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Comment on Laxminarayan and Simpson: Biological limits on agricultural intensification: an example from resistance management

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This article is centred on evaluating the effects of an innovation in the agricultural sector, such as the biotech wave, which is increasing crop yields but, at the same time, requires sustainable management practices. In particular, it highlights the role of 'refuge areas' and the environmental effects of the likely long-term effect of pest resistance to the newly introduced tolerant crops. Results provide useful insight into the factors influencing the optimal resistance-management strategy and show the implication on the distribution of land between agricultural and natural areas in the steady state.

As the authors underline, the results of the study should be carefully interpreted: the developed model is relatively simple and some of the assumptions could be restrictive. Hence, the questions arising to the reader are related to the possible generalization of results. What are the implications of relaxing some of the assumptions? How could the model be extended and made more realistic without losing in tractability? Which of the presented results would reasonably hold under different modelling frameworks?

The answers to the above questions are certainly not simple and the effort made by the authors to qualify the different assumptions and evaluate alternative possibilities in some cases should be underlined; in particular, the focus on the specification of the 'additive' form of the yield function, of the pest population dynamics and of the utility function of the social planner.

However, other assumptions seem important. In particular, the model assumes a "high degree of mobility among pests" that implies a random mating between resistant and susceptible pests. These features are typical of pests such as insects, but are far removed from the characteristics of weeds. If the scope of the work is to cover the evaluation of the effects of biotech innovation in general, then weed control and their resistance management should also be introduced into the framework. This is probably not a trivial task given the peculiarities of weed populations: the assumption of 'proportional' yield function seems more realistic for weeds than the 'additive' form (Mitchell 2001), population dynamics are different and the management of refuge areas is probably not effective for controlling weed resistance as compared, for example, to crop rotation. All of the above points would substantially change the set-up of the presented model with likely important implications on its results. Unfortunately, there is a substantial lack of information on weed-resistance management as compared to that of insects. Few studies in the literature have focused on the topic: some examples, even if from the sole farmer's perspective, are Schmidt and Pannell (1996) and Gorddard, Pannell and Hertzler (1995).

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The inclusion of weed-resistance management would be an interesting direction for further research that could help in providing a more complete view of the global effect of the biotech innovation.

References

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