

Opinion: Agriculture Green Development

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Charles Dickens' novel *A Tale of Two Cities* begins with the words, "It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity." We live in the best of times and simultaneously we live in the worst of times—the best of times because, compared to the lives of our grandparents, we live in a paradise; it is the worst of times because we believe that this paradise can continue forever. The juxtaposition of wisdom and foolishness, opinion and belief versus reason defines our current moment in history.

We have become very good at stating and identifying the environmental problem(s) we face currently and in the future lives of our children and grandchildren. Planetary boundaries have become a popular way to conceptualize the stresses on the biosphere caused by the activities of human beings. Countless reports and papers have detailed every scientific nuance of the fact that humans are living beyond the ecological means of the planet. As such, statements of the problem are not guides to policy actions to reduce the pressures. This is because these boundaries are snapshot statements of the states of environmental problems. Reduction of the pressures by policy measures has to come about by regulating the rates of accumulation of greenhouse gases and other pollutants; rates of destruction of biodiversity and so on. This puts a focus on the kind of the science needed now and in the 21st century.

Our current paradise has been, and is still, based on the science of producing more, doing it more efficiently, consuming more and saving only a little. It has been phenomenally successful in its outputs and outcomes, creating vast wealth and comfort for many, if not all, people. At the same time, current mainstream economics pay almost zero attention to the environment. In fact, most economies depend for their existence on the production of waste to maintain the circulation of fiat methods of exchange, otherwise known as money. Such an economic engine permits governments to present deregulation of environmental laws and destruction of the environment as positive for growth, when in fact they mean short-term growth; long-term human welfare will be hurt by such an approach. Twenty-first century science and economics needs to ask the question of what does an alternative science of producing enough, consuming less and saving more look like for human welfare. Answering this question requires deep reflection, imagination and bravery to change the current science paradigm. However, society has and will always be changed most fundamentally by ideas, especially those that have science at their core. Reduction of pollutants and of dangerous levels of atmospheric gases that humans generate requires rates of reduction per unit of production or per unit area to be meaningful for policy. This is a necessary but insufficient means of limiting environmental damage, but adopting such an approach allows us to focus on reducing the rate of emissions. These rate reductions have to be about as large as the historical rates of accumulation for the absolute levels of pollutants to decline. This means rate reductions of about 4%–5% per year for the foreseeable future; current reductions are about 0.5% per year. In the context of food systems, introducing more circular, rather than linear food systems, and in which waste, consumption and perhaps production are also reduced. This leads not to the idea of more from less but rather to enough from less and would slow emissions and even reduce the global epidemic of obesity and overweight

Received December 3, 2019

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people and, thereby, improve human health—a human planetary boundary that is being rapidly exceeded. The latest (2019) special report from IPCC on land use and climate change concludes that GHG emissions from food are roughly equally divided between food production, food processing and food consumption. This clearly means that only focusing on the efficiency of the production of food will ignore more than 60% of the emissions associated with eating food (Fig. 1).

In 2015, John Ingram (University of Oxford, UK) and I published a commentary piece in *Nature Plants* in which we tried to link plant science to food security. Our essential points, shown in Fig. 1, were that food security does not simply mean lack of food, for which one solution is increased production, but another is better distribution of food and less food wastage. Food security also encompasses people who have excess calories but deficit nutrients and those who have adequate calories but inadequate nutrients. The FAO 1996 definition of food security refers to “all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life.” The definition refers to “food needs” and not “food excess”; it stresses “an active and healthy life”, which requires adequate but not excesses of calories and nutrients. The other essential feature of sustainable food security is the joint necessity of integrating the plant and socio-economic sciences. Food security is, of course, underpinned by the efficient production of food but is turned into an actuality via socioeconomic factors such as wealth, personal values, choices and access to food. It is difficult to identify cases in which this multidisciplinary need has been studied and less often achieved. Two points are worth making. The first is that these multidisciplinary sciences need to be based on the *meeting of disciplines* and not just superficial statements of opinions without evidence. The second point is that time is required to learn each others’ disciplinary language. My personal experience of working in a cross-disciplinary group has been recently at the University of Montpellier’s Advanced Research Institute in France. It took 3–4 months for a group comprising an agronomist, a climate scientist, a medical geneticist, a global specialist on sexually transmitted diseases, a veterinary scientist and a geographer to come to a joint understanding and an intellectual consensus about the production, health and environmental effects of circular, as opposed to linear, food systems. We had to move out of our scientific comfort

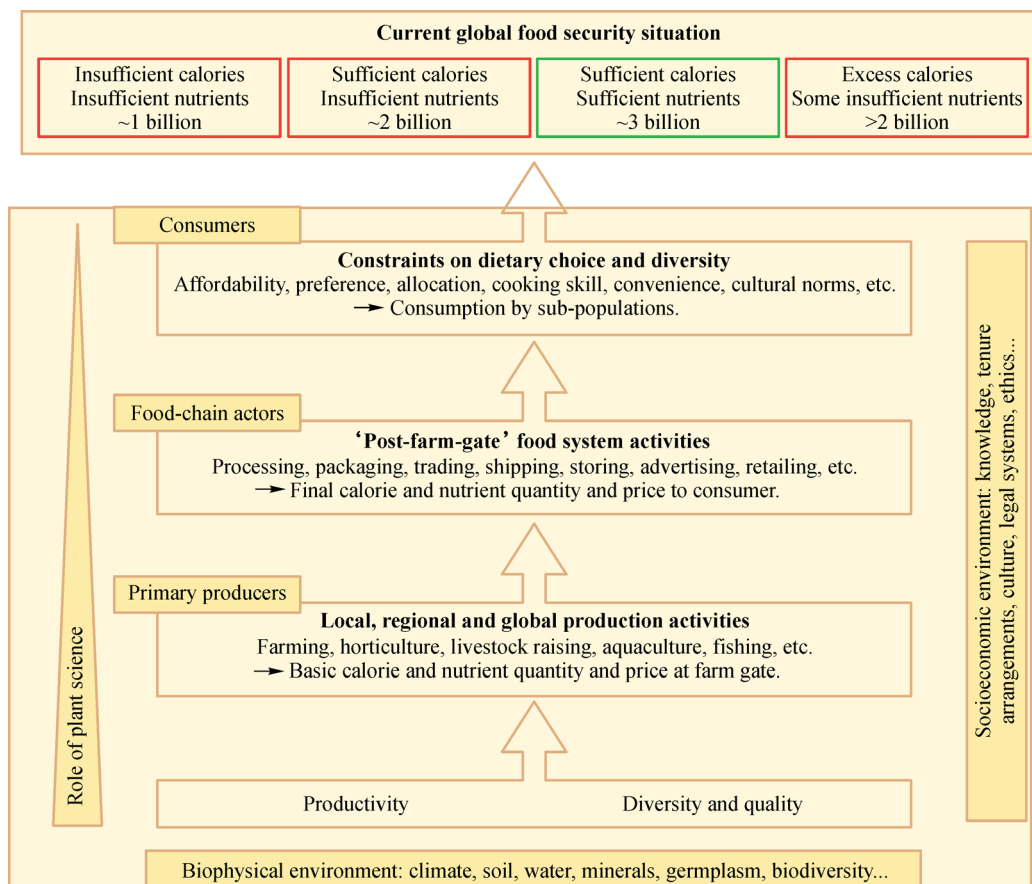


Fig. 1 The interactions between natural and socio-economic sciences in plant physiology^[1].

zones and really listen to and understand the very interesting science from the minds of all the colleagues in the group. This was initially a painful but, in the end, a rewarding process, which took a lot of effort, understanding and compromise. I suggest that development for simultaneously achieving food security, efficient use of resources and environment sustainability, linked to sustainable development goals as well as sustainable intensification for future agriculture development needs to take account of all the above issues and I encourage delegates to the conference on Agriculture Green Development to deal with these issues deeply.

Reference

1. Ingram J S I, Porter J R. Plant science and the food security agenda. *Nature Plants*, 2015, **1**(11): 15173