



Universiteit  
Leiden  
The Netherlands

## FAO's 1.5°C roadmap for food systems falls short

Verkuijl, C.; Dutkiewicz, J.; Scherer, L.; Behrens, P.; Lazarus, M.; Hötzel, M.J.; ... ; Hayek, M.

### Citation

Verkuijl, C., Dutkiewicz, J., Scherer, L., Behrens, P., Lazarus, M., Hötzel, M. J., ... Hayek, M. (2024). FAO's 1.5°C roadmap for food systems falls short. *Nature Food*, 5, 264-266.  
doi:10.1038/s43016-024-00950-x

Version: Publisher's Version

License: [Licensed under Article 25fa Copyright Act/Law \(Amendment Taverne\)](#)

Downloaded from: <https://hdl.handle.net/1887/4197994>

**Note:** To cite this publication please use the final published version (if applicable).

# FAO's 1.5 °C roadmap for food systems falls short

Cleo Verkuijl, Jan Dutkiewicz, Laura Scherer, Paul Behrens, Michael Lazarus, Maria José Hötzel, Rebecca Nordquist & Matthew Hayek

 Check for updates

The first instalment of the FAO food systems roadmap is a key step in identifying pathways to achieve zero hunger without breaching the 1.5 °C climate change threshold. But future instalments should be more methodologically transparent, emphasize the need to reduce animal-sourced food consumption and align with a holistic One Health approach.

The latest Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 28) saw an unprecedented focus on the climate impact of food systems. During the meeting, the UN Food and Agriculture Organization (FAO) published the first instalment of its roadmap for achieving zero hunger without breaching the 1.5 °C threshold<sup>1</sup>. The roadmap outlines several interrelated food security, nutrition and climate objectives. Additionally, it introduces 20 milestones across 10 domains – including livestock, fisheries and aquaculture, healthy diets, forests and wetlands, and clean energy – and puts forward a total of 120 recommended actions. FAO's second planned instalment will focus on regional perspectives and financial aspects, while the third one will outline specific country-level action plans and address monitoring and accountability.

The first instalment of FAO's roadmap is a welcome step in charting a course towards a zero-hunger, climate-compatible food system. However, several areas for improvement can be identified with regard to both process and substance: the roadmap does not describe how interventions were selected; it does not provide a quantification of the expected environmental benefits of these interventions; it does not include a list of authors and reviewers or details about its review process; and it omits key interventions with demonstrated potential to improve environmental and health outcomes – notably, reducing animal-sourced food production and intake.

## Missed opportunities for greenhouse gas emissions reductions

The FAO roadmap presents numerous ambitious objectives for the food system, including eradicating chronic hunger by 2030 and transforming agrifood systems into a net carbon sink by 2050. Modelling a 1.5 °C trajectory is an undoubtedly complex task, fraught with subjective judgement calls – such as determining boundaries between the food and energy systems – and data uncertainties. However, while the FAO roadmap introduces a range of quantified goals and milestones, it remains unclear how the roadmap's 120 proposed interventions were chosen – and how they will put the world on a path to limiting warming to 1.5 °C.



These omissions are particularly concerning given that the FAO roadmap neglects one of the most obvious and urgent interventions to reduce emissions from the food system: shifting away from the production and consumption of animal-sourced foods. Animal agriculture, including animal feed, accounts for 12–20% of total global greenhouse gas (GHG) emissions and is responsible for nearly 60% of the food system's emissions<sup>2</sup>. The FAO roadmap emphasizes the climate impact of animal agriculture, highlighting 'livestock' as its first domain of action, with two milestones: a 25% reduction of methane emissions from the livestock sector by 2030 and a 1.7% annual growth in livestock total factor productivity by 2050. The roadmap also suggests that diets "absolutely must" change to improve both human and planetary health. However, the roadmap does not offer measures or milestones for lowering production and consumption of animal-sourced foods, which could yield meaningful emission reductions, particularly in regions where the consumption of such foods is currently high.

Extensive literature has shown that shifting to plant-rich diets that reduce consumption of animal-sourced foods would make a substantial contribution towards meeting climate targets. Recent analysis has shown that ambitious technological improvements to farmed animal management would not be sufficient to meet the methane emissions reduction targets for the agricultural sector that the Intergovernmental Panel on Climate Change considers necessary to limit warming to 1.5 °C: this means that the consumption of animal-sourced foods must also be reduced<sup>3</sup>. Across all GHGs, global adoption of a healthy plant-rich diet could reduce emissions enough to bring global average temperatures down by between 0.19 °C (342 Gt CO<sub>2</sub>-equivalent (CO<sub>2</sub>e)) and 0.36 °C (648 GtCO<sub>2</sub>e) cumulatively through to 2100 (refs. 4,5).

Beyond limiting ongoing emissions, reducing consumption and production of animal-sourced foods can also free up land for conventional (for example, reforestation) or novel (for example, bioenergy

with carbon capture and storage (BECCS)) carbon removal methods. If freed-up land from a protein transition was used for reforestation, it could remove carbon while generating wider environmental benefits, such as reduced pollution and additional land for biodiversity preservation and restoration. Using the freed-up land instead for BECCS could alleviate some major concerns associated with the technology by avoiding agricultural expansion into natural areas as well as food competition, while removing even more carbon than reforestation in many locations. For instance, replacing half of animal-sourced food with plant-based alternatives by 2050 could free up sufficient land for BECCS to remove 6–9 GtCO<sub>2</sub>e per year, more than sufficient to meet the FAO roadmap's milestone of removing 1.3 GtCO<sub>2</sub>e per year through BECCS<sup>6</sup>.

The roadmap's 'fisheries and aquaculture' section also raises concerns, identifying a milestone of increasing global sustainable aquaculture by at least 75% by 2040. The roadmap underscores that "[d]ue to its low GHG footprint, aquatic food should play an important role in the dietary shift to mitigate emissions". Yet, this milestone overlooks substantial emissions disparities across aquaculture products. For example, GHG emissions per kilogram of farmed shrimp and tilapia can be an order of magnitude higher than those of bivalves or seaweed, and higher than those of chicken<sup>7</sup>. Therefore, any expansion in the sector must be approached with nuance, differentiating between sustainable approaches and approaches that may need curtailing to meet climate goals.

## Limited attention to One Health

Commendably, the FAO roadmap attempts to take a holistic view of sustainable development, with the primary goal of addressing malnutrition in all its forms, including undernutrition, obesity and non-communicable diseases. However, in foregrounding proposals for intensified animal-sourced food production, the roadmap misses an opportunity to explore more diverse and balanced approaches to dietary change with the potential for public health and sustainability co-benefits. The EAT–Lancet Commission recognizes that meat can be an important source of nutrients for some communities, and low-meat diets may have adverse health impacts for low-income countries and other vulnerable groups unless alternatives are made available<sup>8</sup>. However, in many settings, excessive levels of red and processed meat consumption are a key contributor to non-communicable diseases, including cardiovascular diseases, type 2 diabetes and certain types of cancer<sup>9</sup>. The Commission therefore suggests cutting global meat consumption by about 50% from 2021 levels, with the highest reductions needed in the Americas, Oceania and Europe. Additionally, the Commission has recommended an increase in the consumption of legumes, nuts and whole grains in both low- and high-income countries. These under-consumed plant-based foods are associated with improved food security and nutritional outcomes and have far lower GHG emissions per unit kilogram, calorie and protein than meat. The FAO roadmap should incorporate these recommendations or outline what changes are needed on a global average level to ensure healthy, low-emission diets for the next instalments of the roadmap to explore the nuance of these shifts at a regional and country level.

It bears noting that alternative proteins, including plant-based meat alternatives, show promise for far smaller environmental impacts compared with their conventional analogues<sup>10</sup>. However, the FAO largely neglects this potential solution in its first roadmap instalment, even dismissing plant-based meats as "hav[ing] nutritional deficiencies" without providing any evidence to support this claim. The FAO

roadmap could have recommended more context-specific assessments to explore the potential of alternative proteins to contribute to sustainability and health goals in different settings.

A One Health approach, which appreciates the interconnection between human, animal and environmental health, has become increasingly important in policy-making. The FAO, together with the World Health Organization, the World Organisation for Animal Health and the United Nations Environment Programme, is part of the 'One Health Quadripartite', which aims to "advocate and support the implementation of One Health". Yet the FAO roadmap lacks any mention of One Health. Notably, some of the roadmap's proposed interventions, such as transitioning from beef to chicken and intensifying animal agriculture, could maintain or even substantially increase risks of antimicrobial resistance and/or zoonotic disease. This is because farmed land animals are fed high levels of antibiotics, can harbour and transmit potentially highly pathogenic viruses, are bred and kept in large populations, and are kept in close proximity to humans<sup>11</sup>; some of these risk factors are likely more pronounced for conventional poultry farming than cattle farming. Additionally, keeping farmed animals in close quarters can contribute to infectious disease emergence.

One Health also includes animal welfare as an important component, as recognized by the United Nations' One Health High-Level Expert Panel<sup>12</sup>. Intensifying animal farming, as recommended in the report, can potentially lead to overcrowding and restrict natural behaviour, which could harm animal welfare. Furthermore, substituting beef with chicken and expanding aquaculture is expected to increase the number of terrestrial and aquatic animals in intensive farming<sup>13</sup>.

The roadmap acknowledges some of these risks by emphasizing that productivity increases in animal agriculture should be achieved through "carefully planned intensification methods" that avoid negative "adverse consequences [...] stemming from the concentrated housing of animals coupled with excessive antibiotic use". It also underscores the need to protect animal health through improved veterinary services, animal disease surveillance and increased vaccination coverage. Pursuing such goals could indeed support One Health and climate mitigation outcomes in tandem, but meaningfully achieving them may prove challenging and present trade-offs in practice. Here, again, shifting to more plant-based foods, including alternative proteins, is a promising solution to help reduce the risks of zoonotic disease emergence and antimicrobial resistance associated with conventional animal-sourced food.

## A call for more ambition

In making its roadmap more effective in achieving its aims in future instalments, the FAO can take a cue from another international agency: the International Energy Agency (IEA). The IEA's 1.5 °C roadmap for the energy sector has provided guidance for action that has influenced government policy around the world. Central to the success of this effort is a quantitative analysis that gets right to the source of energy sector emissions and how they can be avoided. The IEA has unequivocally stated that there is no room for new coal, oil and gas infrastructure in a 1.5 °C warming future<sup>14</sup>. It has also strongly promoted the accelerated development and deployment of renewable energy sources. Aligning the food system with a climate-compatible future will require a similarly unprecedented amount of ambition involving the scaling down of emissions-intensive activities and increased investment in more sustainable approaches. This includes a deep exploration of the opportunities to decrease both the production and consumption of animal-sourced foods. This can include the investigation of solutions

like alternative proteins, or scaling up behavioural interventions that improve the accessibility and desirability of culturally appropriate, plant-rich diets. These approaches could offer meaningful emission reductions while presenting other co-benefits, analogous to renewable energy investments in the energy sector.

Transforming a sector as vital as the food system presents important challenges, including ensuring a societally just transition for affected consumers, workers, communities and other stakeholders. It is crucial to consider regional and local nuances, recognizing the various socio-economic and environmental contexts that shape global food systems. However, a well-managed transition towards climate-compatible food systems can also offer major health and environmental co-benefits.

To maximize their potential for guiding ambitious action, future instalments of the FAO roadmap should include clear goals underpinned by quantified analysis that demonstrate a cumulative contribution to the 1.5 °C target, increased transparency of methods, authorship and review processes, and vetting by the environmental and health communities. We also encourage the FAO to embrace its role as a steward of One Health in the food system. This means considering the range of public health and animal welfare implications of its recommendations in its roadmaps and seeking synergies where possible.

**Cleo Verkuijl** <sup>1,2</sup>✉, **Jan Dutkiewicz** <sup>3</sup>, **Laura Scherer** <sup>4</sup>,  
**Paul Behrens** <sup>4</sup>, **Michael Lazarus** <sup>5</sup>, **Maria José Hötzel**<sup>6</sup>,  
**Rebecca Nordquist** <sup>7</sup> & **Matthew Hayek**<sup>8</sup>

<sup>1</sup>Stockholm Environment Institute US, Somerville, MA, USA.

<sup>2</sup>Brooks McCormick Jr. Animal Law and Policy Program, Harvard Law School, Cambridge, MA, USA. <sup>3</sup>Pratt Institute, Brooklyn, NY, USA.

<sup>4</sup>Institute of Environmental Sciences (CML), Leiden University, Leiden,

the Netherlands. <sup>5</sup>Stockholm Environment Institute US, Seattle, WA, USA. <sup>6</sup>Universidade Federal de Santa Catarina, Florianópolis, Brazil. <sup>7</sup>Faculty of Veterinary Medicine, Utrecht University, Utrecht, the Netherlands. <sup>8</sup>Department of Environmental Studies, New York University, New York, NY, USA.

✉ e-mail: [cleo.verkuijl@sei.org](mailto:cleo.verkuijl@sei.org)

Published online: 18 March 2024

## References

1. *Achieving SDG 2 without breaching the 1.5 °C threshold: A global roadmap. Part 1 – How agrifood systems transformation through accelerated climate actions will help achieving food security and nutrition, today and tomorrow*, In brief (Food and Agriculture Organization of the United Nations, 2023); <https://doi.org/10.4060/cc9113en>
2. Xu, X. et al. *Nat. Food* **2**, 724–732 (2021).
3. Arndt, C. et al. *Proc. Natl Acad. Sci. USA* **119**, e2111294119 (2022).
4. Ivanovich, C. C., Sun, T., Gordon, D. R. & Ocko, I. B. *Nat. Clim. Change* **13**, 297–302 (2023).
5. Clark, M. A. et al. *Science* **370**, 705–708 (2020).
6. Rueda, O., Mogollón, J. M., Stenzel, F., Tukker, A. & Scherer, L. *One Earth* **7**, 293–310 (2024).
7. Gephart, J. A. et al. *Nature* **597**, 360–365 (2021).
8. Willett, W. et al. *Lancet* **393**, 447–492 (2019).
9. GBD 2017 Diet Collaborators. *Lancet* **393**, 1958–1972 (2019).
10. *What's Cooking? An assessment of potential impacts of selected novel alternatives to conventional animal products* (United Nations Environment Programme, 2023); <https://go.nature.com/48HZSeJ>
11. Gilbert, W., Thomas, L. F., Coyne, L. & Rushton, J. *Animal* **15**, 100123 (2021).
12. One Health High-Level Expert Panel (OHHLEP) et al. *PLoS Pathog.* **18**, e1010537 (2022).
13. Mathur, M. B. *Science* **375**, 1362 (2022).
14. *Net Zero by 2050: A Roadmap for the Global Energy Sector* (International Energy Agency, 2021); <https://www.iea.org/reports/net-zero-by-2050>

## Acknowledgements

We thank O. Rueda for helpful discussions.

## Competing interests

The authors declare no competing interests.