Policy modelling of the trade-off between agricultural development and land degradation—the Sudan case

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Abstract

The agricultural policy model of the trade-off between agricultural growth and land degradation that we have developed, with Sudan as an application, shares common features with the computable general equilibrium (CGE) models. The model is used to address two questions. First, what are the future prospects of a green gross domestic product (GDP), are there reasons for alarm or not, and to what extent? Secondly, which among the four policies of price incentives, property rights, poverty reduction, and human capital are more effective than the others? We show that the prospects of natural resource-friendly agricultural development in Sudan—a rising green GDP—are not promising in the medium run, but that, indeed, there is a range of effective policies and choices that could reduce the trade-off between economic growth and land degradation. © 2001 Society for Policy Modeling. Published by Elsevier Science Inc.

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1. Introduction

Land degradation, deforestation, and desertification can seriously reduce the productivity of land, and thereby jeopardize economic growth. The interdependence between natural resource use and sustainable development is nowhere more obvious than in developing countries where the overwhelming majority of people are engaged in economic activities that are tied to land, such as agriculture, forestry, and animal husbandry.

Four adverse relationships are commonly acknowledged. First, lack of well-defined private property rights over natural resources lead to overexploitation and degradation of these resources. Second, farmgate prices in most developing countries are far below their world market levels, this discourages farmers' incentives for soil conservation and encourages soil depletion. Third, inaccessibility of poor farmers in developing countries to modern technical knowledge and information leads to misuse of natural resources. Fourth, pressurised by their poverty, poor people adopt short-term survival strategies, overuse land resources, and, therefore, give environmental protection a low priority.

Sudan is a typical country in which the four above-mentioned factors apply and adversely affect the use of land resources (cf. Pearce, Barbier, & Markandya 1990). For example, land tenure insecurity has pushed farmers in mechanised agriculture to "mine" arable land in pursuit of short-run gains. Poverty in subsistence agriculture has compelled farmers to exploit arable land unsustainably. In addition to land tenure insecurity and poverty, the low level of farmers' education and training leads to overexploitation of arable land. In general, farmers' crop and soil husbandry knowledge has far-reaching effects for the sustainable exploitation of arable land. Furthermore, price controls imposed by the government on irrigated agriculture have discouraged farmers from adoption of long-term sustainable cultivation practices. In forestry, open access to woodland is a major cause behind the excessive clearance of forestland. Besides, lack of well-defined property rights over grazing land has left no incentives for livestock owners to invest in improving the prevailing conditions in grazing land. In spite of these negative developments, it has not been established for Sudan, nor for that matter other badly affected developing countries, whether the agricultural growth net of land degradation is positive or negative. In other words, if the notion of green GDP can be quantified, it is important to establish whether this green GDP is on the increase or the decrease.

This paper focuses on modelling the trade-off between agricultural growth and land depletion. We take Sudan as a case study, a country very rich and diverse in land potential but equally so with ecological risks. One concern will be to establish quantitatively the future prospects of the green GDP, are there reasons for alarm or not, and to what extent? The other concern is to formulate a framework that can be applied to the appraisal of alternative policies of reducing the trade-off. Which policies are more effective than others? We shall show that