Causing confusion in the debate about the transition toward a more plant-based diet

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White and Hall (1) recently assessed the contribution of animal-based agriculture to greenhouse gas emissions (GHGE) and nutrient provision of the United States society. Unfortunately, their study provides a misleading message. Reducing animal-based food is needed to meet climate goals and future global food demands (2). Hence, it is important to assess impacts of dietary changes. However, to be useful, assessments—or at least their interpretations—need to be realistic. By only discussing a situation without animal-based agriculture, White and Hall (1) neglect a wide spectrum of diets. Importantly, their conclusions implicitly assume linear trends between current diet and an animal-free scenario (Fig. 1*A*). The literature, however, provides evidence for nonlinear relationships with an optimum for GHGE reduction and nutritional capacity at intermediate levels of animal-based agriculture (Fig. 1*B*). Important scenarios to explore in future research include sustainable food production with a varied plant-based diet, a vegetarian diet, and the implementation of standard dietary guidelines (3).

White and Hall (1) selectively discuss nutrient deficiencies of plant-based diets and exclude currently overconsumed nutrients from the analysis (4), providing a biased view on nutritional impacts of dietary patterns. The suggested increase in obesity in the plant-based scenario due to increased overall calorie availability is contradictory to current scientific knowledge about "Western diseases" (4). Vegetarian or vegan diets generally lead to health benefits (4), and could therefore reduce GHGE from healthcare [currently 8% of United States GHGE (5)]. Nutrient deficiencies may have arisen from the unbalanced diet assumed in the plant-based scenario, with grains being 80% of daily consumption. Suggested limitations on increased fruit and vegetable production ignore that United States agricultural policy has been increasingly promoting cultivation of a few crops, including corn, thereby discouraging cultivation of fruits and vegetables (6). White and Hall's (1) argument that the current American diet includes substantial proportions of fruits and vegetables is not consistent with national data showing underconsumption by more than 70% of the American population (4).

The transition toward healthy, more plant-based diets has the potential to reduce GHGE (2). We agree that a total removal of animals could lead to adverse effects (Fig. 1*B*), but White and Hall's (1) estimate is questionable. They assume that current high fertilizer rates should be maintained in the plant-based scenario. However, much less land and lower crop-yields would be needed to sustain food production (2), reducing the need for fertilizers. Moreover, diverse farming systems reduce the need for pesticides (7), further decreasing GHGE. The assumption that large amounts of waste otherwise consumed by livestock would need to be incinerated (1) also seems unrealistic, as other valorization pathways are available. Organic waste can be used for biogas production (8), further reducing GHGE and partly offsetting emissions from associated land-use change (9) or for growing edible, nutrient-rich insects, using less space and less GHGE compared with livestock (10).

Finally, White and Hall (1) further fail to discuss other important issues related to contemporary agriculture that would benefit from this transition, like the impact on biodiversity, degradation of ecosystem services, or the excessive use of antibiotics.

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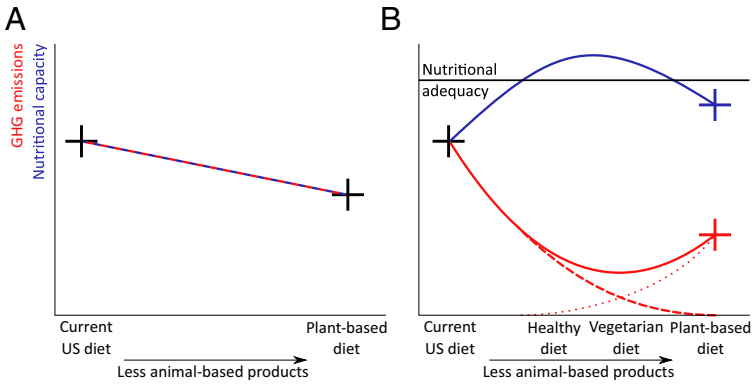

Fig. 1. (*A*) **Implicitly assumed linear relationship between the share of animal-based products in the American diet and GHGE (in red) and nutritional capacity (in blue) by White and Hall (1). The black crosses represent results for GHGE and nutritional capacity of the considered diets, as calculated in their analysis.** (*B*) **More likely (although uncertain) relationships (solid lines), with the optimum not situated in one of the two considered scenarios. Red and blue cross indicate more likely levels of GHGE and nutritional capacity of a plant-based diet. The net GHGE (solid red line) achieve a minimum and increase again when the indirect adverse effects on emission reduction of the removal of animals from agriculture (dotted red line) outweigh the gross emission reduction (dashed red line). Given the highly complex nature of the GHG balance, the shape of the GHG emission curve is uncertain. The position of the maximum and minimum of the curves on both axes are purely illustrative. Only relative positions are considered. Healthy diet limits the consumption of sugar, oil, meat, and dairy, as recommended by the Harvard Medical School (3). Vegetarian diet is without meat or fish consumption. Plant-based or vegan diet is without any animal-based products.**

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