Bioversity International

Book of Abstracts

11th IFDC PRE-CONFERENCE WORKSHOP IV

Biodiversity for improved nutrition and health: The critical role of food composition in decision making for agriculture and nutrition programming and policy

02 November 2015 - Hyderabad, India

Biodiversity for improved nutrition and health: The critical role of food composition in decision making for agriculture and nutrition programming and policy

11th IFDC Pre-Conference Workshop IV

Hyderabad, India, 2 November 2015

Book of Abstracts

Bioversity International is a global research-for-development organization. We have a vision – that agricultural biodiversity nourishes people and sustains the planet.
We deliver scientific evidence, management practices and policy options to use and safeguard agricultural and tree biodiversity to attain sustainable global food and nutrition security. We work with partners in low-income countries in different regions where agricultural and tree biodiversity can contribute to improved nutrition, resilience, productivity and climate change adaptation.

Bioversity International is a member of the CGIAR Consortium – a global research partnership for a food-secure future.

www.bioversityinternational.org

Bioversity International Headquarters
Via dei Tre Denari 472/a
00057 Maccarese (Fiumicino) Rome, Italy
Tel (+39-06) 61181
Fax. (+39-06) 6118402

Cover Photo: Traditional Sri Lankan dishes and vegetables.
Please credit: Bioversity International/S.Landersz

Contents

Biodiversity for improved nutrition and health: The critical role of food composition in decision making for agriculture and nutrition programming and policy, 11th IFDC Pre-Conference Workshop IV: Hyderabad, India, 2 November 2015

Background

Food composition data are an essential yet often underutilized resource to help decision making and planning for nutrition programming and policy decisions. Food composition data could be used much more widely to inform a wide array of stakeholders within multiple sectors including agriculture, health, education and trade. This preconference session will explore how food composition data can be used in nutrition programming as well as for influencing diverse national policies and social protection programmes. We will look at a wide range of programmatic uses of food composition data, including breeding for nutritional outcomes, selection of locally available foods for national programmes such as school feeding and use of intra-specific diversity to promote resilience and greater opportunities for dietary diversification. Case studies that illustrate diverse uses of food composition data for nutrition programing and policy setting will be presented.

Purpose:

- To provide examples from around the world of the role of food composition data in supporting nutrition programme and policy decision making;
- To discuss with participants experiences and opportunities for their own countries.

Who will benefit:

This session is for professionals who work on food-based approaches to improve nutrition and are interested in learning about experiences with using food composition data to influence nutrition programming and decision making.

Outcomes:

A greater understanding of how to use food composition data to leverage decision making for nutrition programmes and nutrition policies, with a focus on national level programming and decision making.

Sponsors:

The event is sponsored by Bioversity International a global research-for-development organization. We have a vision – that agricultural biodiversity nourishes people and sustains the planet.

We deliver scientific evidence, management practices and policy options to use and safeguard agricultural and tree biodiversity to attain global food and nutrition security. We work with partners in low-income countries in different regions where agricultural and tree biodiversity can contribute to improved nutrition, resilience, productivity and climate change adaptation.

Agenda

2 November 2015

9.00-9.10	***Welcome*** **Thingnganing Longvah**, National Institute of Nutrition, India
9.10-11.00	**Session I: Country Case Studies Using Food Composition Data for Nutrition and Agriculture Programing and Policy** Chair: **Ruth Charrondiere** Rapporteur: **Anna Vincent**
9.10-9.30	Nutritional Data for Effective Mainstreaming Biodiversity into Policy and Programs: Opportunities for the BFN Project in Kenya (**John Mwai**, *Ministry of Health*, Kenya)
9.30-9.50	Mainstreaming Biodiversity Conservation and Sustainable Use for Improved Human Nutrition and Well-being (Biodiversity for Food and Nutrition Project – BFN Project) in Sri Lanka (**W.L.G Samarasinghe**, *Plant Genetic Resources Center*, Sri Lanka)
9.50-10.10	Biodiversity for Improved Diets, Nutrition and Livelihoods: the Importance of Food Composition Data in Decision Making for Agriculture, Nutrition and Policy in Turkey (**Nurcan A. Guzelsoy**, *Bursa Central Research Institute of Food and Feed Control*, Turkey)
10.10-10.30	Food Composition Analysis and its Importance for Inclusion and Promotion of Native Underutilized Species on Public Policies (**Raquel Santiago**, *Universidade Federal de Goiás*, Brazil)
10.30-10.50	Studying the Contribution of Wild Foods to Nutrition in Central Tunisia, the Sidi Bouzid Case Study: Preliminary Results, Methodological Challenges and Reflections on Linkages with Agricultural Policies (**Marie-Claude Dop**, *Institut de Recherche pour le Développement, France*)
10.50-11.15	***Coffee and Tea Break***
11.15-13.00	**Session II: Indian Perspective: Use of Food Composition Data for Programmes and Policies in India** Chair: **Thingnganing Longvah** Rapporteur: **Nkechi Ene-Obong**
11.15-11.35	Deploying Small Millets in Food and Nutritional Security (**Mr. N. Kumar**, *M.S. Swaminthan Research Foundation, India*)
11.35-11.55	Rice Breeding Programme for Nutritional Security (**Dr. Ravindra Babu**, *Directorate of Rice Research in India*)
11.55-12.15	Importance of Composition Data in Vegetable Breeding Programme for Improved Nutrient Security (**Pritam Kalia**, *Indian Agriculture Research Institute*)
12.15-12.35	Biodiversity Interventions an Insurance Against Nutrition and Health Security (**Dandin Shankar**, *Bioversity International, India*)
12.35-12.55	Edible Insect Species Commonly Used as Food by the Indigenous Tribes of Nagaland, India (**Dr. Kruolalie Tsurho**, *Nagaland Bio Resource Mission, India*)
13.00-14.00	***Lunch Break***

14.00-17.00	**Session III: International Perspectives** Chair: **Gina Kennedy** Rapporteur: **Norma Saman**
14.00-14.20	The Chronology of Banana as a Source of Provitamin A Carotenoids and its Potential Contribution to Alleviation of Vitamin A Deficiency Among Vulnerable Population Groups (**Beatrice Ekesa**, *Bioversity International, Uganda*)
14.20-14.40	Food System and Nutritional Challenges of the Indigenous People of Northeast India (**Thingnganing Longvah**, *National Institute of Nutrition, India*)
14.40-15.00	Wild Edible Plants Valorization: Sustaining the Moroccan Traditional Diet (**Rekia Belahsen**, *Université Chouaib Doukkal, Morocco*)
15.00-15.20	UN Initiatives Linking Biodiversity to Nutrition Programing and Policy (**U. Ruth Charrondiere**, FAO, Italy)
15.20-15.45	***Tea Break***
15.45-16.30	Open Discussion
16.30-17.00	Conclusions and Wrap-up (**Gina Kennedy**, *Bioversity International, Italy*)

Abstracts

Session I
Country Case Studies Using Food Composition Data for Nutrition and Agriculture Programing and Policy

Nutritional Data for Effective Mainstreaming Biodiversity into Policy and Programmes: Opportunities for the BFN Project in Kenya

Victor Wasike, John Mwai, Angela Kimani, Teresa Borelli and Danny Hunter
Senior Research Officer, Kenya Agricultural Research Institute, Nairobi, Kenya
✉ victor.wasike58@gmail.com

Biodiversity is often considered by local communities in Kenya as an option for the provision of food, feed, medicines and to meet other cultural needs. Yet information on its nutritional content is seldom available or widely shared. While policy makers often refer to indigenous biodiversity as "rich," "healthy", "superior" or "tasty", data to support such statements is scant. This has limited effective mainstreaming of biodiversity conservation and use into relevant supportive policies and programmes in Kenya. The Biodiversity for Food and Nutrition (BFN) project in Kenya has prioritized 20 commonly consumed species or varieties in Busia County, Kenya. Some varieties of these species have been analyzed for nutrient composition in ISO approved laboratories in Turkey. This data and other supportive information is being used to raise awareness on the nutritional value of indigenous biodiversity in the country. This information has afforded the BFN-Kenya project a major opportunity for embedding biodiversity into already established national coordination/collaboration mechanisms such as the Scaling Up Nutrition (SUN) initiative and the National Biodiversity Strategy and Action Plan (NBSAP) process, as well as for influencing policy, advocacy and cross-learning. Data is also reinforcing an already increasing recognition among stakeholders of the (potential) contribution of agricultural biodiversity to achieve nutritional outcomes in communities. The express pronouncement, informed by nutritional data, by policy makers that there is an urgent need for agriculture and nutrition to work together for effective delivery of nutritional outcomes is key.
This paper will share experiences on how BFN Kenya is using analytical nutritional data to influence nutritional outcomes in the Busia County. Dissemination of this information to County stakeholders will continue to assist in the promotion of best practices for incorporating indigenous species, promote dietary diversity, conservation of plant and animal genetic resources, marketing of indigenous biodiversity, creating and raising awareness on the value of indigenous biodiversity. It will also help better inform policy at the County level with Busia set to be the first County out of the 57 in Kenya to realize a biodiversity policy. A policy which will recognize and highlight the value of biodiversity in health care systems and school feeding programmes in the county and in Kenya in general.

Mainstreaming Biodiversity Conservation and Sustainable Use for Improved Human Nutrition and Well-being (Biodiversity for Food and Nutrition Project – BFN Project) in Sri Lanka

W.L.G. Samarasinghe, A. Wijesekara and Danny Hunter
National Project Coordinator, Plant Genetic Resources Centre, Gannoruwa, Peradeniya, Sri Lanka
✉ gaminisam@yahoo.com

Biodiversity of plants and animals with high nutritional properties can contribute significantly to the dietary diversity, livelihoods and well-being of millions of individuals in countries all over the world. Sri Lanka has been identified as one of the countries in Asia with a very high degree of biodiversity. The BFN project objective is to strengthen the conservation and sustainable management of agricultural biodiversity through mainstreaming into national and global nutrition, food and livelihood security strategies and programmes. Three pilot sites; Udukumbura (Kandyan home garden), Gampola (cascading system) and Niwunella (Owita system) were chosen. Baseline assessments for biodiversity and nutritional status were completed in two sites. The baseline research revealed that people consumed in very small proportions from the minimum 400g of fruit and vegetables per day recommended by the World Health Organization. Also reported that home gardens in the Wet zone of Sri Lanka have increasingly been replaced by cash crop cultivation. Traditional varieties of rice (7), banana (5), yams (4), brinjal (2), finger millet, jack, green gram, cowpea and leafy vegetables (3) were identified for detailed food composition analysis. The Traditional Food Festival and the International Symposium on Biodiversity and Nutrition organised were another successful example of country efforts to raise awareness of BFN. Market outlets for agrobiodiversity and traditional foods were opened in several locations in the country by Department of Agriculture. The market outlets are run by women farmers selected among women organizations in the area and subsequently trained by the Women Farmers Extension Program of the Department of Agriculture, a partner of the BFN Project in Sri Lanka.The Project would enable Sri Lanka to accelerate the implementation of the national priorities and policies at a time when the country is facing a nutritional food crisis due to price rises in imported foods and a decline in the quality of diets throughout the country.

Biodiversity for Improved Diets, Nutrition and Livelihoods: the Importance of Food Composition Data in Decision Making for Agriculture, Nutrition and Policy in Turkey

Nurcan A. Guzelsoy, Isa Ozkan, Birgul Guner, Ayfer Tan, Kursad Ozbek, Saadet Tugrul Ay
Bursa Central Research Institute of Food and Feed Control, Bursa, Turkey
✉ nurcanaysar@yahoo.com

Turkey is home to a rich local biodiversity especially in the three biogeographic regions of the Aegean, Black Sea and Mediterranean each with its own endemic species and natural ecosystems. The GEF-Supported Biodiversity for Food and Nutrition (BFN) Project is working in these three regions. These geographic regions are the richest in terms of biodiversity, in particular edible wild species.

Wild species and landraces are very widespread in Turkey and commanly consumed by local people. However, there are few studies on the nutrient content of these food. For the BFN Project 43 wild edible species and landraces were prioritized and analyzed to expand the nutrient composition information available. Proximates, dietary fiber (DF), vitamins and minerals were assayed using standard methods and reference materials. Preliminary findings from the study demonstrates that some wild edible species could potentially contribute towards the requirements for specific nutrients in daily diets.

In this study a wide variability on vitamin and mineral content was obtained among the analysed wild species. Chicory, Indian knotgrass, watercress and purple salsify are some of the species which can be highlighted for their high contribution to microelement nutritional intakes since a 100 g portion of their leaves would provide nearly 100% of the daily recommended intake for iron. Among the species analysed, foxtail lily stands out with the highest value of vitamin C (129.4 mg/100 g) which is in the range of the recommended daily intake (RDI) for adults (75 mg/day for women and 90 mg/day for men), according to the Food and Nutrition Board (2000).

Regarding landraces, Triticum monococcum is one of the prioritized species with many landraces with high nutrient content found in the Black Sea Region pilot site and which are used in the production of bulgur (a traditional local food made from cracked wheat). The ancient preparation process is still used in small villages in the Central and Eastern Anatolia Regions. Because of high nutrient content (some landraces are rich in fiber, B-vitamins, iron and magnesium) further agricultural research is being carried out to promote improved sustainable use. After molecular characterisations of 37 accessions of T. monococcum collected from 8 provinces, grain quality characteristics will be determined. Also studies are going on for the improvement of production systems. Marketing opportunities with national and local initiatives (i.e. Association of Siyez Producers) and market chains are being explored especially with some landraces which may have low gluten content.

The food composition data of these species will be shared with relevant sectors (food, agriculture and health) to improve awareness of the value of local wild edible species as well as potentially useful landraces. In Turkey, national nutrition programming is spearheaded by the Ministry of Health which is one of national partners in the BFN project in Turkey. Scientists, doctors, dietitians can also use food composition data to design personal nutrition programmes for example through national dietary guidelines and in schools and education. Further, by developing value chains for selected wild edible species and landraces the benefits of conserving, collecting or cultivating will be returned to farmers and rural communities. In this regard the BFN Project is looking at support payments which can be made to farmers to grow specific landraces of T. monococcum, while guidelines on the sustainable harvesting of wild species for collectors for the purpose of conservation and sustainable use of biodiversity have been prepared, the 'Foraging Collecting Guide Of Edible Wild Plants'.

Other approaches the project is taking to build on the improved knowledge base of wild edible species and landraces is through support to high profile food festivals such as those of Alacati and Siyez. Various symposiums are planned to promote wild species. In 2015 the Alacati Herb Festival was organized to introduce a wide range of biodiverse plants which have been used traditionally for centuries both as edible foods and for medicinal purposes. Additionally an international symposium named "International Symposium on Biodiversity and Wild Edible Species" will be held in Antalya in 2016 with the aim of improving their mainstreaming, conservation and sustainable use.

Food Composition Analysis and its Importance for Inclusion and Promotion of Native Underutilized Species on Public Policies

Daniela Moura de O. Beltrame, Camila Neves Soares Oliveira, Raquel C. Santiago, Deborah H. Markowicz Bastos, Lidio Coradin, Danny Hunter
National Project Coordinator, Ministry of Environment, Brazilia, Brazil
✉ dani.moura.oliveira@gmail.com

Biodiversity and health are tightly bound together with multiple benefits of biodiversity for improved nutrition and food security. In recent years, the direct and indirect dependence and impact of human nutrition on biodiversity has been increasingly acknowledged by the health, agriculture and biodiversity sectors. However, agricultural programmes and policies continue to focus on increasing the production of a few staple crops, and their success is measured in terms of the food quantity or dietary energy supply.

Brazil is home to the world's greatest biodiversity, representing around 15 to 20% of the total number of species on Earth, much of it is edible and nutritious, yet neglected or underutilized. Brazilian agriculture is mostly based on few (and exotic) species (sugar cane, coffee, beans, rice, soy, orange, corn and wheat). This directly reflects on the population dietary habits: as example, according to individual food consumption data of the last Brazilian Household Survey (POF 2008-2009), only 10 fruits (orange, banana, apple, papaya, mango, watermelon, tangerine, grape, pineapple and acai) represent 91% of the total fruit consumed by the population and, out of this 10, only acai and pineapple are from native biodiversity. Besides, Brazil faces high rates of overweight, obesity and micronutrient deficiencies across different population groups.

Recent studies show that an increase in individual dietary diversity scores is related to increased nutrient adequacy, health and micronutrient density of diets. However, to successfully transform the enabling environment for biodiversity to improve nutrition, significant knowledge and evidence gaps still need to be addressed.

Nutritional data about native edible species are scarce and, to date, there is not a comprehensive online food composition database in Brazil. Aiming to increase the knowledge base about Brazilian biodiversity and provide evidence for the inclusion of native species on public policies related to Food and Nutrition Security, the BFN Project is conducting nutritional analysis of 70 edible plant species, previously identified by the "Plants for the Future" initiative, an ongoing project of the Brazilian Ministry of the Environment intended to identify and document native species with economic potential. To this end, partnership with four Federal Universities was established for data compilation and laboratorial analysis.

The nutritional data generated by the BFN Project will be available online for researchers, nutritionists, students, policy makers and the general public, at the Biodiversity Nutritional Composition Database, currently being developed by UNEP-WCMC as part of the Information System on Brazilian Biodiversity (SiBBr).

With the nutritional database, BFN will provide evidence for the inclusion of nutritious native species in public policies, programmes and initiatives focused on food and nutritional security, promotion of healthy and diversified diets and those linking biodiversity conservation to income generation, including the Food Acquisition Programme (PAA), the National School Meals Programme (PNAE), the National Food and Nutrition Policy (PNAN) and the Minimum Price Guarantee Policy for Biodiversity Products (PGPM-Bio). Besides, the number of native species from Brazilian biodiversity included on the nutritional database was proposed as one of the indicators to monitor the country's biodiversity status and progress in achieving the National Targets 2011-2020, during the NBASPs National Biodiversity Strategies and Action Plans (NBSAPs) revision process.

Nutritional composition data of native species can be used as an advocacy tool for their promotion on the public initiatives and allocation of incentives for improving production and market chains of these foods. Furthermore, combined with other factors such as the resilience capacity, adaptation to the local environment and traditional culture and knowledge associated with the production and use of many foods derived from native biodiversity, the knowledge about the nutritional properties of native underutilized species may help to foster greater appreciation and cross-sectoral collaboration, which is essential to provide the enabling environment for effective promotion of biodiversity into relevant policies, programmes and national and regional plans of action on food and nutrition security.

Studying the Contribution of Wild Foods to Nutrition in Central Tunisia, the Sidi Bouzid Case Study: Preliminary Results, Methodological Challenges and Reflections on Linkages with Agricultural and Biodiversity Policies

Marie Claude Dop, Fayçal Kefi, Olfa Karous, Zeineb Ghrabi, Jalila El Ati, Youna Hemery, Claire Mouquet-Rivier, Sylvie Avallone, Celine Termote, Gina Kennedy and the MEDINA study group.
Nutripass research unit, Institut de Recherche pour le Développement, Marseille, France
✉ marieclaude.dop@ird.fr

The Sidi Bouzid case study is part of the MEDINA research project entitled "Promoting sustainable Mediterranean food systems for good nutrition and health". The objective of the case study is to assess the contribution of wild foods and agriculture in providing healthy diets to women in an agricultural region of Tunisia and to propose policy options to preserve or improve dietary quality. Research questions specifically relating to wild foods are: What is their nutrition contribution? Which segments of the population use these foods?

Context:
The Sidi Bouzid governorate of Central Tunisia experienced rapid agricultural development in the decades following independence (1956) as a result of large public investments in irrigation infrastructure. Since the 1990's however public investment in irrigation was scaled down considerably while private investments in large farms for export have grown rapidly. Overuse of water resources due to deep drilling of aquifers by large farms is making access to irrigation more difficult for small-holder households causing loss of agricultural employment and out-migration. Meanwhile Tunisia is undergoing a nutrition transition and overnutrition is common in both the urban and rural sectors while micronutrient deficiencies are still prevalent.

Material and methods:
The study is multidisciplinary and uses four methodological approaches: 1) an ethnobiological assessment, 2) food composition analyses 3) a nutrition survey and 4) an agricultural survey.
The qualitative ethnobiological study (April 2014) was carried out to identify wild foods consumed by the local population and to describe their availability and food uses. Key informants from local administrations, farms and a WEP vendor were interviewed. Seven focus group discussions were conducted. Samples of wild edible plants were collected, identified and deposited in the National Herbarium.
Nutritional analyses were performed on wild and cultivated edible plants for which compositional data were not available or scarce in the scientific literature.
A nutrition survey (November 2014-October 2015) is currently underway. It includes 4 rounds of dietary assessment (24-hour dietary recall and an FFQ of wild food consumption with a recall period of 3 months), an FFQ of physical activity (3 rounds) and anthropometric measures (2 rounds). Respondents are women of child bearing age (n=740) selected from the population of the governorate by stratified cluster sampling.
The quantitative agricultural survey will be carried out shortly (end of 2015) in the households of the rural stratum of the nutrition survey.

Preliminary results:
The ethnobiological study identified 30 species of wild edible plants (WEPs) consumed by the population. Most of the WEPs are leafy vegetables. One-hundred and sixteen samples were deposited in the Tunisian National herbarium (INAT). Most WEPs were reported to be available during the winter and spring. The most widely consumed are fennel leaves, false-rocket, wild swiss chard, wild garlic, wild leak, cardoon and malva. Respondents believe that WEPs are healthy foods. They are mostly consumed fresh as part of traditional recipes (couscous, stews, flat bread). Traditional recipes were recorded.

The nutritional analyses show a high concentration of βcarotene, folate, potassium and calcium in the dark green leafy vegetables.

Methodological challenges:
We faced several methodological and practical challenges in the study. Firstly, the distinction between wild and cultivated plants was not always straightforward; for example wild fennel (Anethum graveolens) seeds are planted and cultivated. Secondly, identification of WEPs by their vernacular name was sometimes difficult because different species had the same name. A photographic identification guide was developed to overcome this issue. Thirdly, due to security problems for accessing the field the number of samples of WEPs analyzed remains low and new analyses will have to be planned. Finally, the choice of dietary assessment protocol was difficult. Since different WEPs grow at different seasons, ideally dietary assessments should cover the whole year. Short term recall, often used in the published studies, risks underestimating the intake of wild foods. Retrospective assessments are preferable but are cumbersome and lack precision. We overcame this difficulty by using simultaneously a short recall method and an FFQ for the consumption of WEPs with repetitions in order to cover a whole year.

Availability of wild foods and agricultural policies:
WEPs are abundant in the environment of small farms of the Sidi Bouzid governorate. Irrigation tends to increase the availability of some WEPs which grow spontaneously in and around irrigated plots. Wild fennel, for instance has become more abundant and very popular with the development of irrigation. These abundant WEPs could be a key dietary resource for poor women who cannot easily access vegetables from markets. However, modern agricultural practices such as mechanization and use of herbicides decrease the availability of WEPs. The shift from small-holder farming to large farms producing for export will inevitably decrease the availability of WEPs and their contribution to nutrition.

Tunisian policies for the conservation and use of biodiversity:
Tunisia ratified the Convention on Biological Diversity in 1993. The first National Action Plan was developed in 1998 and a new plan is underway. Several inventories of biodiversity have been conducted at national level. Currently most in-situ interventions focus on biodiversity of food crops that have a high export value, for example local varieties of olive trees, date palms and durum wheat. There is to date a lack of recognition by policy decision makers of the potential role of wild edible plants for ensuring healthy diets in the context of the nutrition transition. The results of the MEDINA research project will help raise awareness of the nutritional and health potential of wild edible plants and of the need to consider them when developing health, agricultural and biodiversity policies.

Acknowledgments: The authors are grateful to Cecile Caperan (engineer), Christian Picq (technician), Charlotte Morgant, Bthissam El Hadrati, Sondos Njoumi, Louise Seconda (interns) for their work in the lab and in the field and to the staff of the Regional Agricultural Development Centre (CRDA), Women's extension service (UVF) and Technical Extension Services (CTS) of the Sidi Bouzid governorate for their collaboration. The study is funded by the French Agence Nationale de la Recherche and Bioversity International.

Deploying Small Millets in Food and Nutritional Security

E.D. Israel Oliver King, N. Kumar
Principal scientist, M.S.Swaminathan Research Foundation, Namakkal Tamil Nadu, India
✉ ediok151173@gmail.com

Neglected and Underutilized Species (NUS) such as small millets, quinoa, amaranth, yams and buckwheat have been advocated for their expanded use for more than a decade. The research and promotional programmes on NUS suggest that these crop species should be considered more closely to support sustainable diets for their nutritional values specificity (anti-diabetic, non-gluten, micronutrient rich etc. (Taylor et al, 2013) and role in climate-resilient agricultural systems (IPGRI *et al.*2005, FAO and Bioversity 2012, Padulosi *et al.* 2002, 2011, 2012, 2013, Bioversity 2014). Since early 2001, an IFAD funded project investigated the potential of traditional small millets in enhancing their production thereby contributing to income, climate change adaptation and food security, especially in the marginal areas of India where these crops are also very important for local cultural identity, food security and nutrition. Owing to increasing pressure from market driven cash crops, farmers are increasingly switching to alternative crops such as tapioca, maize and vegetables. This pressure has led to diversity loss of NUS, consequently shrinking the food basket and causing negative impacts on environment and food and nutritional security. The key problems leading to such a switch is poor yield despite high labor demand for cultivation of such crops. Moreover, the key bottleneck for continued use at the domestic level and reaching out to greater market reach has been the **availability and access to simple and efficient postharvest milling equipment, skills and knowledge for value addition, product development and limited understanding about market demands**. In the last decade, International Fund for Agriculture and Development (IFAD) and Bioversity International, supported NUS conservation projects in India, which have successfully demonstrated the significance of an integrated pathway (4 C Approach - Conservation, Cultivation, Consumption and Commerce) for continued conservation and use of these minor crops in different ecological zones in India (Guillaume P., 2009, Israel Oliver King et al., 2011, 2014). **This paper elaborates best practices promoted by the project to identify, process, add value to millets and also to reach out to markets. The paper also discusses potential challenges and opportunity for promoting nutritious millets through existing food and nutrition supplement programmes and policies in the country**.

Rice Breeding Programmes for Nutritional Security

V. Ravindra Babu
Principle Scientist, Directorate of Rice Research in India, Rajendranagar, Hyderabad, India
✉ rbvemuri1955@gmail.com

Micronutrient malnutrition is a distressing phenomenon observed mostly in developing nations owing to their dependence on cereals as major staple food. In India, several research efforts towards nutritious rice are being made with national initiatives and international support. Being a staple food crop, any scientific endeavours in improving the health benefits of rice would directly impact the nutritional security of the country. At Indian Institute of Rice, several plant breeding programmes of rice were initiated with a vision to improve the nutritional security of the rice eating population in the country.

Several thousand of genotypes (~15,000) were analyzed for their iron and zinc content in brown and polished rice using conventional analyses and X-ray Fluorescence spectrophotometer (XRF) provided by the support of HarvestPlus. After identifying the promising donors (range ≥24 ppm in polished rice) several populations were developed and many breeding lines with enhanced zinc content in polished rice have been/and are being developed. For iron, though levels of iron were high in brown rice, no genotypes were identified for high iron in polished rice (recommended range ≥6 ppm). Thus, conventional breeding programmes for high iron in polished rice are still to be initiated and the screening of rice germplasms for high iron in polished rice is in progress.

IIRR is a coordinating centre for rice to identify appropriate varietal and management technologies for all the rice ecosystems comprising 47 funded centres and 100 voluntary centres through All India Coordinated Rice Improvement Project (AICRIP). The Rice Biofortification trial was initiated during Kharif 2013 under AICRIP to assess the micronutrient dense breeding lines developed by different centers across the country. During 2013, 29 breeding lines were nominated and evaluated at 17 locations and 10 lines were promoted to Advanced trial 1 and during 2014, 45 breeding lines were nominated and evaluated at 26 locations and 11 lines were promoted to Advanced trial 1 and three lines were promoted to Advance trial 2 to be tested during 2015.

Through the research efforts of IIRR and evaluation at AICRIP, during 2015 Annual Rice Group Meetings, a high zinc line, IET 23832 ((RP 5886-HP 3-IR80463-B39-3), was identified by Varietal Identification committee for release in the states of Tamil Nadu, Karnataka and Andhra Pradesh. It has 37.1% and 17.2% mean yield advantage over Samba Mahsuri and IR64 with 18.8 ppm Fe and 3.85 ppm Zn. This is a significant achievement of IIRR and AICRIP to address micronutrient malnutrition of the nation. Many more breeding lines are in pipeline.

In addition to the varietal trials targeting biofortification for high zinc in polished rice, attempts are also being made to characterize all advanced rice breeding lines for their nutrient content and to identify the lines with high nutrient content for release as varieties.

Importance of Composition Data in Vegetable Breeding Programme to Improve Nutrient Security

Pritam Kalia and T. Longvah
Head and Principal Scientist, Division of Vegetable Science, Indian Agriculture Research Institute, New Delhi, India
✉ pritam.kalia@gmail.com

Breeding vegetable varieties that are dense in nutrients provide a low-cost, sustainable strategy for reducing levels of micronutrient malnutrition. Biofortification is a new approach that relies on conventional breeding to increase the micronutrient density in crops. It holds a great promise for improving the nutritional status and health of poor populations in both rural and urban areas of the developing world. Biofortified crops can reach relatively remote rural populations where conventional interventions are unable to reach due to various factors and can even have benefits for increased agricultural productivity. Designing of nutrient biofortified varieties of vegetable crops, thus, will not only ensure nutritional security to human being but also will go a long way in sustaining emerging industrial sector in this area.

Composition data on food products are essential to know the nutrient uptake from the food consumed. Vegetable crops are of natural dietetic importance because of their inherent nutrient wealth including components like vitamin and minerals, dietary fibres, amino acids, antioxidants and even natural antibiotics. The nutritional variability present in the germplasm will form the basis for further enhancing the nutrient content which can be known through compositional data only. Nutrient analysis carried out in some important vegetable germplasm such as eggplant, cabbage, cauliflower, tropical carrot and bitter gourd showed wide variability in its nutrient content. This variability in composition data in the available germplasm have tremendous role in intrinsic quality improvement which is being used to develop nutrient rich vegetable varieties to tackle micronutrient malnutrition which will be discussed in details. This paper highlights the importance of nutrients in breeding nutrient dense vegetable varieties to ensure nutritional security to masses by exploiting available germplasm wealth, genomic resources through conventional as well as cutting edge Hi-Tech approaches.

Biodiversity Interventions an Insurance Against Nutrition and Health Security

S.B. Dandin, Mathur P.N. and Bellon M.
Liason Officer, Bioversity International, Bangalore, India
✉ s.b.dandin@cgiar.org

Biodiversity both cultivated and in wild including livestock has been intimately associated with diet, nutrition, health and economy of the agriculture households both directly and indirectly. This interdependence is more pronounced in the dryland agriculture system, as the available biodiversity is limited and in turn limiting the food basket. To have an in depth knowledge and identify the appropriate windows for interventions, an Agricultural biodiversity base line survey was conducted in three states of India involving 874 families of 15 villages and families belonging to six districts where dryland farming is the main livelihood of the farmers of these villages. The survey indicated that households derive their dietary material mainly from what they grow and also what is commonly available in the nearby markets. Because of the limitation of the variety of the raw material for diet preparation due to seasonal cropping , denudation of the common land from wild species, low livestock population etc., the majority of the population in general and women and children in particular suffer from the undernutrition, malnutrition and deficiency of the minerals and vitamins. Most of the children and women were found anemic and weak. To mitigate the problem and also support the dietary source, Bioversity international has started activities to supplement and support building a nutrient-rich biodiversity base through distributing and planting drought resistant fruit species with required technologies. The important species and varieties distributed include Ber (Ziziphus mouriatiana); Sapota (Manilkera Zapota); Jamun (Syzygium cuminii); Guava (Psidium guajva); Pomegranate (Punica granatum); Drumstick (Moringa pterigosperma); Sweet soup (Annona squamosa); Jack (Artocarpus heterophyllus); Indian ghoose berry (Phyllanthus emblica) etc, with 3-4 varieties in each. As backward linkage to produce and supply quality planting material, a mother plant Exsitu gene bank and a nursery have been started. A step forward, community seed banks to be run by the local women self-help groups is also envisaged for assured availability of quality planting and seed material and economic sustainability. It is sincerely hoped this initiative will help in achieving its objectives and becomes a successful model to replicate.

Edible Insect Species Commonly Used as Food by the Indigenous Tribes of Nagaland, India

Kruolalie Tsurho
Team Leader, Nagaland Bio Resource Mission, Kohima, India
✉ krultsurho@gmail.com

Insects have always played a major role in the history of mankind. The relationship shared between insects and humans has shown many significance from food source, dyes, medicine, indicator of climatic changes to important historical events. Out of million insect species worldwide, over 2000 insect species are identified as a source of food. The traditional knowledge of insect as food is well established particularly for the people of Asia, Australia, Africa, South America, the Middle East and the Far East. In North-East India, over 500 species of insects are consumed as food. The seasonal collection of edible insect is an annual activity in many countries. Some rare seasonal edible insects are considered as exquisite culinary delicacy and are highly priced while the others are commonly affordable to the majority of the common people. Today, insects are still apart of many cultures and have become an important source of nutrients in their diet.

The people of Nagaland relish edible insects and many are considered as a delicacy. Since time immemorial, the concept of "entomophagy" was known to the indigenous Naga tribes and the traditional knowledge of edible insects as source of food was passed on orally from one generation to the next. Most of these insects are collected from the wild and consumed in various forms: eggs, larval stages, adult stages according to the species and are prepared differently for consumption as cooked or roasted. In the rural areas, large quantity of these edible insects is collected for consumption or sale in towns and cities for income. The sale of these insects is often found in most local markets or on the roadside often providing as a source of additional income. Some of the edible insects found in the state are: Hornet *(Vespula spp.),* Muga silkworm *(Antheraea spp.),* Eri silkworm *(Samia ricini),* Honey bees (*Apis spp.)* Carpenterworm (*Prionoxystus spp),* Termite (*Macrotermes spp.),* Grasshopper *(Hieroglyphus spp.),* Cricket *(Gryllus spp.),* Red palm weevil *(Rhynchophorus spp.),* Tent caterpillar *(Malacosoma spp.)* and other aquatic insects. The well known exotic edible insects among them are Vespula species and *Prionoxystus* species which are highly priced in the state.

Edible insects have been playing a significant role in the food chain and as such have become inseparable to the Nagas. It is taken as a source of delicacy which provides nutrition, economic and ecological benefits to the indigenous tribal population, yet their importance and species diversity is less known. With the growing of unethical collection, rise in demand, declining forest reserves, loss of habitat, climatic changes, the safeguard of these edible insects has become a concern. Keeping in view, it is now felt that the promotion of edible insects through creating awareness, documentation, conservation, preservation and developing the art of rearing on a commercial scale is the need of the hour.

The Chronology of Banana as a Source of Provitamin A Carotenoids and its Potential Contribution to Alleviation of Vitamin A Deficiency Among Vulnerable Population Groups

Beatrice Ekesa, Gina Kennedy, Inge van den Bergh
Nutrition & Marketing Diversity Programme, Bioversity International, Kampala, Uganda
✉ b.ekesa@cgiar.org

Although bananas are reported to have been first domesticated in Southeast Asia and the South Pacific around 8,000 to 5,000 BCE, it is probable that bananas arrived in India, Indonesia, Australia, and Malaysia, within the first two millennia after domestication and may have been grown in eastern Africa as early as 3000 BCE, and in Madagascar by 1000 BCE. Banana production and consumption in the ancient and early modern world was mostly geared towards small-scale operations for local consumption. Banana's major use was likely as either the main starch consumed, or, given its non-seasonal nature, as an important buffer crop between other staple harvests. Although bananas are a major part of the diet in Sub-Saharan Africa and Southeast Asia, it was long thought as a poor source of vitamin A. The high prevalence of vitamin A deficiencies (VAD) in the Pacific islands triggered scientists like Louis Englberger to begin exploring vitamin A levels in native foods like banana, giant swamp taro, and breadfruit. It was only in early 2000s that interest in vitamin A-rich bananas took off when research by findings by Louis Englberger and collaborators revealed that some orange-fleshed banana cultivars indigenous to the Pacific region have high levels of pro Vitamin A carotenoids (pVACs). Following this, a pulp-color based prescreening of the >1000 accessions at the Bioversity International Transit Centre was carried out and more than 400 accessions have undergone further laboratory screening for pVACs. From the 400, 15 accessions mainly from the Pacific and with >88ug/100g RAE have been undergoing agronomic, acceptability and sensory evaluation within banana-dependent regions of Eastern Africa. Findings indicate that about 40% of the first PVAC varieties selected have potential of integration and viability within local farming and diet systems in East Africa. As the process of integrating the most preferred accessions within local farming and diets goes on, we hope that in the next 3-5 years millions of farmers from VAD prone areas will be growing, consuming and marketing several Vitamin-A rich bananas, with related improvements to their health and livelihoods.

Food System and Nutritional Challenges of the Indigenous People of Northeast India

T. Longvah
National Institute of Nutrition, Hyderabad, India
✉ tlongvah@gmail.com

Northeast India is one of India's two mega biodiversity hotspot. Most of the states in Northeast India have more than 60% of their area under forest cover and 51 forest types are found in the region with high density of flora and fauna. These forests harbour 8,000 out of 15,000 species of flowering plants serving as important source of food and nutrients. Various types of foods including insects collected from the forest still constitute the bedrock of dietary diversity in traditional food systems of the indigenous people of Northeast India. Use of uncultivated indigenous foods not only provides dietary diversity but also ensure that a significant portion of the recommended daily allowances for several nutrients are met from easily available food sources in the diets of resource poor families. At the same time rapid transition in demography, nutrition and lifestyles is affecting the traditional food system leading to rapid increase in diet related non-communicable diseases like obesity, diabetes and hypertension. The lack of compositional data of neglected underutilized foods has greatly hindered their use and consumption to improve food security, nutrition and health. Key government policies such as the Public Distribution System and the Green Revolution Technologies have contributed to the changes in the food systems. In spite of the negative shifts in national agricultural policies and programs, there has remained a global recognition of the vital role that these underutilized food plants play in the traditional food systems of indigenous communities in developing countries. Data from the Northeast India are presented to highlight the diversity of these food resources, their nutritional attributes and the impact of their use on food and nutrition security in developing country communities.

Wild edible plants valorization: sustaining the Moroccan traditional diet

Manal Tbatou, Abdelmonaim Belahyan and Rekia Belahsen
Chouaïb Doukkali University, Biochemistry and Nutrition, El Jadida, Morocco
✉ b.rekia@gmail.com

In Morocco, the diet is of a Mediterranean type that is rich in biodiversity and nutritionally healthy and reported to protect against many diseases risk factors. The dietary diversity of Mediterranean Diet (MD) was also associated with better nutritional status. However the nutritional situation in the country shows a shift from the Traditional (MD) to westernized diet leading to a shift from diversified diet to the adoption of simplified diets.

Indeed, despite the effort made by the government, nutritional problems met in the underprivileged Moroccan households are continually growing. There are still growth retardation or chronic and acute under nutrition in under five children. Deficiencies in micronutrients have been also raised in young children and the pregnant or lactating women in all regions. All these problems reflect the insufficient contribution of proteins and lipids energy and lower nutritional quality of food ration in the population. Other emergent nutritional problems are related to dietary energy excess such as metabolic disorders and obesity and constitute important risk factors of the cardiovascular diseases. Many factors could explain this nutritional situation. Among them, the fact that nutrition transition is associated with the shift from traditional dietary pattern marked by the use of traditional and local foods, to a model characterized by abundance, intensification of production, economic interdependence, a nutritional model based on restaurant and ready to eat foods. Besides, a trend to an increase of food and energy consumption as well as an intensification of production to eliminate deficits, were also reported. This situation raises the problem of MD sustainability because of changes in agriculture system and a decrease of biodiversity.

Wild underused or neglected foods could improve diet diversity and have a positive impact on nutritional and health status. However, as the data on the composition on these foods are lacking in the available food databases, their nutritional value was not evaluated. The long term goal of this research is to valorize wild unused or less used food plants to increase their consumption and safeguard their biodiversity.

Conclusion: The investigation data show that wild edible plants (WEP) continue to be part of food habits among local rural populations especially in winter as additions or complements to cultivated food plants. However, there is a decline in transmitting the knowledge and the practices to younger generations. The data recommend to investigating the nutritional potential of these plants and to promote and encourage the sustainable consumption of these underutilized traditional products.

UN Initiatives Linking Biodiversity to Nutrition Programing and Policy

U. Ruth Charrondiere
Nutrition Officer, FAO, Rome, Italy
✉ Ruth.Charrondiere@fao.org

Background: Mainstreamed agriculture is mostly considering yield, pest resistance, and other agricultural and technological characteristics. They rarely consider nutrient content when selecting species or varieties for breeding or production. While noting that natural and other resources are increasingly limited, agriculture productivity has to increase in the upcoming years to feed the world population. Biodiversity (i.e. foods identified at the taxonomic level below the species level, and neglected/underutilized or wild species) represents a promising solution to address the multiple burdens of malnutrition, and it is a very promising element for sustainable and nutrition-sensitive agriculture. Data show that intraspecific differences in nutrient contents are often as important as between species, with 1000-fold differences and more, representing the difference between nutrient deficiencies and adequacy. For example, one banana can provide 1 or 200 percent of the RDI for vitamin A.

Objective: To mainstream biodiversity into different sectors, especially nutrition and agriculture, to improve nutrition and health worldwide

Results: The role of biodiversity is increasingly recognized at international level. For example, the International Rice Commission recommended in 2002 that nutrient content needs to be among the criteria in cultivar promotion, or that cultivar-specific nutrient analysis and data dissemination should systematically be undertaken, and that existing biodiversity of rice varieties and their nutritional composition need to be explored before engaging in transgenic research. The Convention on Biological Diversity (CBD) established in 2006 the Cross-Cutting Initiative on Biodiversity for Food and Nutrition, and in 2015, this time together with WHO, published 'Connecting Global Priorities: Biodiversity and Human Health, a State of Knowledge Review'. The Global Environment Fund (GEF) also recognized the importance of utilizing nutrition arguments for the use and conservation of biodiversity, and is funding projects in this area. Over the past years, FAO, INFOODS and partners are building the evidence basis to demonstrate the benefits of this biodiversity for nutrition and health, and have published databases, guidelines, indicators and tools to explore and benefit from biodiversity. Also the Second International Conference on Nutrition (ICN2), jointly organized by FAO and WHO in 2014, recognized the importance of nutrition-sensitive agriculture and food-based approaches to combat malnutrition. For their implementation, biodiversity and nutrient composition data are essential. However, there are still few compositional data available on varieties, or wild and underutilized foods. Because their compositional benefits are unknown and they are undervalued and not targeted in programmes and policies.
In order to assist countries to better consider and use biodiversity for improved nutrition, the Commission on Genetic Resources for Food and Agriculture (CGRFA) endorsed in 2015 the *Voluntary Guidelines for Mainstreaming Biodiversity into Policies, Programmes and National and Regional Plans of Action on Nutrition*. They give examples in the areas of planning, research, implementation, and awareness-raising on how to mainstream biodiversity into relevant sectors. Their implementation will hopefully improve the nutritional and health status of the world's population while assisting in reaching nutrient requirements through foods and conserving biodiversity for future generations.

Conclusion: The next step in mainstreaming biodiversity are the uptake at country level. The Voluntary Guidelines for Mainstreaming Biodiversity can be used, together with all the international recommendations, to integrate biodiversity into policies and programmes of different sectors and thus to improve nutrition in a sustainable manner. One important precondition is the availability of compositional data of biodiverse foods. Therefore, donors will have to recognize the importance of these data and invest in chemical analysis.

Bioversity International is a member of the CGIAR Consortium. CGIAR is a global research partnership for a food-secure future.

Bioversity Headquarters
Via dei Tre Denari 472/a
00054 Maccarese, (Fiumicino)
Rome, Italy

www.bioversityinternational.org

Tel. (39-06) 61181
Fax. (39-06) 61979661
Email: bioversity@cgiar.org

ISBN 978-92-9255-027-1

Bioversity International

CGIAR
Science for a food-secure future