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Adding a soil fertility dimension to the global farming systems approach, with cases from Africa

E.M.A. Smaling [a,b,*], J. Dixon [c]

[a] International Institute for Geo-Information Science and Earth Observation (ITC), P.O. Box 6, 7500 AA Enschede, Netherlands
[b] Plant Production Systems, Wageningen University, P.O. Box 430, 6700 AK Wageningen, Netherlands
[c] International Maize and Wheat Improvement Centre (CIMMYT), Apdo Postal 6-641, Mexico 06600, D.F., Mexico

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Abstract

The global farming systems (GFS) approach is extended by adding a soil fertility and nutrient management dimension for Africa's forest-based, maize mixed, cereal–root crop mixed, and agro-pastoral millet/sorghum farming systems. Use is made of sustainable livelihood concepts, translated into farmer capitals (natural, physical, financial, human, social), and the indicator-based DPSIR (driving force-pressure-state-impact-response) framework for environmental reporting. State and impact indicators show, for each GFS, levels of nutrient stocks and flows, respectively. In case of nutrient depletion, soils may (i) initially still be fertile enough to provide reasonable and stable yields, (ii) support declining yields, or (iii) support low yields at low fertility level. In the latter case, food security is generally at stake. Response indicators include the level of uptake of improved integrated nutrient management strategies at land user level, and the enforcement of new and enabling pro-agriculture and pro-environment policies. Although the extended GFS have no direct relevance for farm-level interventions, the approach can be used to frame soil fertility research priorities and policies at a regional level.
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Keywords: Soil fertility; Nutrient stocks; Nutrient flows; Integrated nutrient management; Farming systems; Indicators; Sub-Saharan Africa

1. Introduction

Characterizing and mapping farming systems at a global level seems an almost impossible thing to do, given the large spatial variability of land use that is found in many parts of the world. Dixon et al. (2001) nevertheless made such an attempt with their framework of global farming systems (GFS) in which 72 GFS across six developing regions, including 15 GFS in Sub-Saharan Africa (SSA), were characterized and, for the most part, spatially delineated. The four GFS discussed in this article are shown in Fig. 1. The future of agriculture in developing countries depends, in the view of Dixon et al. (2001), on five key drivers that influence the evolution of farming systems. Two drivers are partly embedded in farm-household systems: the natural resource base comprising land, water and climate, and the uptake of products generated by science and technologies. Three further drivers are largely exogenous to the farm-households and agricultural communities, viz.: trade liberalization and market development; enabling policies supporting institutions and public goods; and, information and educational services. The first two drivers determine, from a bio-physical viewpoint, the set of possible farming systems in a particular area. The last three drivers influence the actual choice of farming systems in the medium term. The characterization of GFS further incorporates the main elements of the sustainable livelihood approach, including the five ''capitals'' shown in Fig. 2 (natural, physical, human, social and financial; after Bebbington, 1999).

The GFS framework has been utilized in a variety of global analyses, including the analysis of 'bright spots' in African agriculture (Noble et al., 2004), and the identification of strategies for science and technology in Africa (InterAcademy Council, 2004). The approach has also been incorporated in applications at regional level, e.g., West

* Corresponding author.
E-mail address: smaling@itc.nl (E.M.A. Smaling).

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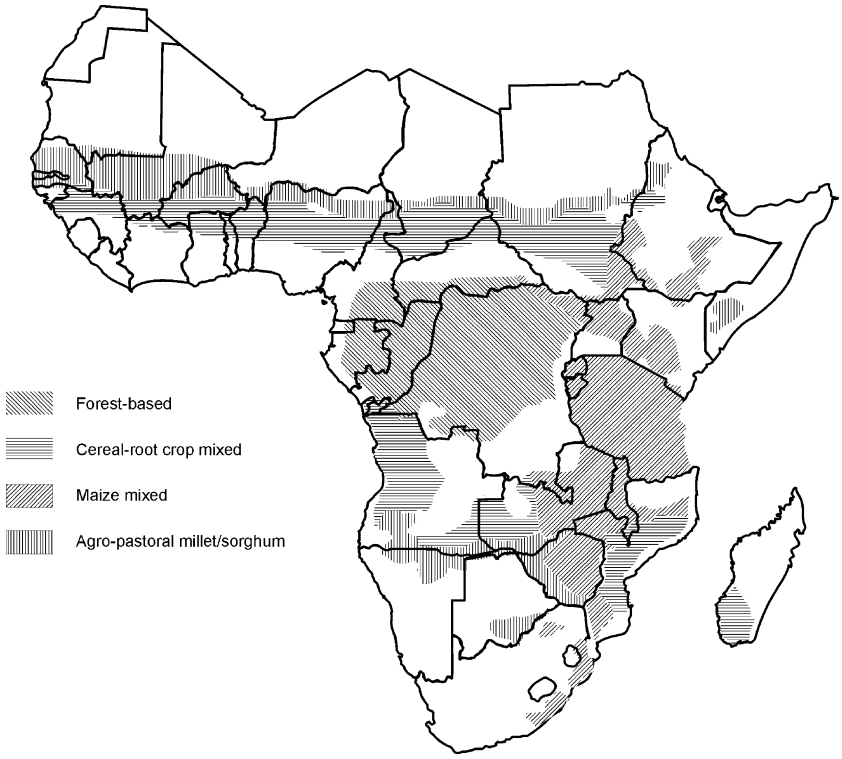

Fig. 1. Global farming systems in Sub-Saharan Africa addressed in this article (after Dixon et al., 2001).

African ruminant livestock systems (Fernandez-Rivera et al., 2004) and at national level, e.g., the Syrian agricultural policy analysis domains.

Given the key role of soil fertility and its management in African farming systems and the fact that GFS are not directly based on differences in soil productivity, this paper explores whether a meaningful extension of the GFS can be realized by adding current knowledge on soil fertility and nutrient management. Although the global and regional scale of GFS is not relevant for devising practical local interventions, it may help to frame regional analyses of strategies and policies aimed at soil fertility improvement, preventing and arresting soil fertility decline, fertilizer production and distribution, affordable nutrient management technologies, and targeted and impact-oriented soil fertility research. The appraisal focuses on four GFS that cover large

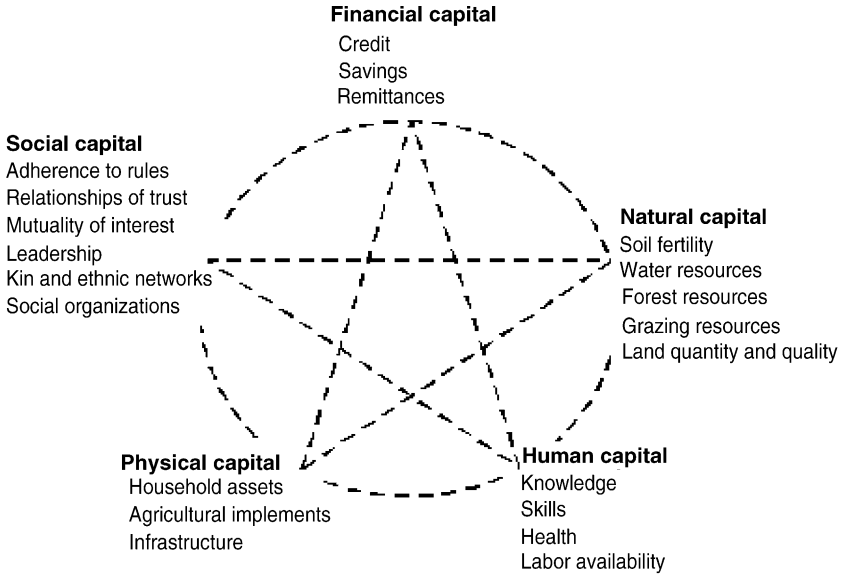

Fig. 2. The five capital assets (modified from Bebbington, 1999).

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