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Neglected and underutilized crops species

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I. Introduction

1. Agricultural productivity must be increased sustainably in order to eradicate hunger and malnutrition as committed to in the 2030 Agenda for Sustainable Development (SDGs)¹ and meet the projected 50 percent increase in demand for nutritious food between 2012 and 2050^{2,3}. The over 800 million people who are chronically hungry and the two billion who suffer micronutrient deficiencies worldwide underline the need to act. This situation is exacerbated by the ever more frequent erratic extreme weather events and the incidents of new strains and biotypes of pests and diseases in new areas, being symptomatic of climate change. Also, the limited natural resource base (especially arable lands and water) and many different socioeconomic drivers confound the efforts being made by governments, global and regional intergovernmental bodies, industry, academia, civil society and others to ensure that countries will achieve the SDGs.
2. Globally, there are almost 400 000 vascular plant species⁴. Of these, a little over 6 000 species have been actively cultivated for human consumption⁵. With this rich diversity available, the agricultural production systems globally depend on a narrow list of crop species. For example in 2013, only nine crops (sugar cane, maize, rice, wheat, potatoes, soybeans, oil palm fruit, sugar beet and cassava) accounted for 53 percent of global average daily calories⁶.
3. While such global averages mask the local diversity that still exists in many parts of the world, they also indicate that a business as usual approach will not avail farmers of the diverse suite of crops and varieties⁷ required for the sustainable agricultural production and food systems that would enable the achievement of the 2030 Agenda for Sustainable Development and the Sustainable Development Goals (SDGs). Clearly, the widest possible diversity of crops and their varieties must be harnessed as a means to increasing the production and productivity. Far too many nutritious, hardy and external input use-efficient crops which could be deployed in ecosystem-based, environment-friendly and climate change-resilient agricultural production systems are neglected or otherwise underutilized.
4. This paper introduces neglected and underutilized species (NUS), plants with prospective value as crops but which have been paid limited attention by agricultural researchers, plant breeders, seed companies and policymakers. Typically non-commodity crops, they include thousands of domesticated, semi-domesticated or wild species of cereals and pseudo-cereals, roots and tubers, fruits and nuts, vegetables, legumes, spices, condiments and food dye agents⁸. A database, INFOODS List of underutilized species contributing to the Nutritional Indicators for Biodiversity, of the International Network of Food Data Systems (INFOODS) of the Food and Agriculture Organization of the United Nations (FAO), lists the countries where more than 1000 unique NUS are found⁹.
5. Some of the critical constraints to the widespread cultivation and consumption of NUS are also highlighted. Additionally, the paper suggests areas for concerted interventions and identifies relevant prior and ongoing endeavours which may be built upon or otherwise leveraged. In making the case for the increased use of NUS for adapting crop production systems to climate change and for improving nutrition and livelihoods, it is also underscored that significant additional financial

¹ United Nations, "Transforming our World: The 2030 Agenda for Sustainable Development," 2015. http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E

² FAO. 2017. Food and Agriculture: Driving action across the 2030 Agenda for Sustainable Development. Rome.

³ FAO. 2017. The future of food and agriculture – Trends and challenges. Rome.

⁴ Royal Botanic Gardens, Kew, UK. State of the Worlds Plants 2016. <https://stateoftheworldsplants.com/2016/>.

⁵ Mansfeld's World Database of Agriculture and Horticultural Crops. <http://www.re3data.org/repository/r3d100010097>.

⁶ FAOSTAT Food Balance Sheets 2018.

⁷ FAO. 2011. Save and Grow: A policymaker's guide to the sustainable intensification of smallholder crop production. Rome.

⁸ Padulosi, S., Thompson, J., Rudebjer, P. 2013. Fighting poverty, hunger and malnutrition with neglected and underutilized species (NUS): needs, challenges and the way forward. Bioversity International, Rome.; also:

<http://www.nuscommunity.org/nus/neglected-underutilized-species/species-list/>

⁹ <http://www.fao.org/infoods/infoods/food-biodiversity/en/>.

resources must be dedicated to both research and development (R&D), including crop improvement, and for strengthening institutional and human capacities.

II. Opportunities for Mainstreaming NUS

6. The ongoing United Nations Decade of Action on Nutrition¹⁰ while recognizing the relative reductions in global undernourishment, aims to address the significant increases in malnutrition. The untapped diversity of NUS can contribute to achieving this aim, as they are important sources of nutrients - such as proteins, vitamins and micronutrients - which are in short supply from the carbohydrate-heavy major staple crops.

7. The increasing availability of "indigenous" vegetables in markets and supermarkets and on restaurant menus worldwide and increasingly in urban Africa is a promising trend towards the increased cultivation and consumption of NUS. For instance, in Nairobi, Kenya, restaurants serve dishes made from African nightshade, amaranth and leaves of cowpeas while the fresh produce can be purchased in the city – a reflection of the 25 percent increase in the cultivation of these vegetables in the country between 2011 and 2013¹¹. Thus, the enhanced consumption of NUS would improve both nutrition and the livelihoods of rural dwellers who would increase production to match the demand.

8. In addition, the diversification engendered by the cultivation of NUS enhances the resilience of production systems - especially to the vagaries of the abiotic effects of climate change, for instance drought and flooding and the biotic ones, such as new strains of pests and diseases. This is because the more diverse a system is, the less likely it would be that all its components would be uniformly vulnerable to the same biotic or abiotic stressors. Also, as many NUS are parts of low external input local production systems, it is also likely that they would thrive better than many staple crops in hitherto non-arable marginal environments.

9. Enhancing NUS implies working towards achieving many different SDGs at the same time. Care has to be taken to avoid overharvesting of wild or semi-domesticated NUS. For domesticated NUS, concerted action by a multiplicity of stakeholders is required to translate their potential into improved production on-farm, diversified value chains, improved household diets and enhanced incomes and livelihoods.

10. After decades of neglect, R&D endeavours to unlock the inherent potentials of NUS must now be accelerated. Areas of intervention would include, among others: genetic characterization and assessment of nutritional quality; breeding for improved yields, quantitatively and qualitatively, and robustness; integration of NUS into diversified cropping systems; development of value chains and awareness raising about NUS nutritious values^{12, 13}. Interventions are needed to facilitate the changes required to both generate and meet market demands and hence the incentives to remove constraints along the entire value chain. Other needs include the strengthening of human and institutional capacities, especially for R&D activities. It is also important to increase the availability of high quality seeds and planting materials of such crops and their varieties; to improve extension services; and to strengthen advocacy efforts to create an enabling policy environment for enhancing NUS at country level. Combined, these changes would achieve year-round sustainable agricultural and food systems that are resilient to shocks, efficient and profitable and engender innovative agri-business opportunities for fresh and processed nutritious products.

¹⁰ United Nations Decade of Action on Nutrition. <http://www.who.int/nutrition/decade-of-action/en/>.

¹¹ Cernansky, R. 2015. Super Vegetables. *Nature* 522:146-148. <https://www.nature.com/news/the-rise-of-africa-s-super-vegetables-1.17712>

¹² Hughes, J.d'A., Ebert, A.W. 2013. Research and development of underutilized plant species: the role of vegetables in assuring food and nutritional security. *Acta Hort.* 979, Vol. 1, 79-91.

¹³ Ebert, A.W. 2014. Potential of underutilized traditional vegetables and legume crops to contribute to food and nutritional security, income and more sustainable production systems. *Sustainability* 6, 319-335. <https://doi.org/10.3390/su6010319>.

11. The following are examples of a FAO global instrument and endeavours, together with partners, to enhance the use of NUS. These could be built upon and their outputs adapted to the various contexts in which the increased use of NUS add value to efforts to create sustainable food systems.

- i) The Second Global Plan of Action for Plant Genetic Resources for Food and Agriculture¹⁴ is the globally agreed framework for the conservation and sustainable use of plant genetic resources for food and agriculture. Its Priority Activity (PA) 10 is dedicated to “promoting diversification of crop production and broadening crop diversity for sustainable agriculture” while the PA 11 is aimed specifically at “promoting development and commercialization of all varieties, primarily farmers’ varieties/landraces and underutilized species”. Countries’ progress with the implementation of these and other 16 PAs are published through the FAO-managed platform, the World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture¹⁵ and will be an integral part of the forthcoming Third Report on the State of the World’s Plant Genetic Resources for Food and Agriculture.
- ii) The NUS Community. Managed by Bioversity International, a CGIAR center, this web portal¹⁶ is dedicated to providing support tools for research on, and promotion of, the use of NUS. It serves as a repository for research results and varied information, news and literature and policy advice on the use and conservation of NUS. The platform aims to strengthen food security, build more resilient and climate-smart agriculture, and empower people through income generation and revitalized local food cultures.
- iii) FAO launched the Future Smart Food (FSF) Initiative *inter alia*, to promote the widespread cultivation and consumption of NUS as means to improved nutrition and enhanced productivity and resilience of agricultural and food systems. The FSF Initiative – with 30 national and international organizations collaborating – is being implemented under the auspices of FAO’s Regional Initiative on Zero Hunger Challenge for the Asia and Pacific Region (RI-ZHC)¹⁷. As part of the RI-ZHC, Cambodia, Lao PDR, Myanmar and Nepal are being assisted with the mainstreaming of NUS in their National Food Security and Nutrition Strategy through the Regional Technical Cooperation Project (TCP) "Creating Enabling Environments for Nutrition-sensitive Food and Agriculture to Address Malnutrition".
- iv) Crops For the Future (CFF), an AIRCA (Association of International Research and Development Centers for Agriculture) center conducts research on underutilized crops and has developed a global knowledge base to support value chains under current and future scenarios. In 2017, CFF launched the Forgotten Foods Network (FFN) as a global repository on recipes, uses and nutritional values of ingredients and products from NUS.
- v) The African Orphan Crop Consortium (AOCC) is a collaboration between the African Union Commission, African governments (through the New Partnership for Africa's Development (NEPAD)), international organizations (FAO, United Nations Children's Fund (UNICEF)), companies (Google, Mars), scientific bodies and civil society organizations to improve the nutritional values of the food crops that 600 million rural Africans depend on. The AOCC aims to sequence the genomes of 101 crops by the end of

¹⁴Food and Agriculture Organization of the United Nations: Second Global Plan of Action on Plant Genetic Resources for Food and Agriculture. Rome: FAO; 2011.

¹⁵ World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture.
<http://www.fao.org/wIEWS/en/>

¹⁶ NUS Community. <http://www.nuscommunity.org/about-us/the-nus-community/>

¹⁷ FAO, Future Smart Food: Unlocking hidden treasures in Asia and the Pacific, Policy brief on Agricultural diversification for a healthy diet, Regional Initiative on Zero Hunger Challenge, 2017, <http://www.fao.org/3/a-i7717e.pdf>.

2019 for this data to be used to breed more nutritious crops. The third cohort of African scientists will graduate in 2018 from its African Plant Breeding Academy in Nairobi, hosted by the World Agroforestry Centre, and graduates have returned to their home countries to establish national and regional orphan crops consortia.

III. Conclusion

12. A significantly increased cultivation and consumption of NUS, clearly relevant to the United Nations Decade of Action on Nutrition, will be a contribution to the efforts to eliminate hunger, malnutrition and poverty by 2030 as committed to in the SDGs. It will also enable countries to increase resilience and better adapt their agricultural production systems to climate change. However, significant obstacles have to be overcome in the quest to increase the cultivation and consumption of NUS. The obstacles, which occur along entire value chains, can be addressed through R&D and suitable policy frameworks. FAO's ongoing efforts to mainstream NUS into national programmes signal the Organization's commitment to leverage solutions in the multi-pronged campaign against hunger and malnutrition and precarious production systems that are unsustainably underpinned by only few crops. Efforts will continue to target the development of appropriate national strategies and policies to promote diversification of cropping systems, enable R&D and the uptake of their outputs. Importantly, FAO will continue to facilitate multi-stakeholder engagements to permit the sharing of experiences and the pooling of resources. However, significant amounts of additional financial resources are required to generate and adapt such innovative solutions and to strengthen human and institutional capacities.