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"Filling gaps and removing traps
for sustainable resource management"

Modelling Crop Diversification Strategies for Sustainable Intensification in Dryland Cropping System of Semi-Arid Southern India

Ranganath Lakshmaiah, Ernst-August Nuppenau, Stephanie Domptail

Justus-Liebig University Giessen, Inst. of Agric. Policy and Market Res., Germany

Abstract

Agriculture intensification in dryland cropping systems has relied upon adoption of crops with high yielding varieties and external chemical fertilisers. This intensification further coupled with declining land size has led to increase in monocropping and has completely disregarded potential of crop diversification as soil fertility management strategy. Legume-based crop diversification with appropriate input management strategy have proven to increase the productivity of the soil based on long-run field level experiments. However, in short-run, farmer adopting a legume-based rotation must forgo returns from relatively high remunerative cereal crop for less remunerative legume crop. Any recommended crop diversification strategy must inform farmer on this trade-off in short-run and appropriate input management strategies in cropping system for sustainable long-run benefit. In this study, we model adoption of legume based cropping patterns as a part of field level sustainable intensification strategy for dryland agriculture from economic point in semi-arid region of southern India. Sustainable intensification of dryland cropping systems is defined as efficient allocation of external inputs (non-renewable resources) and temporal choice (long-run) of crops over finite period for given output, factor prices and crop yield levels.

A plot level data of 838 dryland plots collected from 198 family households for the year 2013–14 and 2014–15 is used for analysis. Maize, finger millet and groundnut are major crop in the region that are grown individually as monocrop or two crop rotation (finger millet and groundnut) or three crop rotation (finger millet, maize and groundnut). Optimal input allocation strategy is evaluated using yield response function and alternative input management strategies (with only high fertiliser, fertiliser and organic matter and low chemical fertiliser) observed at field level for each crop in five different crop patterns. Grid point approximation technique is used obtain optimal input. Finally, long term optimal cropping pattern is evaluated using dynamic linear programming technique by imposing different level of yield penalty for monocropping based on long term field experiments results. This model further adds value to experimental station results by identifying possible ways to achieve sustainable intensification through optimal choice of cropping pattern and input management strategies at farmers' field.

Keywords: Cropping system, soil fertility management, sustainable intensification

Contact Address: Ranganath Lakshmaiah, Justus-Liebig Universität Gießen, Inst. for Agricultural Policy and Market Research, unterhof, 35392 Gießen, Germany, e-mail: ranga.laki@gmail.com