Genetic resources for enriching diets and improving nutrition

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Where we are and where do we want to go?

Focus on leveraging potential of genetic resources for maximizing yields.

Increased focus on nutrition and need for diversity of nutrients.

Potential of genetic resources to select/co-develop nutrient-rich varieties demonstrated and increasingly utilized.

Evidence-base on importance of whole-of-diet diversity for human and planetary health strong, growing and increasingly emphasized.

Urgent calls for food systems transformation for improved nutrition, planetary health, equity and resilience.

Opportunities for leveraging the potential of genetic resources?
1. Address the multiple dimensions of malnutrition
We are experiencing a profound paradox
Global malnutrition is massive, and complex

690 million of the world’s population are undernourished

144 million children under five years of age are stunted

47 million children under five years of age are wasted

38 million children under five years of age are overweight

2.1 billion adults are overweight or obese

Hidden hunger remains significant but is shrouded in mystery

It’s often cited that:

“Over 2 billion people worldwide suffer from a chronic deficiency of micronutrients, a condition known as hidden hunger.” -- World Health Organisation, 2006

Yet we don’t know the state of micronutrient deficiencies in nutritionally vulnerable populations, such as children under five years of age, women and adolescent girls

Source: Development Initiatives: 2018 Global Nutrition Report
The double burden of malnutrition is rising in low- and middle-income countries

Evidence-base that species and genetic DIVERSITY can address multiple dimensions of malnutrition

- Increased adequate nutrient intake
- Reduced mortality rate

**Graph:**
- Mean nutrient adequacy ratio vs. dietary species richness for different countries.

**Table:**

<table>
<thead>
<tr>
<th>Multi-adjusted model</th>
<th>HR (95% CI)</th>
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<tbody>
<tr>
<td>10-species increment</td>
<td>$P&lt;0.001$</td>
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<tr>
<td>Q_2</td>
<td></td>
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<td>Q_3 (moderate)</td>
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<td>Q_4</td>
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<td>Q_5 (high)</td>
<td></td>
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</tbody>
</table>

**Note:** $P_{adj}<0.001$, Q_1 (low) is the reference.

**References:**
- Lachat et al. 2018, PNAS
- Giles-Hanock et al. 2021, forthcoming
Support access of genetic resources for a diversity of food types

How we should be eating
(Harvard's healthy eating plate model)

What we are actually producing
(According to 2011 FAO)

Source: Redrawn from data in KB KC et al. (2018)⁹⁴
Changes in relative abundance of crops
(1960–2009 in terms of calories)

Most research on the impact of climate change on the nutrient content of crops has focused on staple crops; to date, very few studies have examined how climate change may influence changes in production and consumption of non-staple food groups. More research is needed on how different kinds of crops – particularly those that are nutrient-dense such as fruits, vegetables, and legumes – will fare in a +2 C degree world.
2. Take a food systems approach, engaging with multiple actors and policies and bundling solutions
The strength of multi-functionality of genetic resources

Recognizing the megatrends shaping the future

Climate change
NCDs
Nationalism
Breakdown of multilateralism
Geopolitical shifts
Polarizing societies
Rising inequality
Demographics

Economic Risks
Environmental Risks
Geopolitical Risks
Societal Risks
Technological Risks

Risks
Number and strength of connections ("weighted degree")

Trends
Number and strength of connections ("weighted degree")

- Climate change
- NCDs
- Nationalism
- Breakdown of multilateralism
- Geopolitical shifts
- Polarizing societies
- Rising inequality
- Demographics

Growing middle class
Migration
Urbanization
Degrading environment

Food systems approach and genetic resources

Biodiversity for Food and Nutrition Project

- Context and partner-based approach – unique/novel
- Demonstrating value of nutrient-rich species
- Mainstreaming biodiversity across sectors
- Awareness
Biodiversity for Food and Nutrition Project

- E.g. Kenya
  - Farmer Business School: training, linking farmer groups directly to schools
  - Home-Grown School Feeding
Leveraging the potential of genetic resources potential in food-based dietary guidelines and nutrition policies

Analysis of nutrition and agricultural policies for agrobiodiversity inclusion Juventia et al. 2020

Increased attention for food-based dietary guidelines as connector between different food system related policies and guidelines

Food-based dietary guidelines (also known as dietary guidelines) are intended to establish a basis for public food and nutrition, health and agricultural policies and nutrition education programmes to foster healthy eating habits and lifestyles. They provide advice on foods, food groups and dietary patterns to provide the required nutrients to the general public to promote overall health and prevent chronic diseases.
Bundling of solutions

**FIGURE 1.** Entry and exit points for increasing net nutrition along the food value chain under climate change

Maximizing nutrition “entering” the value chain

- Improved varieties, biofortification, fertilizer, irrigation
- New production locations, diversification, CO2 fertilization, focus on female farmers, and extension
- Aflatoxin control, refrigeration
- Fermentation, drying, fortification, and product reformulation (to reduce salt, sugar, and unhealthy fats)
- Moving food from areas of shortage to areas of surplus, and targeting vulnerable groups
- Messaging on the importance of nutrition and sustainability, and the benefits of certain foods
- Home fortification with micronutrient powders, and training in nutritious food preparation, time management, and food preservation

Minimizing nutrition “exiting” the value chain

- Lack of access to inputs (seed, fertilizer, irrigation) and extension
- Limited availability of land, soil degradation, loss of biodiversity, temperature and water stress, and CO2 effects
- Contamination, spoilage, increased electricity demand, and damage from extreme weather events
- Improper processing of foods, nutrient losses during milling, use of unhealthy ingredients
- Climate impacts on transportation and retail infrastructure, and export/import impacts on prices and availability
- Advertising campaigns for unhealthy foods, and loss of small food retailers
- Lack of knowledge of nutrition, nutrient losses during preparation, and increased diarrheal disease

Source: Fanzo et al. (2017b).

Bundling of innovations

Innovative Food System Solution (IFSS) portal
3. Monitor indicators on genetic resources along the food system ‘to manage it, we need to measure it’
‘Movement’ of increasing transparency and traceability

Traceable supply chains mitigate operational and financial risk from systemic shocks like recalls, outbreaks and climate events.
Link to nutrition and food systems approaches for monitoring and tracking change
1. Consider the multiple dimensions of malnutrition
2. Take a food systems approach, engaging with multiple actors and policies and bundling solutions
3. Monitor indicators on genetic resources along the food system
Thank you