



**Biodiversity and Food Security – From Trade-offs to Synergies**

3rd International Conference on Biodiversity and the UN Millennium Development Goals -  
October 29-31, 2014, Aix-en-Provence, France

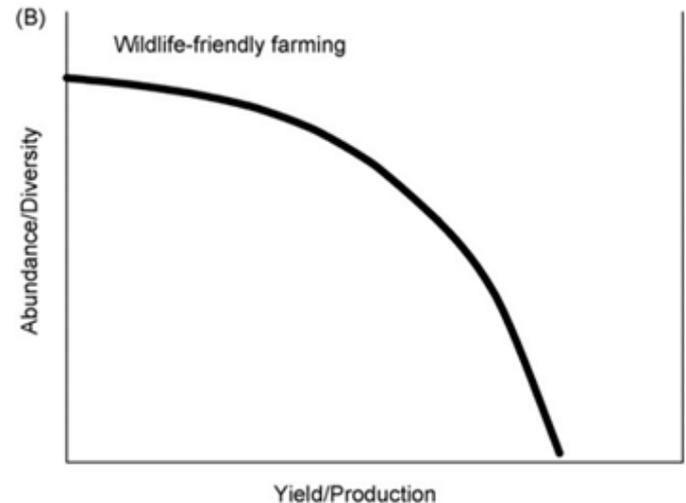
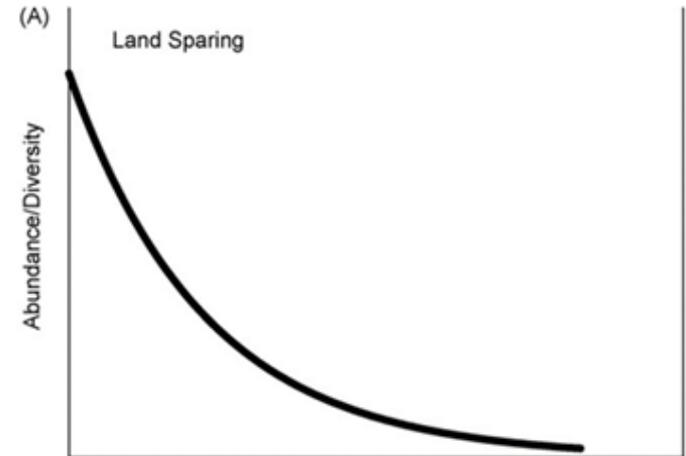
Land sparing vs land sharing:  
where do we stand?  
An economist perspective

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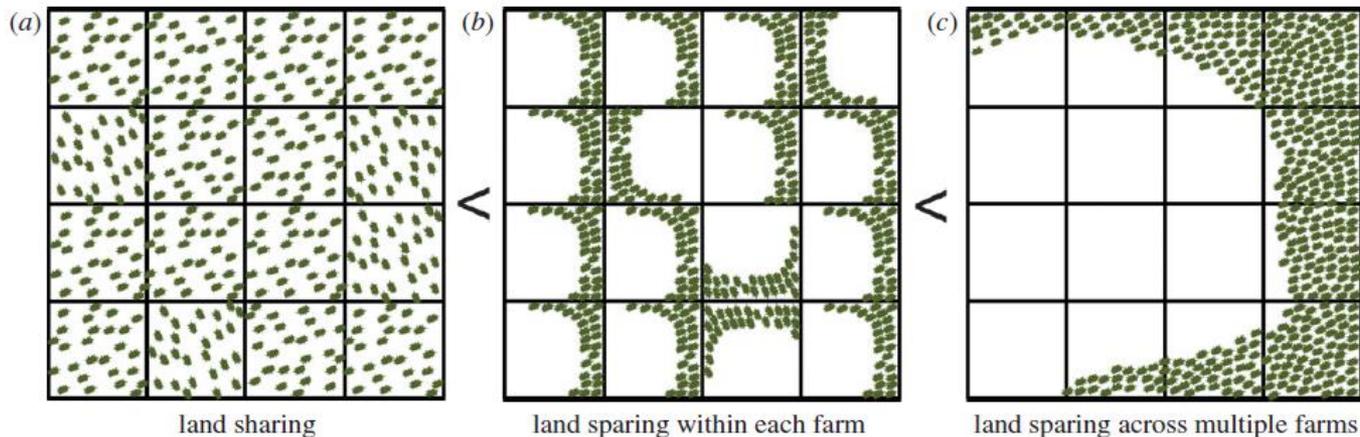
# The "land sparing" vs "land sharing" debate

- Waggoner (1996) introduced the idea of « *land sparing* » from agriculture for biodiversity conservation
- Green et al (2005) have set up the debate « land sparing vs wildlife-friendly farming » (wildlife-friendly farming = land sharing)
- The **focus is on the ecological response of biodiversity** to agricultural intensity
- A number of paper conclude that increased efficiency and intensification of agricultural production have the potential to help biodiversity conservation by sparing land from production (Tilman et al, 2002; Green et al, 2005; Balmford et al, 2005)
- They may concern either developing or industrialized countries



# The "land sparing" vs "land sharing" debate

| Land sparing   | Land sharing  |
|--|---|
| <p>Production and conservation on distinct area</p> <p>Production intensification</p> <p>Less land allocated to production</p> <p>More inputs to agricultural production</p> <p>Monocropping</p> | <p>Conservation in agricultural area</p> <p>Agricultural production benefits from ecological systems</p> <p>More land allocated to agriculture</p> <p>Less inputs (self-sustained agriculture)</p> <p>Diverse or associated crops</p> |



Source: Balmford et al., RSBS, 2012

# Some key points of the debate

- Nobody believes it is possible to have a universal solution
- Local parameters such as topography, type of soils, climate may strongly influence the best local solution
  - Perfecto-Vandermeer (PNAS, 2010) suggested an approach in terms of an *agro-ecological matrix* incorporating ecological process
- Land productivity ( $\neq$  labor productivity) will impact the relative performance of the two approaches
  - “Can organic farming feed the world ?” is still an active debate (Badgley et al, 2007; Seufert et al., 2012); strongly related to the land sparing/land sharing issue
- Dominant paradigm and social preferences
  - The green revolution has promoted a high input model of agriculture that appeared appropriate to the world hunger issue (Borlaug, 2000)
  - Preferences for organic agriculture in rich countries are not only based on a tradeoff between production and conservation

# What is the meaning of an economist perspective

- A central point is to consider observed or expected evolutions as the result of choices made by agents following some kind of rationality (although the metaphor of an omniscient and well-intentioned central planner is sometimes used as a baseline)
- The changes at the landscape scale are the result of choices made by a set of individuals (farmers, policy-makers, agroindustry, final consumers...)
  - Assumptions must be made about their individual rationality
  - Assumptions must be made about their interaction (competitive market, monopoles, externalities...)
- It is difficult to characterize « needs » in absolute terms :
  - Example : Balmford, A., Green, R., & Scharlemann, J. P. (2005). Sparing land for nature: exploring the potential impact of changes in agricultural yield on **the area needed for crop production**. *Global Change Biology*, 11(10), 1594-1605.
  - In an economic perspective, land allocation will depend on several variable such as relative prices of crops, labor productivity, local opportunity cost of time, etc.
  - If agriculture produces more efficiently, the prices will decrease and the demand may rise (agricultural production is not just about human food, but also animal feed, biofuels, industrial raw material...)

## Some economics of the food vs biodiversity debate (cont'd)

- Question: considering that land allocation results from rational choices, what would be the best situation according to various policy options
- Classical assumptions (Martinet, 2013):
  - heterogeneous land and decreasing productivity of agriculture with respect to land use (Ricardian hypothesis that best land is put into cultivation first),
  - private ownership of land which implies a decentralized optimization problem on the definition of land use and agricultural intensity,
  - decreasing returns to scale in the agricultural sector.
- Results :
  - wild-life friendly farming, when it is a desirable option, should not become a norm for all agricultural production,
  - when production increases, it may be efficient, in terms of biodiversity preservation, to intensify agricultural production on the best quality land, instead of extending the area of less productive wild-life friendly farming on lower quality land.

# Some economics of the food vs biodiversity debate

- Policy option:
  - Policy instruments can be implemented in order to balance the social benefits of natural reserves, intensive agriculture on high quality land and wild-life friendly farming on lower quality land.
  - Typically, these instruments (policy mix) may combine taxes on inputs and public subsidies to natural reserves.
- Results:
  - An improvement of social welfare can be reached
  - It is not possible to define a public policy that is both market-neutral (i.e., that does not modify the food production when modifying the land use) and budget-balanced (i.e., for which the revenues from intensity taxation offset the cost of natural reserves subsidies).
  - Further arguments emphasizes that it is not necessarily sensible, in an economic perspective, to set the debate in terms of food versus biodiversity. In a welfare economics perspective, the trade-offs are between biodiversity production and agricultural profit ,if one considers a local scale conservation problem, or between food, biodiversity and the rest of the economy if one considers the global conservation issue.

# Land sharing vs. land sparing for biodiversity: How agricultural markets make the difference

- Desquilbet et al (2014) have introduced more explicitly the effect of agricultural markets by adding price as an adjustment mechanism between agricultural supply and demand
- They questioned the implicit assumption that in the two production systems the market equilibrium will reach the same production target
- In their model, prices and production levels are endogenous outcome of the supply and demand equilibrium
- The effect on global welfare then depends on the relative weights linked to producer and consumer surplus on the one hand, and to better biodiversity conservation in the short and medium term on the other
- They find that, even with a convex relation between biodiversity and yield, extensive farming may increase biodiversity compared with intensive farming. The lower efficiency of extensive farming leads to a higher market price, and a lower demand and a lower production output than with intensive farming.
- Consequently, land used for production either increases less than if the level of production was kept constant, or even decreases in some situations. And, shifting to extensive farming appears favorable to biodiversity in more cases

## Land sharing vs. land sparing for biodiversity: How agricultural markets make the difference (cont'd)

- However, this shift to extensive farming has a negative effects on the sum of producer and consumer surplus, with consumer surplus necessarily decreasing, while producer surplus may either increase or decrease.
- It must be reminded that agricultural production is not limited to food production, but also to animal feed, biofuels, etc. It can then be assumed (they briefly study the point) that the main effects are not related to the price of food - which would increase food insecurity - but on less essential and therefore less valued crops.
- A point which is not analyzed here, is the assumption that a land sharing strategy will imply more agricultural work, and then more agricultural jobs.
- Any serious analysis should of course consider the fact that the job gains in agricultural production could be partially or completely offset by losses due to spillover effects on other sectors
- But it remains an important question, because we know that food security depends less now on global food production than on the capacity of the poors, particularly in rural areas, to get the income needed to gain access to food.

# Some (premature) concluding remarks

- The “land sparing vs. land sharing” debate is essentially a new way to think about the future of agricultural and conservation policies (as well as “ecosystem services” is a new way...)
- The economic perspective may help us to better analyze the societies or various social groups act or will react to new context, namely new policy framework.
- There is no reasonable reason to imagine that economic approaches might forget to rely on the best works of ecologists and agronomists
- But the purpose of this discussion is not only to understand, assess or value, but to invent and justify the effective actions and policies to improve food security in an heterogeneous world





Thank you for your attention

