Research round-up

Highlights from sustainable-nutrition research. By Dyani Lewis

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Rapeseed crops depend on pollinators such as bees.

Farming trends deplete pollinators

Most cultivated crops depend on insect pollinators, such as bees, but global crop trends are leaving pollinators worse off.

Using data from the United Nations' Food and Agriculture Organization, an international team, led by Marcelo Aizen at the National University of Comahue in Rio Negro, Argentina, assessed changes in the amount of land used for agriculture and the types of crops cultivated between 1961 and 2016. During that time, the area of land used to grow crops increased by around 40%, and pollinator-dependent cropland more than doubled. Soya bean, rapeseed and oil palm — crops associated with deforestation and diversity loss — account for much of the expansion and for the increase in pollinator dependence.

But although the land used has increased, crop diversity has remain largely the same since 2000. Producers have opted for large-scale cultivation of one crop. That's a problem because monocultures don't provide pollinators with a stable, year-round supply of food. This ultimately leads to a fall in insect numbers, lower yields and increased deforestation as demand for land surges.

Greater reliance on crops that are dependent on single-species pollinators, coupled with declining pollinator populations, could cause problems for food security. Poorer regions will be the hardest hit by crop failures, but higher-income countries that rely on imported food will also be affected.

Rotating a diverse range of crops on a single piece of land could help to stem the decline in pollinator populations. Planting native flowers and hedgerows on agricultural land and restoring neighbouring natural environments could also preserve pollinator habitats.

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US household food waste calculated

Working out how much food goes uneaten in an individual household is notoriously difficult. Comprehensive data on how much food ends up in the bin does not exist. But Yang Yu and Edward Jaenicke at Pennsylvania State University in University Park used a new method to overcome the lack of data.

Instead of trying to measure food waste directly, Yu and Jaenicke calculated a household's ability to efficiently convert food brought into the household into the energy required to maintain the body weight of its residents. First, they obtained data on food purchases from around 4,000 households that took part in the 2012 US Department of Agriculture's National Household Food Acquisition and Purchase Survey. The authors then calculated the metabolic energy requirements of the people living in each household from attributes such as height, weight, age and gender. The amount of food waste was estimated according to the difference between the household's food inputs and its members' energy requirements, not accounting for overeating.

The study showed that the average household wasted close to one-third of the food that it bought, which means that the United States wastes an estimated US$240 billion worth of food per year. The most efficient household in the study wasted about 9% of its food. Healthier diets created more waste than unhealthier diets, owing to the greater proportion of fruit and vegetables. Higher-income households wasted about 50% more food than lower-income households,

and small households wasted more per person than large households.

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Hidden hunger a global problem

There is more than enough food to feed the global population. But local patterns of production still leave 10% of the world's people with insufficient calories, and more than half with inadequate quantities and variety of micronutrients — known as hidden hunger.

These are findings of a detailed analysis of food production by Ozge Geyik and colleagues at Deakin University in Burwood, Australia. The team gathered data on the nutrient content of 174 individual foods produced across 177 countries between 1995 and 2015. The researchers analysed whether individual countries and regions could meet the energy needs of their populations, as well as supply them with protein, iron, zinc, vitamin A, vitamin B12 and folate.

The study is one of the first to take such a detailed look at global patterns of nutrient production using disaggregated food data over time. Previous work has typically grouped foods into broad categories, such as cereals, dairy and vegetable oils, which can lead to under- or overestimates of specific nutrients.

Global food production increased steadily over the two decades, and outpaced increases in food requirements. However, on a regional level, the analysis found that more than half of the countries in Africa and Asia were not producing enough calories for their populations.

In 2015, more than 20% of the global population lived in countries with inadequate iron, vitamin A, vitamin B12 and folate production. Food production often fell short in multiple nutrients. More than 70% of countries with nutrient shortfalls produced inadequate amounts of iron, vitamin A and folate. And more than one-fifth of those not producing enough nutrients, fell short by more than half of what was necessary for their population.

The authors suggest that countries with nutrient deficiencies could prioritize the production of foods that contain the nutrients that their population needs. For example, in places where protein production is adequate, shifting production to protein sources that are higher in vitamin A and iron could alleviate these nutrient shortfalls. Adding micronutrients directly to soils and the leaves of crop plants is another possible solution.

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Nutrient recycling possibilities mapped

The age-old practice of fertilizing crops with livestock manure has been reimagined in a study led by Sheri Spiegal from the US Department of Agriculture in Las Cruces, New Mexico. In the study, the team introduces the concept of a manureshed — land around livestock farms that could benefit from the nutrient-rich manure that those farms produce.

Spiegal and her colleagues mapped a patchwork of more than 3,000 counties across the United States. They classified counties as manure sources if they could supply nutrients in manure from livestock, or sinks if the crops grown could use the nutrients from manure.

The work reveals a surfeit of opportunity to recycle nutrients. The researchers identified counties that could recycle nitrogen and phosphorous nutrients at the local county level, as well as four regional manuresheds — in the northwest, southwest, central and southeast United States — where clusters of source counties could join together to develop sustainable redistribution programmes over longer distances. The work suggests a pathway towards removing manure from areas where it can pollute the local environment and delivering it to nutrient-poor agricultural lands, easing the reliance on commercial fertilizers that pollute the environment and deplete finite natural resources. But the authors note that further research — on how best to recover and transport manure, for instance — will be needed to turn the vision into a reality.

Agric. Syst. **182**, 102813 (2020)

Intervention trade-offs assessed

Transforming the way land is managed and food is produced could shore up food supplies and address the challenges of climate change and biodiversity loss. But an assessment of proposed interventions reveals that few are up to the task of protecting both livelihoods and the environment.

Pamela McElwee from Rutgers University in New Brunswick, New Jersey, and her colleagues assessed the benefits and trade-offs of 40 proposed changes to land management, food-production chains and the management of environmental risks. The potential interventions are outlined in the 2019 report from the Intergovernmental Panel on Climate Change, and include improving management of livestock, reforestation, reducing consumer and retail food waste and management of urban sprawl.

The authors assessed each of the actions against the United Nations' 17 Sustainable Development Goals (SDGs), as well as 18 measures from the Nature's Contributions to People (NCP) framework, which was drawn up by scientists associated with the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services in 2017. This framework is intended to recognize nature's social, cultural, spiritual and religious significance, as well as its role in providing food, clean water and healthy air.

The analysis revealed that several interventions carried unintended negative consequences. The production of bioenergy, either with or without carbon capture, planting forests and commercial crop insurance all had potentially negative consequences for both SDGs and NCPs. For example, bioenergy had large negative impacts on maintaining land biodiversity, freshwater quality and food production, despite providing affordable clean energy. About one-third of the interventions proposed had no substantial trade-offs. These included improving water management, increasing soil organic carbon content, reducing pollution, reducing post-harvest losses and fire management.

The analysis could help decision-makers to assess environmental or developmental policies to avoid unintended trade-offs, the authors say.

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