Avoiding Malthus 2.0: the links between human diets and health and climate outcomes in the world's macro-regions during the last 50 years

Introduction

Planet Earth's natural resources, such as land, freshwater, raw materials etc., have to be shared among an increasing number of people (and farm animals). Moreover, human life expectancy has continuously increased. Consequently, more people consume for longer, leading to fears whether there is enough for all of them, now and in particular in the future.

One particular concern is about human diets and their resource implications. Globally, agriculture accounts already for up to 40% of global land use, 70% of freshwater withdrawals and 30% of greenhouse gas emissions (FAO, 2017). The question is whether humankind can go on consuming food and drink as it currently does.

While food security fears have been with humans for their entire existence, the British scholar Thomas Malthus, at the turn of the 18th century, introduced the notion of the "population trap". Rapid population growth would eventually outstrip agricultural production thus leading to shortages of food supply and starvation. The much more recent concerns about food system sustainability add fears that current agricultural production practices damage environmental ecosystems and world climate, thus threatening the natural resource base of future generations. The current perception is that the very activity of food production that is meant to keep humans alive kills them eventually in the long run.

The definition of diet sustainability is complex since it comprises multiple criteria. However, dietary diversity is a key recommendation for healthy food intake (WHO, 2018; Willet et al., 2014) while a low consumption of animal products is considered to have minimum negative environmental and climate consequences (Searchinger et al., 2018; Smith et al., 2013).

Methods and data

This study investigates the evolution of the world's macro-regional diets between 1961 and 2013, using three indicators:

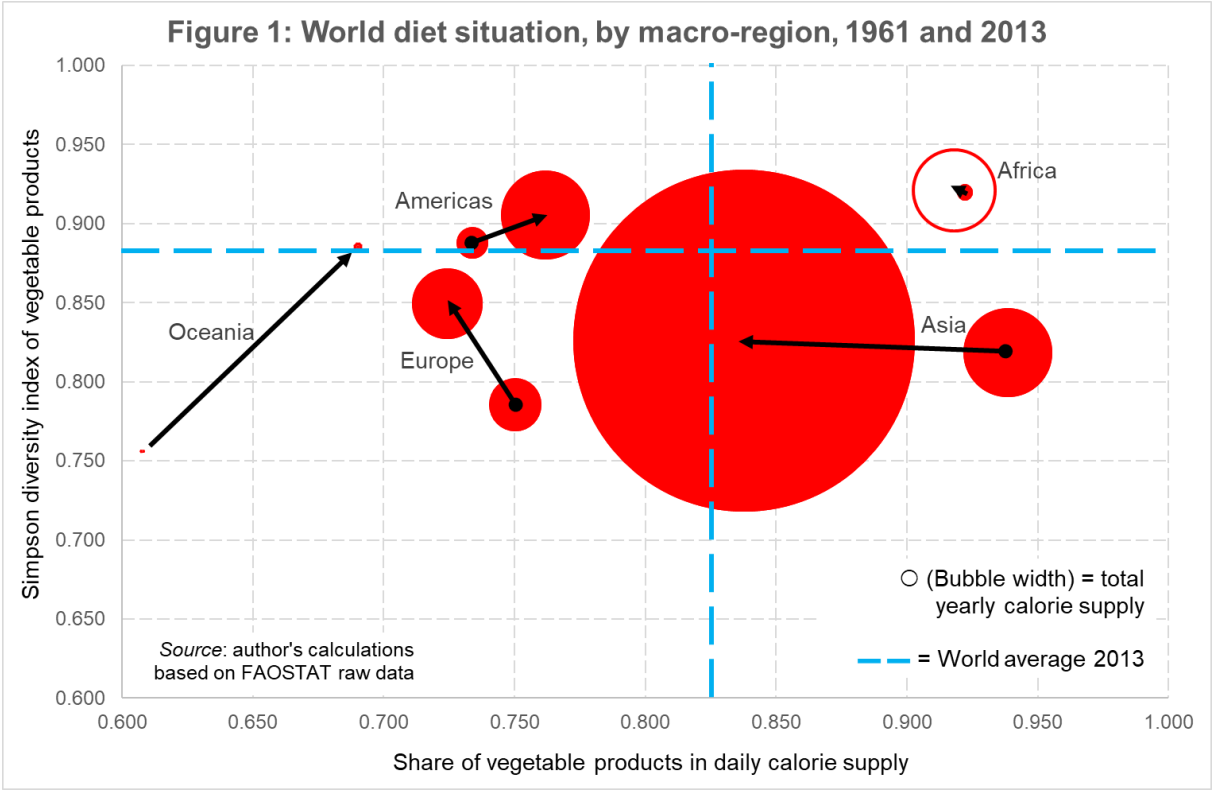
a) the share of daily per capita calorie intake derived from vegetable/plant products (range from 0 to 1);
b) the variety of vegetable/plant products consumed, measured by the Simpson diversity index (Simpson, 1949) (range from 0 = no to 1 = maximum variety);
c) total annual food calories consumed in a given macro-region and year, reflecting the contributions of both total population in this area and its per capita calorie intake per day.

The macro-regions and years covered are: Africa, Americas, Asia, Europe, Oceania and World for 1961, 1970, 1980, 1990, 2000, 2010, 2013.

Raw data were taken from FAOSTAT, Food Balance Sheets, food supply (kcal/capita/day).

Results and discussion

The summary results are presented in Fig 1. For space reasons, the evolutions of the individual macro-regional diets for the years mentioned are not discussed in this abstract.



The results show that:

1. The world average diet became more based on animal products and remained unchanged regarding the variety of vegetable products consumed. (Fig 1 shows only 2013 values.) The share of kcal in daily food intake derived from vegetable products decreased from 84.6% (1961) to 82.2% (2013), while plant product variety decreased slightly from a Simpson index score of 0.888 to 0.881. However, both changes are comparatively small. At the same time, total world calorie consumption more than tripled (from 2.48×10^{15} kcal per year to 7.59×10^{15} kcal per year; not shown in Fig 1).
2. Macro-regional consumption patterns are not uniform (see Fig 1). In Africa, the share of vegetable products in the regional diet slightly fell from 92.2% (1961) to 91.8% (2013) while the variety index score remained virtually unchanged (0.920 to 0.921). Over the same period, total calories supplied increased more than fivefold. The diet of the Americas improved in both measures (vegetable share 73.4% to 76.2%, plant product variety from 0.888 to 0.905), while total calorie supply almost tripled. In Asia, the share of vegetable products in the diet fell from 93.9% to 83.8%, the variety index score slightly improved from 0.819 to 0.826 and total calories supplied almost quadrupled. The European diet's share of vegetable products decreased from 75.0% to 72.4%, while vegetable product variety increased from 0.786 to 0.849, and total calorie supply increased by 34%. Finally, the Oceania diet also improved in both measures (plant-product share from 60.8% to 69.0%, plant product variety from 0.756 to 0.885) while total calorie supply increased by a factor of more than 2.5.

Life expectancy rates improved in all macro-regions over the period analysed. According to Riley (2005) and WHO (online), the world average lifespan increased by 48% from 48 years (1950) to 70.8 years (2013). In Africa, over the same period, it increased by 65% to 58.8 years, in the Americas by 31% to 76.5 years, in Asia by 73% to 71.8 years, in Europe by 25% to 80.6 years, and in Oceania by 22% to 77.5 years. Life expectancy depends on multiple factors. Suboptimal diets only account for about 20% of deaths globally (GBD 2017 Diet Collaborators, 2019).

The links between diet diversity as well as plant-product content and life expectancy are contrary expectations whether for absolute levels or changes over time. Correlation coefficients are negative and larger for plant-product content (–0.9 and –0.7) than for diet diversity (–0.5 and –0.7).

Food systems contribute 19–29% of global anthropogenic greenhouse gas (GHG) emissions of which agricultural production, including indirect emissions resulting from land-cover change, contributes 80–86% of total food system emissions (Vermeulen et al., 2012). In 2013, food represents 97% of world agricultural production (value) and 23% of world food production was exported, according to FAOSTAT Production and Trade databases (online).

Regionally, agricultural production can differ from food consumption. In 2013, the shares of food in agricultural production value were: Africa 98%, Americas 97%, Asia 96%, Europe 99.5% and Oceania 85%. In the same year, net food exports represented –11% of production in Africa, 12% in the Americas, –5% in Asia, –2% in Europe and 50% in Oceania. For 1961, no comparable data are available in the FAOSTAT Production and Trade databases (online).

Macro-regional per capita food system GHG emissions in 2013 amounted to ($kgCO_2eq$): Oceania 1,939, Americas 1,153, Africa 816, Europe 779, Asia 527. These numbers are agricultural production emissions from the FAOSTAT Emissions database (online) adjusted for food shares and net exports. The correlation coefficient between 2013 macro-regional diets' plant-product shares and food system per capita GHG emissions is –0.64. Europe, in particular, does not fit the pattern since it has low emissions despite a low plant-product share.

Conclusions

Assuming data reliability and method validity, the presented analysis suggests that the nexus between diets and health and climate outcomes is not fully evident at the macro-regional level. Therefore, we should avoid Malthus 2.0 – i.e., scientific food pessimism. Maybe, food system GHG emissions are better tackled at the supply side by tightening production standards in particular for ruminant products, which would cause their costs and prices to rise and their demand and consumption to fall. Moreover, the limitations of dietary contributions to overall health should perhaps be more widely acknowledged.

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