



# Doing the Sum Right or the Right Sums? Techno-Optimist Numbers in Food Security Scenarios

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In a paper recently published on the journal *Food Ethics* (Saltelli and Lo Piano, 2017), we take issue with a scenario for the future of agriculture recently published. The scenario we target, which is not uncommon in present discourse on food security, assumes that improving in agricultural techniques and adopting better dietary styles will lead to producing more food in less land, as to feed 10 billion people in 2050. While the proposed scenario—and its quantitative estimates—may be useful to initiate a debate on the important issue of food security, it also poses the risk of anchoring the discussion to a pre-defined narrative.

The scenario frames the world as suffering from conjoint obesity and hunger because of the food production system. We suggest an alternative framing of the problem based on global inequalities between haves and have nots.

The scenario—which we take as exemplifying techno-optimism in agricultural studies, foresees for the year 2050 a total of 438 million hectares less land than at present, as to feed a planetary population of 10 billion.

Big data analytics as applied to farming systems, and the adoption of better diets are the factors behind this result, which is based on the world agriculture having reduced the production of cereals, starches, oils, fats, and sugars—as responsible *inter alia* of common diseases such as obesity and diabetes—and having increased that of fruit and vegetables. The improvement is achieved thanks to a policy mix including consumer education, better food literacy and cooking skills, taxing unhealthy food, limiting both the use of antibiotics and greenhouse gas emission in agriculture, reducing the US corn subsidy, and better storage facilities in developing countries. This last appears to be the only measure targeting the global South. These elements are typical of the type of quantifications we wish to criticize; here our doubts:

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## HOW CAN THE IMPROVEMENT IN FOOD PRODUCTION IN 2050 BE “438 MILLION HECTARES,” WITH THREE SIGNIFICANT DIGITS?

Crop yields per hectare are typically not known with three digits accuracy, especially at the global level. Taking only into account to the FAOSTAT figures for the agricultural land worldwide (Food and Agriculture Organisation of the United Nations, 2017), it is probable that the overall uncertainty on the global cultivated land in the year 2015 alone outpaces the land use reduction claimed by the scenario for 2050. A one-digit precision would be more realistic for this quantification.

## IS MORE FOOD PER CAPITA AVAILABLE IN 2050?

Our own analysis reveals that a 9% reduction in land use, a 1% yearly improvement in production between now and 2050, and a population of 10 billion at that point in time balance out to give in 2050 the same amount of food per capita in 2050 as today.

## CAN AGRICULTURE GROW ON AVERAGE BY 1% BETWEEN NOW AND 2050?

While this is possible—faith in technology is an important ingredient of the works we criticize—the principle of diminishing return could be at play here. Historical trends show higher uses of, e.g., fertilizers just to keep the same output level (Byerlee, 1992). Additionally, will precision agriculture be able to ensure that increased output is not associated with increased stress of soils? What would the consequences be on the labor force in agriculture in developing country when adopting these practices?

## HOW ABOUT ADOPTING LOW-INPUT AGRICULTURE?

Even neglecting the gap in yields with industrial capital-intensive agriculture, low-input agriculture requires far more labor to replace the lack of external inputs (Pimentel, 2012). This would imply a global agricultural system where the workforce will be totally devoted to food production with almost no room for the industrial and service sector, let alone the compression of free time available for leisure activities. We doubt that high-income and mid-high-income countries would willingly accept this.

## WILL PEOPLE DESIRE TO ADOPT A LESS CEREAL- AND MEAT-BASED DIET?

We know that in 2050 there will be a higher share of adults given the forecasted reduction in natality, and adults need more calories than children. We also note that existing literature point to an increasing consumption of meat in developing countries (Smil, 2013).

## WHAT EFFECT CAN WE EXPECT FROM BETTER LEGISLATION AND EDUCATION?

The scenario which is the object of our critique presents smoking as an example of how a combination of better policy and education may lead to better habits. We note that while smoking decreases in developed countries, it increases in many populous developing ones. These same countries have additionally weak regulatory systems, less capable to contrast food lobbies, so that the desired end could only be achieved in case of improved global governance.

## CONCLUSION

Additional technical problems are discussed in our study (Saltelli and Lo Piano, 2017). Our objections can be summarized by noting that the scenario has arbitrarily framed the issue of food security as one, where food production is unbalanced and unhealthy, and

too much land is being used. Thus, the scenario offers a solution based on better diets and precision agriculture.

We submit that a better framing should consider global unbalances and injustices and that applying to the issue a developed world perspective of techno-optimism is possibly unethical. We perceive here the substitution of a political problem (power asymmetries) with a technical one (a mismatch between what the world needs for everyone to enjoy a nutritious diet and what the world is actually producing). Asymmetries in the political power of trade patterns are exactly at the root of the issue of diet quality in several areas of the world, a phenomenon that has been recently named caloric unequal exchange (Falconí et al., 2017) whereby although the export of Latin America and the Caribbean to the rest of the world are more expensive than those imported, the ratio of the two is decreasing with time, with the global south subsidizing the diet of the global north.

These discussions are not new—though they are given new urgency by the ongoing discussion of food sustainability in the context of the 2030 Agenda (United Nations, 2016). Indeed, developing a global agricultural system capable of meeting food safety while attaining environmental, economic, and social sustainability is a complex challenge requiring political negotiation as well as models of extended participation involving practitioners, policy-makers, scientists, consumers, and citizens. Jerome R. Ravetz warned in 1971 (Ravetz, 1971) that science may be tempted to reframe practical and social problems as technical ones, forgiving the social context and the associated power relationships. The function of such technical explanations is to minimize the threat displayed by the problem, either by explaining it away, or by giving assurance of the possibility of its comfortable resolution.

Last but not least, we are convinced that the present trade patterns and economic consensus based of Ricardian economics and free trade—whereby the best option for a country exporting bananas is to stick to its competitive advantage by keeping exporting bananas—are in fact a recipe to keep the poor countries poor. Exchanging raw material against finished goods has never made countries rich (Reinert, 2007).

## AUTHOR CONTRIBUTIONS

AS had the research idea, worked on the manuscript elaboration and its final proofreading. SL contributed to the manuscript elaboration.

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