

Economic valuation of the potential impact of insect pollinator decline on world agriculture



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Introduction

The consequences of biodiversity decline on the ecosystems become increasingly clear¹. At the same time, the positive value of ecosystem services on the human activities start to be recognized and even valued in economic terms². A review of world crop production for human food found that fruit, vegetable or seed production from 87 of the leading global food crops is dependent upon insect pollination while that of 28 is not³. The pollination of entomophilous crops thus constitutes an important economic service, but it is clearly at risk⁴. Within the framework of ALARM (Assessing LARge-scale environmental Risks with tested Methods; <http://www.alarmproject.net>) one of the goals is to value in monetary terms the potential impact of pollinator decline on the welfare of European consumers with a dynamic approach.

The study will be divided in 3 parts: (1) a economic valuation of the potential impact of the decline (2) a static modeling of this impact on consumer welfare (3) a dynamic modeling.

In the first part of this project, we valued the economic impact of insect-mediated pollination.



Figure 1 – Some example of insect pollinators, left to right (3 bees & 1 syrphid fly): *Megachile* sp., *Bombus* sp., *Apis mellifera* L. & *Volucella* sp. (© Mouret, © Morison)

Materials and Methods

➤ **Production data y** - for 2005 we selected all crops used for human foods on the FAO database⁵.

➤ **Dependency coefficient c** - quantifies the level of dependency of crop production in regards to animal pollination. This level varies with crop species and even among varieties within species, as well as with climate and production system (open field vs greenhouses). We use an average coefficient based on the minimum d_{max} values reported in Klein *et al.* (2006).

➤ **Producer prices p** - We calculated producer prices in each of 5 world regions taking into account the effects of specialization, geographical location and socio-economic context.

➤ After the economic valuation, we made a ranking of crop values v'_i . We chose the leading crops that amounted to 99% of the total world crop value. All crops of this list were then classified following their level of dependency on insect pollination. The value of crops impacted by insect pollinators was calculated as :

$$V' = \sum_{i=1}^n (\text{crops not impacted})$$

➤ The list of crops that produce fruits or seeds for direct human use come from the appendix 2 of the review of Klein and al. (2006). It is calculated the v'_i of each crop.

Formula

$$v_i = p_i * y_i * c_p$$

$$v'_i = p_i * y_i$$

Where v_i , the economic impact of animal pollination for crop i ,
 v'_i , the value of crop i ,

p_i , the price paid to the producer per metric ton,

y_i , production (metric ton)

c_i , the level of dependence on insect pollination for crop i

$$V = \sum_{i=1}^n N(v_i)$$

$$V' = \sum_{i=1}^n N(v'_i)$$

Where V , the economic impact of animal pollination,

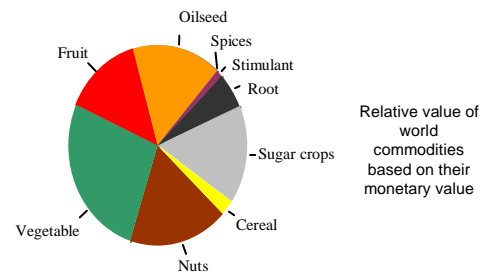
V' , the total world crop value.

Results

Impact of pollinators on world crops

➤ The total value of crops used for human food V' is 1.68 trillion euros and 10 of the 20 most important crops worldwide from an economic standpoint depend to some extent on insect pollinators (9 of them are directly dependent on insects for their production)

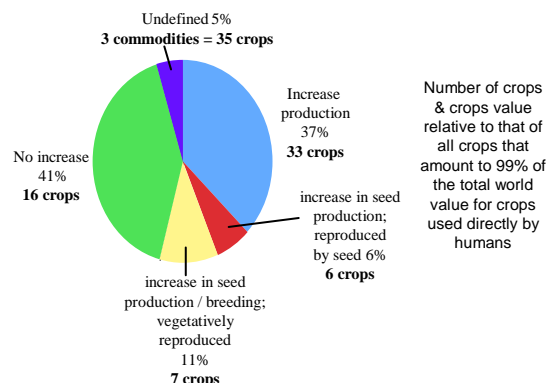
➤ Based on the crops that amount to 99% of the total world crop value, 54% of this value rest upon crops that depend on insect pollinators. Among these, vegetables, oilseed crops and fruits are the most important crops that are dependent of pollinators.



Relative value of world commodities based on their monetary value

Potential economic impact for global crops directly consumed by humans

➤ The economic impact of insect pollination on a worldwide basis, V , amounted to 149 billion euros, or 21.3% of the total value of the crops that produce fruits or seeds for direct human use.



Number of crops & crops value relative to that of all crops that amount to 99% of the total world value for crops used directly by humans

Discussion and Perspective

➤ These results demonstrate the potential impact of insect pollinators on world economic growth as well as development and sustainability of agriculture.

➤ Many crops depend on pollinators. A significant decline will likely translate in decreased crop production.

➤ For many crops, we still lack a precise coefficient of dependency of their production on insect pollinators. So more empirical work is needed to determine these values.

➤ This is a static approach. We will further study this impact with a dynamic model in which we will value the welfare of states composed of consumer welfare and producer welfare, both of which are likely to be influenced by the decline of insect pollinators.

Bibliography

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⁵<http://faostat.fao.org>