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Land husbandry: an agro-ecological approach to land use and management Part 2: Consideration of soil conditions

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"Porosity was defined and calculations were made relating porosity to bulk density, and so on. What was missed was that it is the pore space, and more specifically the water films in the pores, that are the spaces used by life in the soil. Pore space is where the action is!" (Anderson, 2006).

Abstract

This paper, complementing the first part (Shaxson et al., 2014), sketches the outlines of an ecologically-based approach to better care of soils, within the overarching context of 'land husbandry', contributing to more-effective conservation of soil and water. It suggests an up-dated paradigm which concentrates more on renewing and conserving the biologically-moderated spaces in the soil in the root-zone rather than on the solid soil-particles themselves. When read in sequence, the two papers offer contributions to better understanding of both the problems and the possibilities for solving the ongoing uncertainties of how best to repair damaged lands, to maintain and improve those areas already in use, and to safeguard the potentials of those as-yet-unopened areas which surely will be brought into production in the future, by the planning and executing of optimum strategies for assuring sustainability of their uses into the future. These two papers do not set out to challenge existing knowledge, but rather to suggest additions to, and alternative interpretations of, what may already be known. The conclusions suggest some important amplifications to any curriculum for the training and/or up-dating of people involved in those subject-areas which contribute to better land husbandry and more-effective conservation of soil and water, as well as to the buffering of soils' productive capacities against the possible adverse effects of climate change.

Key Words: Organic matter, Soil porosity, Paradigm-shift

1 Introduction

Within the context of modern concepts of soil conservation, as described in previous issues of this journal, (e.g. WOCAT, 2007; Motavalli et al., 2013; Dumanski & Peiretti, 2013; de Freitas & Landers, 2014), this article follows-on from its first part (concerning landscape) (Shaxson et al., 2014), which described conceptual and practical means for harmonising proposed types of land use with the significant characteristics of a particular catchment within a landscape. This second part considers aspects of the soils which clothe such landscapes, and some means by which these soil/plant agro-ecosystems should be appropriately managed for them to provide – and maintain – optimum conditions for yielding plants and water on a sustainable basis.

The paper draws on and expands on topics considered in Shaxson (2006).

2 Causes for concern

As human populations continue to rise towards a plateau of some 10 billion people in the second half of this century, there are major concerns about the Earth's capacity to satisfy associated demands for regular supplies of water, food and other products of the land (Oldeman et al., 1991); Reserves of unused but potentially productive

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land have been diminishing: by 2005, some two-thirds of the world's ecosystems had already been severely degraded, and only about 11% remained in reasonable condition (MEA, 2005). Coupled with the effects of inappropriate land use and/or management methods, more-intense rainstorms and more-severe droughts contribute to rising production costs under conventional tillage systems of agriculture, and diminish such systems' potential for sustainability in the future under a changing global climate (Maslin, 2013). The global challenges to be faced now and into the future regarding global food security have been concisely summarized in Beddington and Warham (2014).

Although much effort in soil conservation has been expended since before the 1930's (see e.g. Bennett, 1939 to WOCAT, 2007) and to the present day, erosion and floods continue. Despite good efforts, repeated damage to the lands from which they still emanate has often not been lastingly repaired, nor has their repeated degradation been automatically avoided. Where inappropriate selection and management of land and soil continues, in coming years the sustainability of their potential for production of plants will continue to be compromised. In addition, the regularity, volume and quality of streamflows from such areas are likely to be prejudiced, even as demands for dependable and clean water supplies continue to rise (Fig. 1).

Fig. 1 River-water contaminated with soil eroded from the upland catchment: Lake Malawi (Photo: courtesy of T. R. Jackson)

Three errors are commonly made in discussions about how best to address the problem of soil erosion. First, it is unhelpful to conceive of erosion using statements such as: "*the war against erosion*", as if "*erosion*" is an invisible force in its own right. In reality, erosion is an ecological consequence – not a primary cause – of soil damage. Second, it is similarly unhelpful to state that the three main causes of erosion are "*deforestation, overgrazing and excessive cultivation*" (even though they are certainly contributing factors). Many governments have legislated against these supposed causes, though with little success in diminishing the erosion problem, because neither the reasons for the occurrence of runoff and erosion, nor the most-appropriate means of minimizing them, are widely-enough appreciated. The underlying cause of erosion by water is the force of water's downwards impact (of rainfall and/or irrigation) interacting with a somewhat fragile soil matrix whose aggregate-stability and -structure have been disrupted and whose absorptive capacity has been diminished, resulting in "avoidable" runoff and soil erosion. A third common fault is the failure to anticipate the possibility and nature of future problems, and only to react, if at all, after they have arisen. From this, it may be stated that soil erosion is not necessarily an automatic consequence of using land for agriculture.