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**Frame Conditions for a More Sustainable Pesticide Use: Evidence  
from Smallholding Potato Producers in Boyacá, Colombia**

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**Abstract**

Environmental, economic and health effects deriving from pesticide overuse are considered among the most relevant threats to agricultural sustainability and understanding farmers' pesticide use is fundamental in fostering a transition towards more sustainable agricultural practices.

The present paper addresses the issue of pesticide overuse and its determinants among smallholder potato producers in four communities in the Department of Boyacá, Colombia. Firstly, pesticide use is analysed to determine which farmers are overusing crop protection products and to what extent. In doing so, a measure of overdosage and one of efficiency estimated through a damage abatement function approach are compared. Secondly, the factors affecting farmers' behaviour are investigated through a multinomial regression approach, based on the integrated agent-centred (IAC) framework.

The analysis shows that relevant differences existed between and within the four communities and that these also depend on the product considered (i.e. fungicide or insecticide). Moreover, while the two definitions of overuse tended to converge, inefficiency has to be preferred to overdosage, because it better represents farmers' crop protection strategies.

The analysis also shows that external conditions tended to prevail over internal factors in influencing farmers' decisions. Technical aspects (the area of the parcel), training and educational level, membership in a cooperative and income level were among the most influential aspects for determining farmer level of efficiency.

Finally, the analysis suggests that frame conditions for a more sustainable pesticide use are not static. Instead, feedback processes exist in the agricultural system between the environmental and social subsystems (*i.e.* farmers' adaptive behaviour to perceived pest resistance) and between the micro and macro level (*i.e.* farmers' conformity to the social norm). Such feedback processes need to be addressed extensively both at conceptual and methodological level (*e.g.* IAC framework and simulation modelling respectively), in order to support a transition towards more sustainable agricultural practices.

**Keywords:** Colombia, determinants, efficiency, farmer feedbacks, integrated agent-centred framework, pesticide use, transition towards sustainability