
Title: Optimization of crop water requirements under fluctuating rainfall regimes in semi-arid catchment area : evidence from Muooni dam site, Machakos district, Kenya

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Abstract: The aim of this study is to predict the impact of rainfall fluctuation on farmers' water demand in Muooni catchment. In particular, it seeks to assess the impact of land-use change on soil and water at Muooni dam site, and apply optimization models to adjust crop water requirements under fluctuating Muooni dam's active water storage capacity. Results reveal that soil erosion problems and eucalyptus water over-abstraction, farmlands sub-division for the purpose of settlement and Muooni dam siltation threaten the economic viability of smallholder farms in Muooni catchment through decrease of fertile soils and increased water stress. Farmers have adopted multiple cropping of about 9 seasonal crops and 6 perennial crops on a small parcel as a strategy to cope with crops failure under unexpected drought. Also, the adjustment of their water orders with soil moisture depletion does not allow them meeting their crop water requirements. Therefore, efficient farmers' water demand requires the optimization their crop water requirements in the limit of affordable costs, under any rainfall regime. They may opt either for an economic order quantity (EOQ), or for a quantity well-matched with the limit average cost (LAC) or again for a minimum efficient scale (MES) quantity. This may be possible if only farmers implement rational farming water use and appropriate alternative technologies that foster agricultural allocative and technological efficiencies within the production possibility frontier.

