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Indiscriminate devegetation under improper farming system: a root cause for surface and underground water and food crisis in Ethiopia

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Abstract

Deforestation has caused surface and underground water imbalance in the hydrologic cycle followed by subsequent food, feed and wood productivity crisis. This paper reviews the role of traditional farming systems in wet and dry agroecology. It further compares it with existing improper farming practice, which productivity is examined from agroecology based climatic and edaphic perspective. Experiments were carried out to determine the amount of rainfall intercepted by dominant trees on farm, namely by *Cordia africana*, *Afrocarpus falcatus*, *Millettia ferruginea*, *Juniperus procera*, *Syzygium guineense*, *Olea europaea* subsp. *cuspidata*, *Acacia albida*, *Albizia gummifera* and *Moringa stenopetala*. Deep rooted trees planted on farms are found to be sources of feed, food and moisture conservers, that sustain and boost production in moisture scarce agriculture. Under irrigation they are found to be good for salinity protection and marginal land reclamation. Soil infiltration data from secondary sources were examined for cultivated area, wood land and open overgrazed pasture in central Rift Valley. The relative infiltration rates are highest for grasslands. This research work is intended to initiate interdisciplinary networking approach in water and natural resource conservation, proper land use potential development and environmental sustainability.

Key words: farming system, deforestation, on-farm trees, interception, infiltration, water balance crisis.

1. Introduction

Major effects for the agricultural production crisis in Ethiopia are connected with backward agricultural implements, and land overgrazing and freely browsing animals – in consequence soil and nutrient loss due to erosion. Conservation oriented development in food feed, wood and water supply under proper land use with special focus on perennial plant is an urgent need. Crop production, animal rearing and tree planting are analyzed from proper farming land use potential perspective. Traditional role of model farming systems in wet and dry agroecology of Ethiopia is reviewed and compared with present improper practice. The role of trees and grass cover in sustaining surface and underground water balance in the hydrologic cycle is presented. Research results of a role of dominant trees on farm: *Afrocarpus falcatus* – a common soft timber species, *Juniperus procera* – a widely

growing durable timber tree, and *Cordia africana* – a common tree on farm, in intercepting rainfall in 2006 rainy season are presented.

It is intended to initiate interdisciplinary approach for water and natural resource conservation, sustainability and development from proper land use and environmental conservation using trees on farm as an entry. A model has been further demonstrated as an input to enrich the integrated water development national strategic plan.

1.1. Agroecology based approach

A lack of integrated approach – specialization of professionals in narrow portion of life science only (Reid, Wilson 1985) brings about a critical gap in agricultural development. A discipline that integrates the major agricultural sector is agroforestry. According to International Council for Research in Agroforestry (ICRAF) (Hoekstra *et al.* 1990) 'agroforestry refers to a dynamic, ecologically based, natural resource management system that, through the integration of trees in farms and agricultural landscape, diversifies and sustains the production for increased social, economic and environmental benefits for land users at all levels. Agroforestry is a deliberate interaction between environmental component, management strategy, crop, livestock, forestry and land in economically viable, socially acceptable and environmentally sound in scientific, artistic and business approach for the benefit of people. Agroforestry is an interaction of environment, management strategy, agriculture and forestry component and land to avail and sustain basic human needs (Smite *et al.* 1998; Danforth, Noren 1994).

The improper farming management and land devegatationin in Ethiopia constrained the development of agroforestry system and the subsequent productivity. As a contrast – Australia is one of the best exemplary models in being competent on harsh and arid conditions and in poorest soil. In reality, the agroecology uniqueness and diversity in the highlands of Ethiopia is not a challenge, it is more of an opportunity if we correctly understand the root causes of the problem and take appropriate mitigation measures.

In Ethiopia climatic and edaphic information on factors determining potential productivity (like soil moisture and nutrient, humidity, temperature, and sunlight) is so far generated for shallow rooted and short height annual crops cultivated in open flat landscape. Such basic information is reliable to a large scale mechanized farm of same representation. But the predominating land form conditions are hilly, rugged, depressions, gorges, pockets, sharp hill tops and multi-storey closed and open forests and bushy landscapes. Therefore such a limited basic information service marginalizes the majority of the farm and the farmers. In higher elevations and in frost pocket areas dry wind and cold temperatures are critical and are causes for animal and plant loses (Reid, Bird 1990). In such condition a shade and shelter effect of trees in establishing temperature and reduction of desiccation has positive impact on crop and animal production. Ethiopia being a highland is severely prone to cold temperature. Climatic and edaphic data that has determined the agroecology needs has to be revisited as it has little relevance for forestry and available water in the soil that determines productivity. The conventional national meteorological data provide information only similar to the ones shown in the shade. Most crops and tree seedling faces temperature in open and in pockets. Effective temperature in windy and humid condition has not been considered.

Acacia tree canopy intercept 52% of rain water and allow 48% to reach the ground upon reducing its acceleration and droplet size by increased rate of infiltration (Dechasa 2004a). The intercepted rain directly evaporates to the air and increases air humidity that can lead to increased rainfall in the upcoming days against higher slopes.

The phenomena of sharp reduction in minimum temperature occurred in Ethiopia in October and January, has brought a dramatic frost effect on an over century naturalized exotics eucalyptus. Similar harsh climatic events compounded by the shift in wind direction that had killed 30 000 newly shorn wool sheep brought Australians to overcome the problem by planting wind breaks in all directions as a shelter and windbreak (Cremer 1990). The following potential productivity of the highland is determined both for edaphic and climatic conditions from data generated in the open and flat land. Thus, it is not relevant for perennial crops like coffee, forest or fruit trees and land forms outside flat and open land. The existing data on plant water relation and ecohydrological information are irrelevant. Preliminary, applicable climatic zonation is the Australian classification. The Ethiopian highlands are omitted as a blank "bird" shape on a map, while the entire African continent has been well classified. This paper is initiated to contribute in the filling of the identified gaps by determining basic climatic input data which would enable a better understanding of the hydrological cycle in the Ethiopian highland complex.

In a forested area the temperature is stable and there is no risk of extremes endangering crop or animal production. The perennial plants, which are in focus, growing taller in the air and deeper in the soil, have different climatic and edaphic requirements, than shallow rooted crops. Relevant basic information applicable in cultivation of such plants is missing. Such critical gap should also be filled with an integrated interdisciplinary approach.