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# Economic assessment of technological change and land degradation in agriculture: application to the Sri Lanka tea sector

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**Abstract**

Productivity change is an important potential aspect of technological change, so that productivity measurement plays a crucial role in assessing the effects of technological change in agriculture. This study contributes to an understanding of total factor productivity change by assessing the extent and nature of such change for the Sri Lankan tea industry over the period 1960–1995. The total factor productivity measures are then used to define a conceptually sound measure of the production cost of land degradation, providing insight into the scarcity of soil in the tea sector. Based on the theoretical relationship of the impact of technological progress and land degradation on tea production, a regression model is fitted to decompose the total factor productivity variable. Technological change, when the study period as a whole is considered, produced cost savings, rather than output increases. Tea output levels have been maintained, despite significant decreases in total inputs. On the basis of available data and the chosen model, it could be concluded that the positive impact of technological progress has outweighed the negative effect of land degradation in Sri Lanka's tea sector, over the study period. The study highlights the systems aspect of analysis into the productivity and land degradation issues in agriculture.


*Keywords:* Technical change; Total factor productivity; Soil erosion; Sri Lanka tea

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## 1. Introduction

Technological change, also known as technical change, refers to changes in techniques of a production process that come about both from research and development and from learning by doing. These changes in the production process can be realised in various ways at the business level: through improved methods of utilising existing resources such that a higher output rate per unit of input is obtained, often referred to as disembodied technological change; through changes in input quality, referred to as embodied technological change; or through the introduction of new processes and new inputs. Productivity change is an important aspect of technological change, so that productivity measurement plays a crucial role in assessing the effects of technological change in agriculture. Total factor productivity (TFP), the productivity of all purchased inputs, is the broadest measure of productivity, and is clearly the most useful approach to productivity measurement when the objective is to understand the effects of technological change (Norsworthy and Jang, 1992).

Soil erosion is perhaps the most serious form of land degradation throughout the world. Erosion, mass movement and solution act to remove material from a site, i.e. they are responsible for quantitative soil degradation (Kirkby and Morgan, 1980). These three processes are natural, worldwide components of soil erosion, and therefore, soil erosion is used as an inclusive term. All known forms of water-induced erosion have been reported to occur in the tropics (Hudson, 1971). These include geologic (natural), or accelerated erosion in such forms as sheet (inter-rill), rill, gully, tunnel, pedestal, pinnacle, puddle, vertical, streambank, valley trenching, and landslides. Most authors agree, however, that from the agricultural viewpoint insidious rill and inter-rill erosion represent the most sustained, though perhaps least spectacular damage, in comparison with such forms as gully or landslide formations (FAO, 1977).

Although there is substantial research on land degradation, mainly soil erosion (Rozelle et al., 1997; Scherr, 1999; Shiferaw and Holden, 1999, 2001), there is a lack of information, which links those physical measures of land degradation to productivity losses. As Kirby and Blyth (1987) and more recently Alfsen et al. (1996) have pointed out, the physical existence of land degradation is not necessarily evidence of an economic or social problem. An economic assessment requires measurement of the effects of particular forms of land degradation on productivity and the associated costs and benefits of treatment. Therefore, it would be of considerable policy interest to find an economic value for this problem by quantifying the impact of land degradation on agricultural production. Land degradation is hypothesised as causing a downwards shift in the aggregate production function, and hence may be viewed as a negative technological development. The TFP measures constructed in the determination of technological change are then used to define a conceptually sound measure of the production cost of land degradation. Such an analysis is expected to reveal the extent to which soil is a constraint (soil scarcity) on the production aspirations in agriculture. It would also help detect whether degradation is accelerating or stable within a farming system. This information would be of considerable value to the public authorities involved in directing