

# The Changing Composition of the Global Diet: Implications for CGIAR Research

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In the five decades during which CGIAR has worked to reduce poverty and hunger through agricultural research, very substantial changes have occurred in human diets worldwide and in the production systems that sustain them. National diets around the world have become increasingly similar, gaining in calories, protein, and fat, as animal-derived foods and high-calorie plant foods (oils and sugars) have risen in importance. The proportion of diets consisting of major cereals and oil crops has increased, while regionally and locally important cereals, root crops, and oil crops have generally become further marginalized. Developing countries show the most significant shifts in diets over this period.

These changes have been driven by globalization, urbanization, and economic development, including agricultural research. While this “nutrition transition” has enhanced food security by making macronutrients more readily available worldwide, it has had mixed effects on micronutrient sufficiency, and the over-consumption of macronutrients has contributed to a global surge in diet-related non-communicable diseases. Dietary change is also linked with greater homogeneity in farmers’ fields and the associated commodity trading systems, thus heightening concerns about genetic vulnerability to biotic and abiotic stresses as well as food system vulnerability to climatic and political instability. This policy brief provides an overview of the key results from a recent study published by the International Center for Tropical Agriculture (CIAT) and CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) (Khoury et al., 2014), which has important implications for CGIAR research priorities.

## Key messages

- The results of a recent CIAT/CCAFS study reveal three major trends in the roles that various crop species play in global diets: (1) a steady increase in the importance of major cereals, (2) the growing importance of oil crops, and (3) a decline in regionally important crops.
- CGIAR research on three global staples – wheat, rice and maize – continues to be critical because of their increasing importance for the global food system.
- The rising global significance of oil crops creates new opportunities to benefit farmers in parts of the developing world but also poses major agro-ecological challenges.
- Increased investment in developing and promoting nutrient-rich, stress-tolerant varieties of crops that are becoming relatively marginalized (e.g., sorghum, millets, cassava, and yams) offers a means to diversify the global food system and enhance long-term food security.
- Agricultural research should pursue a systems approach aimed at enhancing the nutrition of an increasingly urban world population, while conserving natural resources.

Since the creation of CGIAR, global diets have undergone significant changes, which are reflected in three main crop trends:

1. The major cereals – wheat, rice, and maize – remain primary calorie and protein sources for the developing countries of Africa, Asia, and Latin America and the Caribbean. These crops have gained importance in diets outside their regions of origin, and their overall relative contribution to diets in developing countries has gradually expanded.
2. A number of oil crops have emerged from relatively minor positions to assume very significant roles as sources of calories and fat worldwide. Soybean and oil palm in particular have figured importantly in plant oil commodity development, providing the world with cheap cooking oil, which otherwise may have come from animal food products.

3. Regionally important cereals, root crops, and oil crops have either remained static or declined in relative importance as sources of calories, protein, and/or fat in national diets. Crops such as sorghum, millets, sweet potato, cassava, yam, bananas and plantains, beans, Old World pulses, coconut, and groundnut, while in some cases expanding into new regions, have as a whole played reduced roles in global diets during recent decades, as major cereal and oil crops have increased in significance.

What are the implications of these changes in global diets for CGIAR research? Are the current mandate crops still relevant for alleviating poverty? Is CGIAR neglecting non-mandate crops that are important for improving diets and incomes, particularly as developing countries urbanize? Which crops should receive primary emphasis in research, as policy makers seek to promote healthier and more sustainable food systems?

## Global staples: Continued commitment

Trends in global diets clearly justify CGIAR research on the staple cereals wheat, rice, and maize (Figure 1). As these crops gain importance in global diets, both their production stability and nutritional quality become ever more critical issues. The extensive history of research with these crops in diverse regions makes CGIAR a crucial partner in global efforts to support these crops in the face of land, water, and other resource limitations; climate change; and agriculture's increasing pressure on ecosystems. CGIAR should take the following actions to prepare the world's most important food crops to meet increasing demand:

- Conserve and describe the full range of genetic diversity within these crops and their wild relatives and make diverse genetic material and associated information available to researchers and breeders.
- Facilitate sharing of plant genetic resources through policy leadership, particularly in support of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).
- Breed more productive and resilient varieties, with emphasis on enhancing nutritional quality by means of biofortification.
- Through agricultural extension and development partnerships, promote widespread adoption of genetically diverse, locally adapted varieties to minimize vulnerability associated with genetic uniformity.
- Reduce the negative environmental impacts of major crops through research aimed at maximizing the eco-efficiency of production practices.

## Emerging crops: Oiling the wheels of research

CGIAR has historically given little emphasis to the oil crops that have become an important part of the global diet over the past 50 years (Figures 1 and 2). These crops have created new market

opportunities for farmers in the developing world, but only sparse benefits have accrued to low-resource growers. These crops are associated with major impacts on natural ecosystems in developing countries through deforestation and contribute significantly to greenhouse gas emissions. Excessive consumption of oil crops has also contributed to the global rise in diet-related disease. CGIAR research collaborations could include:

- Develop and promote eco-efficient production and processing methods through engagement with major actors

in oil value chains for the purpose of minimizing environmental damage.

- Enhance the genetic diversity and nutritional traits of oil crops through crop research, policy advocacy, and public-private partnerships aimed at developing a wider range of productive, nutritious, and well-adapted varieties.
- Diversify oil crop production, processing, and markets through research on crops of particular importance for developing countries and with potentially high direct benefits for farmers (e.g., coconut, groundnut, sunflower oil, cottonseed oil, olives, rape

## Diets in developing countries increasingly comprise major globalized crops.

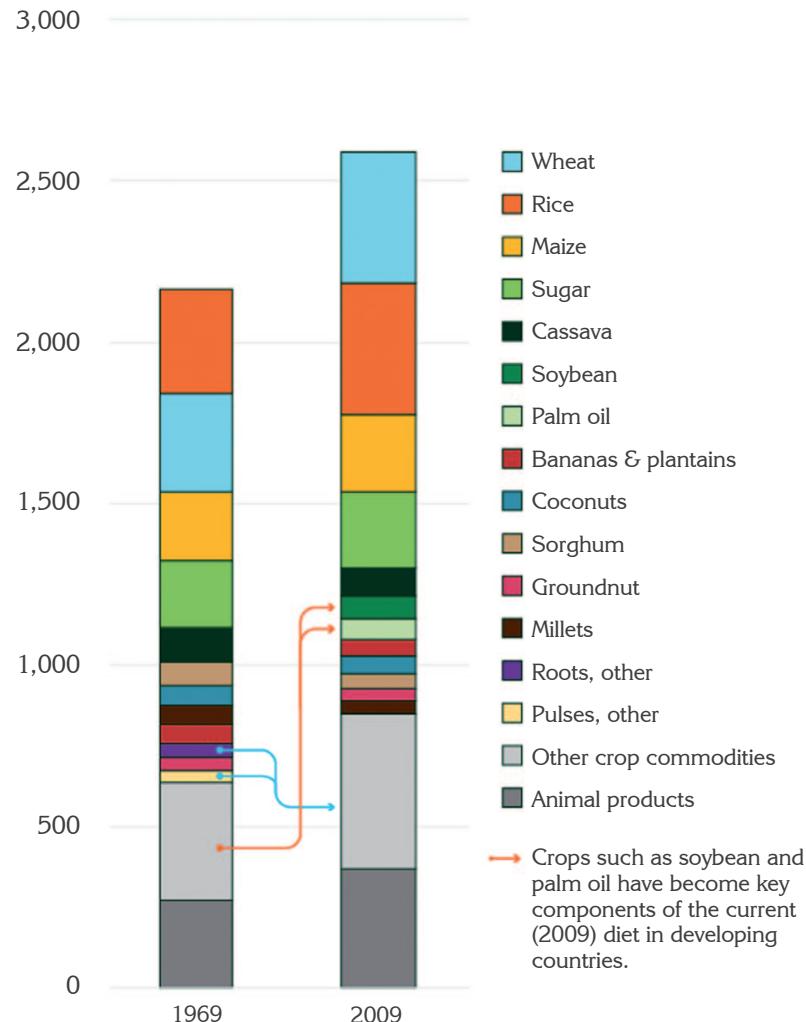


Figure 1. Contribution of crops to mean food supplies in developing countries for calories (kcal/capita/day), 1969 and 2009.

Source: Adapted from Khoury et al. 2014.

and mustard, sesame, and shea nut).

- Support education, advocacy, and policy development aimed at increasing availability and access to, and in promoting the judicious consumption of, healthy oil crop products.

### Marginalized, regionally important crops: Into the limelight

Regionally significant cereals, root crops, and oil crops, many of which are especially important for the rural poor in developing countries, have generally remained static or declined in terms of their relative contribution to national diets since CGIAR's inception (Figure 2). Since many of these crops are both stress tolerant (Figure 3) and nutritionally rich, investment in their improvement offers a wise long-term option for diversifying global food supplies, as the environmental challenges that agriculture faces intensify and as more people suffer from the negative health effects of the nutrition transition.

The monumental advances in our capacity to generate genetic information and associated breeding tools and the experience gained from application of these tools to major crops provide tremendous potential for accelerating the improvement of crops that are being marginalized in developing country diets. One of the keys to CGIAR's success in crop improvement has involved the expansion of crops into new production regions, and many regionally important crops have shown significant potential for cultivation elsewhere. The recent rise of quinoa shows how global food supplies can be diversified through research and advocacy, against a background of growing consumer interest in diverse and healthy food alternatives. Given CGIAR's worldwide reach and broad experience with such crops, it is well positioned to facilitate crop-level diversification through several key steps:

- Identify regionally and locally important crop species – both among and beyond the current mandate

crops – that show potential for improved productivity, enhanced nutritional quality, and greater competitiveness under challenging conditions, and conserve as well as foster the use of their genetic diversity.

- Breed productive and resilient varieties of these crops; make these materials widely available to breeders and other researchers; facilitate their uptake through support for agricultural extension and training; and develop robust seed systems for their multiplication and distribution.

- Stimulate policy measures that strengthen market demand for these crops, both within and outside their traditional areas of distribution.
- Perform targeted biofortification of crops that are locally or regionally important to address nutrient deficiencies.
- Support education, advocacy, and policy development aimed at mitigating the effects of malnutrition through dietary diversification.

**Since the inception of CGIAR, diets in developing countries have shifted dramatically, including greater amounts of major oil crops and lesser quantities of regionally important staples.**

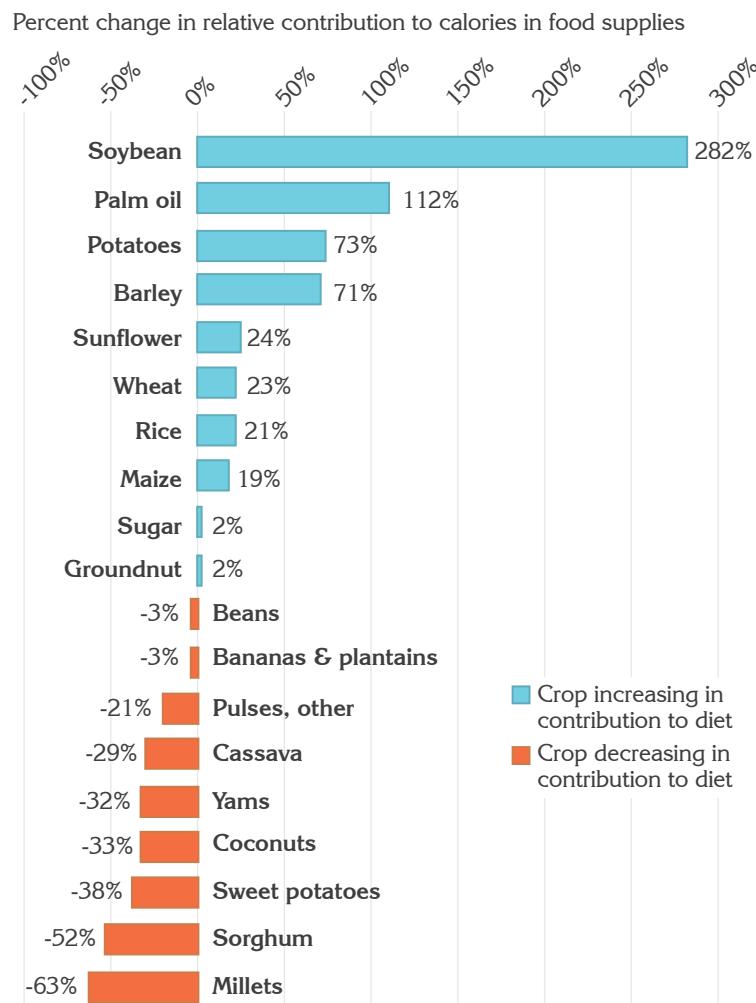


Figure 2. Median change in the relative contribution to calories from crops of interest to CGIAR in national diets in developing countries, 1969–2009.

Source: Adapted from Khoury et al. 2014.

## Systems-oriented research for food security

A comprehensive view of food security emphasizes both availability and access to adequate and nutritious food as well as empowerment of consumers to use this food for improved health. Over the long term, food security also requires actions to mitigate the negative ecological effects of food systems and adapt agriculture to future climatic variability and natural resource limitations. Achieving long-term food security thus requires a systems approach to agricultural research. From a crop diversity perspective, such an approach aims to build food systems in which a broad range of crops can flourish in terms of production, markets, and consumption.

The increasing homogeneity evident in diets in developing regions, in concert with the nutrition transition, raises the urgency for further research to explain the relationship between food diversity and human nutrition, and to translate the results of this research into forms that are useful for consumers. The rising healthcare costs prompted by diet-related non-communicable diseases will increase the demand for such research and advocacy.

Local and national food security depends increasingly on production stability in other regions, trade dynamics and related economic policies, and the price of non-renewable energy needed for large-scale production and transport. Research aimed at bolstering food security should include assessments of the appropriate balance between local production and importation. It is also critical for research to analyze trade policy and seek means to increase food safety within large-scale production, packaging, and transport systems.

Increasing urbanization worldwide lends real urgency to research needed for achieving sustainable food production in densely populated and peri-urban areas, and for overcoming micronutrient deficiencies in urban "food deserts."

Several food crops important in diets in developing countries – including sugar

crops and a number of oil crops (e.g., palm oil, coconut, and sunflower oil) – are not covered by CGIAR crop mandates. Vegetables and fruits also contribute importantly to protein and food weight, but the relative importance of the specific crop species belonging to these general commodity categories are not elucidated in globally comparable data on national food supplies. Furthermore, these statistics do not fully capture the total range of crop diversity produced and consumed in different

communities within countries, and this failure is especially marked for crops cultivated in small areas, such as vegetables in home gardens. The importance of such crops to food security, particularly for the poor, can be very significant. With the urgent need to increase availability and access to micronutrient-rich, lower calorie foods, the expansion of CGIAR research on vegetables and fruits is absolutely warranted. This research requires a more robust system for monitoring food crop

### Future climatic suitability for cassava, sorghum, and pearl millet gives hope for continued productivity.

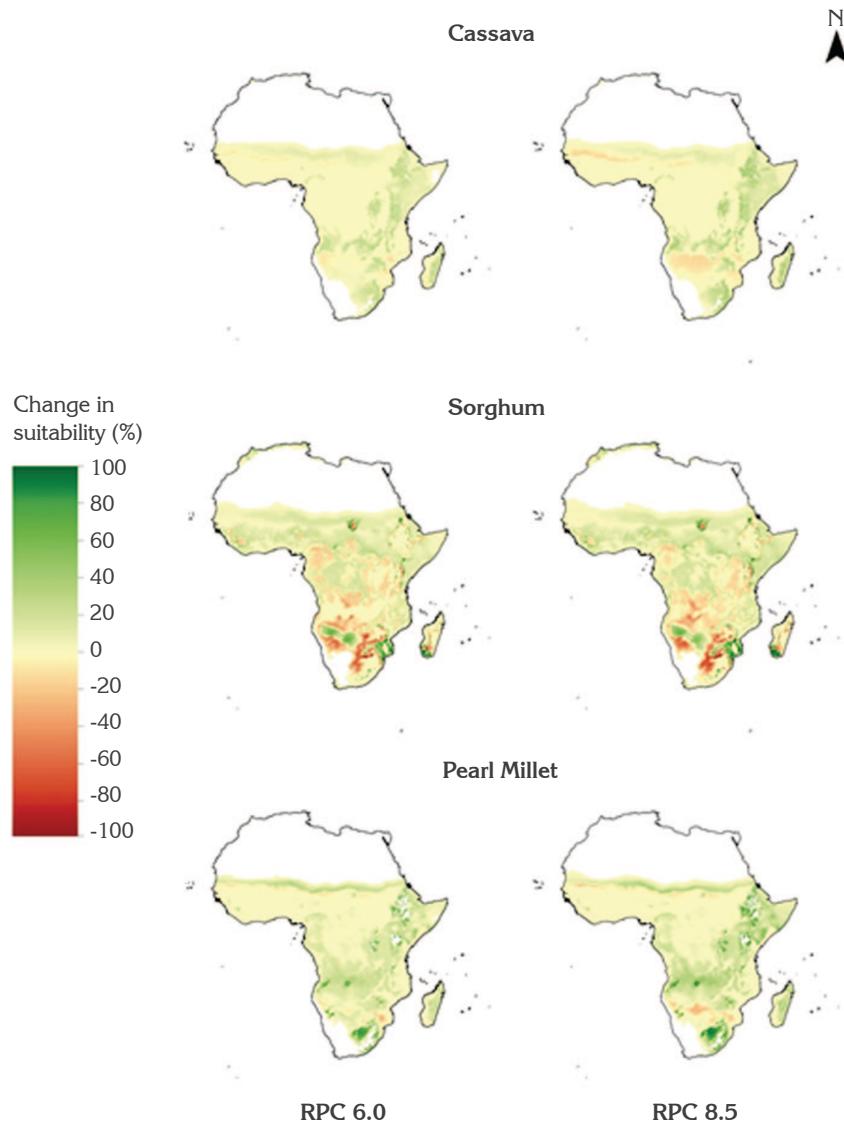


Figure 3. Projected changes (%) in climatic suitability for cultivation of selected crops by 2050 in sub-Saharan Africa as the average of 19 CMIP5 models (RCP 6.0) and 32 CMIP5 models (RCP 8.5).

production and consumption at the national, community, and household levels, in order to identify the full range of factors contributing to diets, to work to ensure that important diversity is not lost under changing food systems, and to conceptualize the options potentially available for further diversifying the global food system. The need for research focused on reducing post-harvest waste is also particularly acute for these crops.

The increasing importance of animal-derived products in developing-country food supplies provides a strong argument for further investments aimed at achieving sustainable livestock production, including more feed and forage crop research. Given the negative health impacts of over-consumption of energy-dense animal foods together with concerns about the environmental impact of livestock, CGIAR should help develop policies that promote healthier animal-derived foods with lower environmental impact, and it should

conduct research on attractive protein and fat alternatives to livestock products, including crops and potentially insects and microalgae.

### CGIAR funding and collaboration priorities

The complex, interrelated environmental, political, economic, and nutritional challenges associated with food security justify the allocation of over half (56%) of current CGIAR Research Program funding to various systems-oriented programs dealing with themes that range from drylands, humid tropics, aquatic agricultural systems, forests and agroforestry, and water to policy and markets, nutrition, climate change, and genetic resources conservation.

Funding for CGIAR Research Program crops generally parallels the importance of these crops for food supplies in developing countries, particularly in terms of calories (Figure 4) and less so for protein and fat (see Supporting

Information). Almost 70% of current funding on specific crops and livestock is directed toward rice, maize, and wheat, with 26% devoted to other mandate crops and 5% to animal products.

As research funding not only follows the importance of particular crops in food supplies, but also influences it, the elevation of diverse and relatively neglected cereal, pulse, root, and oil crops in global and regional food supplies will require increased investment. It is remarkable that CGIAR contributes so significantly to agricultural research, even though its funding represents only 3% of public investment in agricultural R&D worldwide. Since partnerships make this possible, CGIAR must strengthen its efforts to create new synergies with well-funded national agricultural research programs as well as with the private sector, which now accounts for over 20% of global agricultural research.

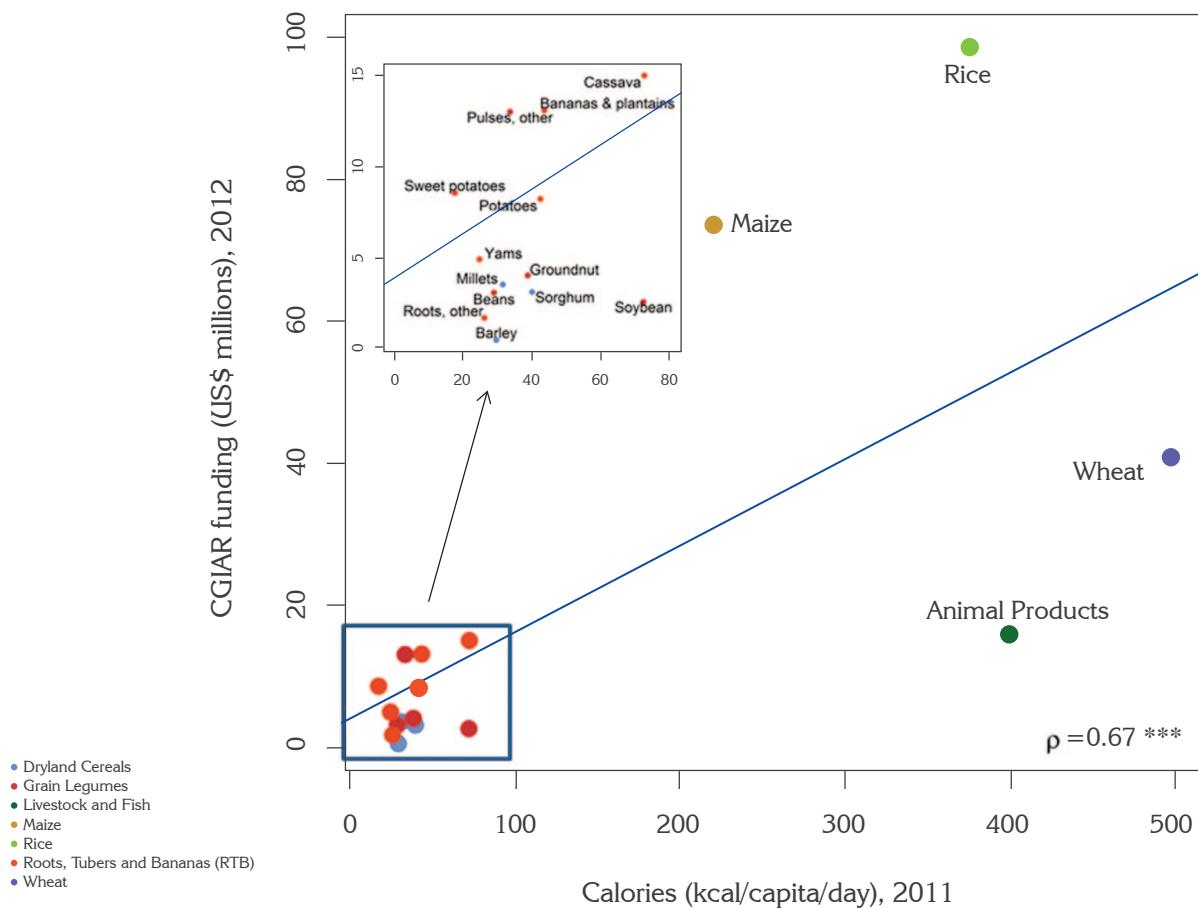


Figure 4. The importance of crops in mean food supplies in developing countries compared to current CGIAR crop research funding.

## Policy recommendations

CGIAR continues to play a critical role in the conservation and development of most of the food crops of greatest importance for the provision of calories, protein, and fat in developing-country diets. Its research has increasingly been contextualized within biodiversity conservation, natural resource management, and ecosystem function needs, and broadened to include the contribution of animal-derived foods to global production systems. Increased research on nutrition and health as well as policy and markets has expanded crop research beyond its original concern with macronutrient availability and identified key steps for extending the benefits of agricultural research to marginalized producers and consumers. These developments have been essential for widening the impact of CGIAR work on food security.

Given the significant changes in global diets documented here and their long-term implications for agricultural productivity and stability as well as human health, future research should:

- Continue to safeguard and improve major staple crops.
- Extend the benefits of emerging crops to more farmers in an eco-efficient manner.
- Aggressively promote the development of previously neglected crops that are resilient and nutritious.
- Address food security in a holistic manner through the development of ecologically sensitive and nutritionally diverse food systems.
- Better explain the relationships between food diversity and nutrition, while closely monitoring this diversity and advocating for its use to improve human health.

### Further reading

Khoury CK; Bjorkman AD; Dempewolf H; Ramírez-Villegas J; Guarino L; Jarvis A; Rieseberg LH; Struik PC. 2014. Increasing homogeneity in global food supplies and the implications for food security. *Proceedings of the National Academy of Sciences of the United States of America* 111(11):4001–4006. Available at: [www.pnas.org/cgi/doi/10.1073/pnas.1313490111](http://www.pnas.org/cgi/doi/10.1073/pnas.1313490111)

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See [supplementary information](#) attached.

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