow happened due to coppiced bluegum growth during the months from July through October. The bluegum covered only 59% (18.7 ha) of the total watershed area of 32 ha. If the entire watershed area had been fully stocked, the reduction due to bluegum plantations would have been much higher. The analysis of peak flows for the selected storm events revealed significant moderation of peakedness. The average ratio of peak discharge from planted and natural grassland watershed decreased from 1.03 during the calibration period to 0.54 during the first rotation and to 0.52 during the second rotation. The dry period (January-April) total flow also reduced by 20% due to bluegum plantations during the first rotation and by 28.6% during the second rotation. The base flow went down by 18% during the first rotation which was further reduced to 24% during the first coppice growth period. The low flow analysis assuming 10 days flow duration curves for the calibration also confirmed reduction in water yield due to bluegum plantations both during first rotation and second rotation periods. The Low Flow Index (LFI) indicating 10 days average flow which exceeded 95% of the time of the duration of series registered a decrease of 3.75 times during the second rotation as compared to 2 times during the first rotation, thereby indicating higher reduction in water yield due to coppiced bluegum. This dry period flow, though small, is very crucial for sustaining water supply in hydro-electric reservoirs. The increased utilization of water produced 42% more biomass and 40% higher economic returns during the second rotation as compared to the first rotation. The coppiced bluegum depleted soil moisture from deeper soil layer whereas during the first rotation, the extraction was mostly confined to the surface layers. Direct contact of the root system with the ground water table was not observed during the two rotations.

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A-0207

Indicators for the sustainability of land use systems on degraded areas of the Terra firme in the Amazon Basin : soil characteristics and parameters for transport processes. Wenceslau Gerales Teixeira, Götz Schroth, Jean D. Marques, Johannes Lehmann, Manoel da Silva Cravo, Bernd Huwe- Wolfgang Zech, Embrapa - Amazonia Ocidental, Manaus - Manaus - AM - Brazil. Institute of Applied Botany, University of Hamburg - Germany. Institute of Soil Science, University of Bayreuth - Germany.

This study is part of a long-term program for the recultivation of degraded monoculture sites in the Central Amazon Basin. The soils occurring on upland site in this region generally have a low fertility. Large areas with those conditions are deforested and abandoned after short period of cultivation. There is a need to develop alternative land use systems which allow the utilization of degraded areas in an economically viable, and socially and ecologically sustainable way. If this can be achieved, there is a chance to reduce the rate of deforestation and to reintroduce those areas in the production process. The objective of this work is to investigate the soil characteristics and water fluxes under different types of land use and to use this information for the identification and the design of sustainable, site adapted and productive land use systems. The present experiment was conducted on a Xanthic Hapludox near Manaus. The investigated systems were monocultures of cupuacu (tropical fruit -*Theobroma grandiflorum*) and pupunha (peachpalm - *Bactris gasipaes*) and an agroforestry system composed of cupuacu, pupunha, urucum (seeds for red dye - *Bixa Orellana*), castanha do Brasil (nuts and wood - *Bertholletia excelsa*) with a cover crop of kudzu (*Pueraria phaseoloides*). For comparison adjacent sites with fallow and primary forest were included. The physical (particle size, bulk density, pore size distribution, aggregate stability), chemical (organic matter, available nutrients, soil solution composition) and

hydrological (hydraulic conductivity, soil retention curves, water storage, soil matric potential) parameters were evaluated. The soil parameters showed a high spatial heterogeneity caused by different sources (natural development, root distribution, macrofauna activity as affected by different management). Especially the chemical characteristics varied between treatments and species due to different doses and sources of fertilizers. A comparison of soil water behavior in different layers measured close to individual plants using tensiometers and TRD probes indicated a "single tree effect" on the available water in the soil and a high matric potential in dry season. Practical and ecological interpretation of these data are emphasized.

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A-0209

Water conservation and utilization. K. G. TEJWANI, LAND USE CONSULTANTS INTERNATIONAL, NEW DELHI, INDIA

The paper focuses on rainwater-catchment management issues at Micro and Field - scale levels, in sub-humid and semi-arid regions with dense human and livestock population levels. While doing so, it describes some actual case studies. In all the case studies the central theme is that the edaphic conditions and the land use in any size of a catchment and in any agro-ecological conditions determine the water yield and therefore have to be taken into account in determining the actual land use within and outside the catchment. While the climate, the rainfall, the geology, geomorphology and inherent soil conditions cannot be changed, the land use, the hydrological behavior, and the production and productivity within a catchment can be modified. While describing the three types of water harvesting, the paper focuses on the technology of ponds and tanks, which are very extensive in India. The impact of land use, the degree and length of the slope, and the conservation measures on the amount and rate of runoff are described for designing of ponds / tanks, details of technology available in India (e.g. determining peak rate of runoff, runoff volume, storage, conveyance and recycling of runoff, water application and budgeting, and crop production etc.) are described. Four case studies of successful application of this technology are described. In one case a severely degraded and denuded catchment was intensely treated to reduce sediment yield, harvest and store runoff, and develop the command area for irrigation. This case study resulted in the protection of the catchment and also increased crop production and diversification in the command area. This led to an overall socio-economic development in the project. In two other case studies the catchment treatment improved the underground water storage as indicated by the increase in the number of wells, and the well irrigated area and crop diversification. In the fourth case study, the afforestation of a watershed led to a decrease in the water yield for hydropower purposes. This is an important finding for sub-humid tropical areas where the value of the water could be monetized in terms of hydropower or industrial wood/fuelwood production etc. The issue of managing the rainwater within the individual fields by "conservation bench terraces" is addressed.

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A-0211

Important and controversial watershed management issues in developing countries.

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Over the last decade, international meetings in soil conservation have raised many interesting but controversial issues in watershed management. One who has attended these meetings or reviewed their proceedings often finds that these issues are important but they needed to be discussed more in order to obtain complete pictures and better answers. The first of such issues has been in developing countries who should receive most benefit from watershed management work, upstream people or downstream people? Or, should the main objective of watershed management be production-oriented, or protection-oriented? The next controversial issue has been whether or not incentives should be given to farmers who practice watershed conservation work. Should farmers carry out conservation work in compliance with an overall plan but without government financial support? The third issue often discussed is whether structural measures or vegetative measures should be emphasized in watershed conservation. Structures can be costly, yet vegetative measures may not be effective in erosion control on steep slopes. The fourth issue is, in watershed conservation, should the major work concentrate on prevention or rehabilitation? What are the differences in technical designs and requirements? The next issue deals with watershed planning. One school of thought is that planning should be done on farm basis rather on watershed basis. Another school of thought, however, puts emphasis on whole watershed or integrated watershed planning. The last issue which is related to integrated watershed management is how far integration should go? If a watershed plan integrates every activity in a watershed, it becomes a regional development plan and it needs no less than a local government to manage it. This paper focuses on discussing the above mentioned six important, but often controversial, issues. Pros and cons of both sides of arguments are presented, and an objective analysis is given. The author tries to present an overall picture and wishes to stimulate further discussions for the benefit of watershed work in developing countries.

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