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Expert meeting on neglected and underutilized species (NUS) value chains in sub-Saharan Africa

Agricultural diversification, Agenda 2030 and climate change responses

29-30 November 2016
IITA, Cotonou, Benin

Edited by Per Rudebjer and Wilson Kasolo

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 CGIAR Research Centre. CGIAR is a global research partnership for a food-secure future. www.bioversityinternational.org

The project 'Strengthening capacities and informing policies for developing value chains of neglected and underutilized crops in Africa' was implemented during 2014–2016 under the African, Caribbean and Pacific (ACP) Group of States – EU Cooperation Programme in Science and Technology (S&T II), funded by the EU with co-financing from project partners.

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Content

Executive summary

This Expert Meeting on neglected and underutilized species (NUS) value chains in sub-Saharan Africa was held on 29-30 November 2016 in Cotonou, Benin. Organised by the partners of the project '*Strengthening capacities and informing policies for developing value chains of neglected and underutilized crops in Africa*', the meeting marked the end of a three-year effort supported by the ACP-EU Science & Technology Programme (S&TII) 2014–2016. The meeting took stock of lessons learned during the project's work in Benin, Kenya and Zimbabwe and also brought insights from other invited organizations working on NUS globally. Thirty-three participants from 13 countries attended the meeting.

Drawing on information from presentations by project partners on results achieved, presentations by other stakeholders, and group work and plenary discussions, the participants recommended the way forward for mainstreaming NUS in agricultural development, with focus on sub-Saharan Africa, summarized as follows:

- We wish to see NUS at the centre of global efforts on nutrition, sustainability and climate change adaptation. We wish to see NUS contributing to Agenda 2030. This vision should be reflected in the way we allocate funds, engage with donors, research value chains and develop capacity, for a continuum that is transformative.
- Mainstreaming NUS needs time and constant commitment over years by researchers and policy makers. It needs champions. Successful policies in one country can be used as guidance in other countries through sharing experiences and lessons.
- Champions play a key role in bringing NUS to the forefront: scientists that have a passion for NUS research; educators that include NUS in higher education curricula and supervise students' theses; development experts that promote NUS in the policy arena. Identifying and coaching such champions are essential actions.
- At the institutional level, Bioversity International, the African Network for Agriculture, Agroforestry and Natural Resources Education (ANAFE), International Foundation for Science (IFS) and Crops For the Future are such champions that can help build broader platforms for mainstreaming NUS.
- Multiple entry points can be used for mainstreaming NUS including climate change, nutrition, gender, entrepreneurships, etc.
- Access to quality information on NUS needs to improve, to guide decision-making. Suitability maps of NUS crops (from 'big data'), crop phenology calendar, pest and diseases and their management, and nutritional properties of NUS are but some of the areas for which value chain actors need better information.
- Mainstreaming of NUS in higher education has only just started. Promoting the NUS curriculum guide, recently published by the ACP-EU project, is high priority. There is also need to develop user-friendly, accessible learning resources on NUS topics. All this requires active work among both academic leaders and lecturers at all levels, and support from policy level and donors.
- Institutional capacity for mainstreaming NUS in agricultural development also need to be strengthened. This includes capacity for facilitating a value chain approach for

NUS, involving all the key actors in the value chain, from farm to fork. There is need for both disciplinary capacity (specialists) and capacity to connect with other disciplines.

- Expand partnerships in research and development initiative on NUS and bring in more entrepreneurs, processors and consumers. Involving business people in NUS activities is important. Communication strategies also need attention to effectively target the different categories of NUS stakeholders. Engaging with the youth is an opportunity for job creation.
- A tracer study of some 400 trainees in two consecutive ACP-EU NUS projects should be carried out. Such a study would provide interesting insights in the outcomes and impacts of the projects, and provide feedback and lessons learned for future NUS initiatives.
- Since the number of NUS is huge, this ACP-EU project worked on two model species—Bambara groundnut and grain amaranth—that allowed development of methodology and solutions that can be then applied to other similar species. To draw the full benefits of this approach, the continued work on upgrading the value chains of the two crops need support. The lessons learned need to be systematically documented and shared. Other priority pilot crops should be added to the portfolio. Learning from pilot NUS crops, instead of re-inventing, is a good strategy.
- Business incubation opportunities are clearly present. However, in terms of commercialising NUS products, going from pilot scale to wider scale can be beyond the means of small-scale entrepreneurs, even if the pilot scale is profitable. Institutional support, including access to financing, meeting food safety standards, advise on packaging, export marketing, etc., for such value chain upgrading, will be required.
- Literature on NUS is difficult to access and a lot of research results on NUS is in the 'grey' domain (e.g. MSc and PhD theses). Facilitating access to scientific publications as well as project-related publications through sharing, networking and open source articles is a priority. One such repository is www.nuscommunity.org/ managed by Bioversity International.
- Researchers working on NUS need to be better connected with one another. Creating a forum of all platforms working on NUS crops would help avoid duplication of research and would promote exchange of ideas through networking. For example, thesis research on NUS is valuable but needs to be better 'pooled', marketed and funded.
- NUS research in sub-Saharan Africa needs more visibility. An African centre for research on NUS should be set up, to work with CFF and other organisations (covering NUS in a broad sense, including edible insects and mushrooms). The International Institute for Tropical Agriculture (IITA) is ready to collaborate on NUS initiatives.
- Expand research on nutritional content of NUS and standardize methodologies across countries to enable comparison.

Introduction

Agricultural biodiversity contributes to food security, nutrition and health, and ecosystems resilience. It sustains future evolution and adaptation in species upon which humanity depends. At the local level, this biodiversity is the backbone of value chains that provide income and jobs, especially for women farmers and processors, and youth. **Diversifying agriculture in Sub-Saharan Africa** is one of the approaches available for meeting the Sustainable Development Goals (SDGs) of the Agenda 2030 for Sustainable Development. Similarly, mixing species and varieties can help farmers adapt agriculture to climate change and hence contribute to the Paris Agreement of the UN Framework Convention on Climate Change.

Agricultural research and development (R&D) has concentrated heavily on a few staple crops and commodities, side-lining other agricultural biodiversity. As a result, a large proportion of available useful agricultural biodiversity is largely neglected today. In recent years, however, a growing number of conferences, policy forums, and scientific publications are praising the value of agricultural diversification. Some 'novel crops' have already emerged in global food markets, such as quinoa, amaranth and baobab. Many more are waiting for their 'break-through'. This has implications for education, research, extension and policy, not only in the agricultural sector, but also in forestry, health and nutrition, and environmental sectors, among others. Identifying ways and means for embedding crop diversification into relevant policies and programmes is therefore becoming both urgent and important.

Africa's rich diversity of neglected and underutilized species (NUS) is in focus of the project '**Strengthening capacities and informing policies for developing value chains of neglected and underutilized crops in Africa'** (NUS Value Chain, for short). The project was implemented from 2014 to 2016 under the African, Caribbean and Pacific (ACP) Group of States – EU Cooperation Programme in Science and Technology (S&T II), funded by the EU with co-financing from project partners (Annex 3).

Over a three-year period, the project has been particularly successful in four areas:

1. Development of National Action Plans for upgrading value chains of Bambara groundnut and amaranth in Benin, Kenya and Zimbabwe
2. Integrating NUS as topic or a course in curricula of higher agriculture education institutions by publishing and promoting a curriculum guide on NUS
3. Strengthening of capacity for research on NUS value chains among young scientists of three sub-regions of sub-Saharan Africa
4. Providing policy advice to NARS for the integration of NUS into national agricultural programmes

As the project was coming to an end, the project partners organized the **Expert Meeting on on neglected and underutilized species (NUS) value chains in sub-Saharan Africa: agricultural diversification, Agenda 2030 and climate change responses** on 29-30 November 2016 at the IITA campus, Cotonou, Benin. The purpose was to take stock of best practices and lessons learned during the project's implementation. This learning would

be valuable also to other stakeholders, processes and policies striving towards sustainable agricultural development in sub-Saharan Africa. Representatives from the private sector, farmers' organizations, research, education and policy, as well as donors and international organizations attended the meeting. A total 33 participants from 13 countries were invited to reflect on the results of the NUS Value Chain project, and to debate the future of such work in the light of the broader sustainable development agenda in sub-Saharan Africa. Specifically, the **objective was to map out the way forward for mainstreaming NUS into national, and regional processes and programmes**, as part of broader agricultural diversification strategies and the work towards the SDGs. The expert consultation aimed to identify specific milestones for the coming 5-10 years, with regard to such integration.

Plenary recommendations: Way forward

This Expert Meeting focused on charting the way forward for mainstreaming NUS in agricultural development. The following plenary recommendations were proposed:

Vision for NUS

Regarding the future outlook for NUS, participants recommended that:

- That NUS should be at the centre of global efforts on nutrition, sustainability and climate change adaptation.
- The allocation of resources, engagement with donors, and development of research initiatives on value chains should reflect the commitment to the development of NUS and a continuum that is transformative.
- Each participant should have a personal goal on contributing to the development of NUS and the Agenda 2030.

Leadership

Regarding leadership for NUS development initiatives of NUS, it was agreed that:

- There is need for champions who can work with colleagues and also lobby to bring issues of NUS to the forefront; scientists and other stakeholders with a passion for NUS play critical roles.
- At the institutional level, Bioversity International, the African Network for Agriculture, Agroforestry and Natural Resources Education (ANAFE), the International Foundation for Science (IFS) IFS and Crops For the Future are such champions.
- There is a need for a platform involving financial, political and other stakeholders to mainstream NUS in various development initiatives.

Collaboration and Partnerships

Regarding collaboration and partnerships it was agreed that:

- Thematic agendas should be used to identify entry points for NUS 'mainstreaming'. Climate change was indicated as one of the several such entry points for pushing NUS in the right direction.
- Access to scientific information on NUS is critical. Scientists need to make results available, to inform decisions.
- New projects should involve business people, to effectively bring NUS 'from farm to fork', and also involve demand-side partners: entrepreneurs, processors
- There is a need to enlarge the 'NUS movement' to include more stakeholders.

Way forward

The Expert Meeting identified the following priority thematic areas for the way forward:

1. Information, communication and networking
2. Capacity development
3. Enhancing value chains
4. Research, development and innovation
5. Policy and public awareness

The following section discusses these areas in detail.

Information, communication and networking

The Expert Meeting advised that much more needs to be done to share information and knowledge among those working on NUS. For instance, many students and researchers are interested in working on Bambara groundnut but they may not be aware of the work done by others already, or of the existence of collaborative opportunities. It would be also very useful if researchers share theses and any other relevant publication on this crop, to create an international knowledge base on this particular crop. Similar knowledge base could of course be created for other priority NUS as well. The aim is to move away from today's fragmented, isolated situation.

We should also create a forum for sharing knowledge, information and opportunities for projects, and for lobbying donors on NUS crops. The participants called for Bioversity to follow up and take a lead on sharing information on NUS. The NUS community website www.nuscommunity.org/ with uploaded publications should be enriched, updated and integrated with information coming from other stakeholders.

Other key points raised regarding information and knowledge sharing are:

- The need to provide information that entrepreneurs need. Examples could be suitability maps NUS crops (from 'big data'); crop phenology calendar that show flowering, etc. for different agro-ecological zones; information on pest and diseases and how to manage them using IPM. A database on NUS in sharable format would address this.

- Communication strategies are needed, in local languages, to bring the NUS back to the plate.
- The need to boost networks on NUS: Enhance networking between countries at sub-regional and regional levels; There is opportunity for new collaboration on NUS, for example with the Catholic Relief Service (CRS).
- Specifically for this ACP-EU project: Partners should produce a timely and good quality project report, which is important for future project opportunities. It would share information from this project with others who have not participated in it, and help scale up the results beyond project countries.
- The report from this Expert Meeting is one communication tool. So is the project website, http://www.nuscommunity.org/research/projects/acp-eu-value-chains/.

Capacity development

The capacity development theme has been central to this ACP-EU project's scope and it is not surprising that participants offered most reflections and recommendations in this domain. Two central needs were addressed:

- The need for creating a pool of expertise at PhD, MSc and Diploma levels, which requires integration of NUS into tertiary education programmes
- The need for having institutional capacity for mainstreaming NUS into agricultural development, using a strong value chain perspective and multi-disciplinary approaches.

Creating a pool of expertise at PhD, MSc, BSc and Diploma levels

Regarding the creation of a pool of expertise on NUS, the following were highlighted:

- **Mainstreaming of NUS in education**: Topics where NUS are relevant to agricultural and human development should be identified, and be supported by practical, tangible, concrete examples of the role of NUS. Educational institutions and governments should work in synchrony to popularize NUS.
- **NUS curricula:** There is a need to engage with academic leaders on issues of NUS, and work with them on the integration of NUS in existing curricula, development of new curricula and delivery of NUS related topics/courses.
- **Promotion and use of the NUS curriculum guide**: The NUS curriculum guide developed by the ACP-EU project needs to be promoted as a source material for integrating NUS content into existing courses and programmes. Dedicated MSc programmes on NUS might be rare; NUS will largely be taught within existing programmes.
- **Lecturers** at all levels should be able to include NUS in their lectures.
- **User-friendly, accessible learning resources:** It was agreed that structured and easy-to-use comprehensive learning resources on different aspects of NUS, e.g. crop suitability maps, genotypes, production calendar, pests and diseases, utilization methods, and marketing need to be developed.

Develop institutional capacity for NUS mainstreaming in agricultural development

- **Vale chain enhancement**: Adopt a value chain approach in the development and promotion of NUS. Involve all the key actors in the value chain - entrepreneurs and supermarkets – from farm to fork.
- **Multi-disciplinary capacity development:** There is need for a multi-disciplinary approach to develop capacities on NUS. Actors need capacity to work across disciplines for a better comprehension of NUS bottlenecks and sustainable solutions. There is need for disciplinary capacity plus capacity to connect with other disciplines.
- **Support entrepreneurs:** Provide support for entrepreneurs to upscale their businesses; such interventions will be very helpful towards an increase in NUS utilization .
- **Bridge the research-development gap:** Expand partnerships in the research and development initiative on NUS and bring in more entrepreneurs, processors and consumers.
- **Communication**: Develop a communication strategy to reach different categories of NUS stakeholders.
- **Climate change:** There is need collate and make available concrete information on climate change and its impacts on agriculture as it relates to NUS.
- **Youth and NUS:** Engage the youth who can bring about change, enable entrepreneurship initiatives, and bring on board private partners, e.g. Nestle. People in urban areas get more interested in healthy foods e.g. millets, which is an opportunity for NUS.

Private sector contributing to capacity development

- **Capitalize on the project's community:** Follow up the trainees of the two consecutive ACP-EU NUS projects in order to learn lessons. All those trained, plus those participating in various meetings is a valuable resource. A tracer study of some 400 trainees would provide useful information!
- **Youth and NUS-related business opportunities**: ANAFE could support an initiative to promote young students' interest in NUS research and entrepreneurship. It could be supported in more collaborative and organized fashion rather than being opportunistic.

Enhancing value chains

This ACP-EU project has demonstrated that a value chain approach to NUS is useful not only for identifying constraints and setting joint priorities for upgrading of a particular NUS value chain, but also as a tool for capacity development. A value chain approach puts a particular expertise into a wider context and brings in the needs for collaboration across multiple disciplines and stakeholders, which makes research and development efforts more relevant and applicable.

The Expert Meeting made a number of observations and recommendations on how to enhance NUS value chains:

- **Model species approach:** Since the portfolio of NUS is huge, there is need to work on model species, like Bambara groundnut or grain amaranth, that allow development of methodology and solutions that then can be applied to other similar species. Communities have their own local crops and they need methodologies that can be adapted to those species.
- **Leverage on-going efforts:** There is need to leverage national, regional and international efforts, both upstream and downstream the value chains. In the case of Bambara groundnut, it is recommended that all experts working on this crop join the existing BamNetwork, hosted for the community by CFF.
- **Link NUS to markets**: Attract processors that can value add, develop new products, etc., and thereby create new and wider markets, from which producers feel they benefit.
- **Food science research:** Such research contributes to develop products and practices that meet EU standards, as avenues to new markets. These standards then need to 'trickle down' to producers for quality assurance.
- **Indigenous knowledge** (IK) on NUS: it is important to document IK as source of important information for cultivation and value addition (cooking, processing etc.).
- **Private sector participation:** The private sector should be encouraged to develop many products coming out of NUS. This would help promote various NUS species and their large scale production.
- **Nutrition:** Document nutritional content of NUS and share such information for evidence-based promotion.
- **Promotion tip:** Make NUS more 'sexy' by getting them into high-end supermarkets and restaurant chains, and promoting them in export markets.

Research, development and innovation

To develop value chains of NUS, for which existing scientific knowledge is limited, it is obvious that research plays a key role. Often, an approach that respects traditional knowledge is required. While this meeting did not go deep into current research issues around NUS, the following overall observations were made:

- It will be very helpful to learn from pilot NUS crops initiatives, instead of re-inventing (see also the capacity development section).
- Creating a forum of all platforms working on NUS crops will be very useful (see also capacity development).
- Bringing in private sector partners (for example, Nestle is blending wheat with other healthy cereals) can accelerate the development of NUS. Having information on nutritional values of NUS available can help create interest.
- Business incubation opportunities are clearly present.
- Literature on NUS is difficult to access; efforts to facilitate access through sharing and open source articles will be rewarding.
- Avoid duplication of research (due to lack of communication) andpromote exchange of ideas, and networking.
- Expand research on nutritional content of NUS. Also standardize methodologies across countries to enable comparison.

- New partnerships: there is need for an African centre for research on NUS – including edible insects and mushrooms—to work with CFF. IITA is ready to collaborate on NUS initiatives.
- Thesis research on NUS is valuable but needs to be better 'pooled', marketed and funded.
- Nurture incubation opportunities for NUS-related technologies, for young entrepreneurs to tap into.
- Education, research and industry linkage: there is need to ensure strong university-NARIs-private sector partnerships.
- Create a pool of expertise to train from lower levels to PhD levels.
- Establish a journal to disseminate NUS research results.
- IFS should give priority to NUS in their calls for research grant proposals.
- Resourcing NUS initiatives: there is need to engage more with IFAD, FAO and EU, to generate support for the work on NUS.
- Beyond food security and nutrition, we should support research also on their therapeutic functions of NUS.

Policy and public awareness

Strong policy support and public awareness will help keeping the momentum for mainstreaming NUS in agriculture development. It was however noted that:

- 'Champions' are needed at institutional and country levels to raise interest in NUS among policy makers and consumers, and to develop capacity for NUS development.
- There is need to build awareness regarding NUS generally in society, and create awareness of NUS products, using also local languages
- Efforts are needed to make NUS more 'sexy' – get them into 'the McDonalds'. That would help marketing and awareness raising.

Session 1. Opening

The chair and rapporteur for this first session were Dr **Faouziath Sanoussi** and Dr I**nnocent Dossou Aminon**, respectively.

Opening session

After a brief introduction to the meeting programme by the chair, the first welcome remark was given by **Prof. Alexandre Dansi**, Director of LAAPT-BIORAVE, a partner of the project. He started by thanking all the participants and especially Mr Per Rudebjer for including Benin in this project. He also informed participants that this project has been very helpful in training young researchers.

He was followed by **Enrico Baccioni**, Initiative Manager at Bioversity International. In his remarks he informed that Bioversity is studying how agrobiodiversity can be supported to mitigate climate change and increase food security.

Mr **Jean Adoguidi**, representing the Director of FAO Benin, noted that FAO is also working on NUS for food security. On behalf of FAO he thanked the organizers of this meeting for giving such issues attention.

Mr **Per Rudebjer**, Bioversity International's project coordinator of this project, gave a brief background to his organization's work on agrobiodiversity and specifically on NUS. Bioversity and other organizations started working on underutilized crops more than 20 years ago. Since 2009, two consecutive grants from the ACP-EU Science & Technology Programme are helping to share this knowledge in sub-Saharan Africa. The projects are implemented in partnership with universities in Benin, Kenya and Zimbabwe (and Ghana and Malawi in the first project) and international partners: International Foundation for Science (IFS), African Network for Agriculture, Agroforestry and Natural Resources Education (ANAFE) and, in the first phase, Regional Universities Forum for Capacity Building in Agriculture (RUFORUM). Mr Rudebjer informed participants that the objective of this expert meeting is to share project results and experiences with a wider group of stakeholders, for broader impact. He concluded his remarks by thanking Prof. Dansi and his team for their excellent working during the project implementation.

The last remarks were given by Dr **Honnorat Satoguina**, Director of *Fonds National de la Recherche Scientifique et de l'Innovation Technologique* (FNRSIT). He noted that it is the second time he participated in a meeting on the NUS. Research is studying the performance of NUS and the evidence will be used to develop strategies for training our children. Competitive funds are sometime limited and scientist should make effort to convince donors. In Benin, agriculture is a priority and it is important to reveal the added value of NUS, to create a market for them and push their promotion.

He commended all researchers working on NUS, and reminded researchers in Benin that his institution is ready to support any research programme that will demonstrate the importance of NUS for food security. He the declared the Expert Meeting open.

Project background

After the coffee break, Mr Rudebjer introduced the 'the NUS Value Chain project', then in its third and final year. He noted that NUS have a role to play in the implementation of the 2015 global agreement on the Sustainable Development Goals (SDG) and the Paris agreement on climate change. He described key technical and institutional challenges affecting the NUS, including a deficiency of adequate capacity for research and innovation. Research can solve many problems related to NUS value chains, and he noted that the large number of applications received to the project's training courses indicated that many young scientists in Sub-Saharan Africa are prepared to work on NUS, if they can get adequate financial and institutional support.

Finally, Mr Rudebjer briefed the participants on the objective of the project: i) strengthened capacity for research, development and education on NUS value chains, and ii) informing on the roles and benefits of deploying NUS into strategies and programmes for agriculture, nutrition and adaptation to climate change.

Working on two priority 'model' crops, Bambara groundnut and amaranth, the project partners in Benin, Kenya and Zimbabwe developed National Action Plans for upgrading value chains of the target crops. Led by ANAFE, a network on higher agricultural education, the project developed a curriculum guide, which was promoted at three sub-regional workshops. Capacity for NUS research and communication of results was developed at six sub-regional training courses reaching 150 young scientists, a project component led by the International Foundation for Science (IFS).

Comments from the participants:

Given the successes and gaps highlighted by the project and the reality that the project was ending, participants indicated concern about:

- Sustainability plans of project initiatives in the different countries
- Strategies and support for introducing the curriculum guide at universities and colleges, and how to have it accepted.
- Sharing and dissemination of the results of this project which were indicated as original, beyond the participating countries – countries like Mali and others that would find the results very useful.

Session 2. National Action Plans for NUS value chains in Benin, Kenya and Zimbabwe: lessons learned

The session was chaired by Dr **Matilda Dzomeku** from Ghana Food Research Institute. Rapporteurs were Dr **Faouziath Sanoussi** and Dr **Innocent Dossou Aminon**.

Kenya

The first presentation of this session, by Dr George Chemining'wa, University of Nairobi, was entitled 'Upgrading value chains of Bambara groundnut and amaranth in Kenya'. He talked about the production constraints and market demand of the two crops in Kenya. There is a need for equipment for harvesting and processing as well as storage. Kenya also needs to develop new products and build the capacity of farmers, including in agribusiness.

There is little information on the genotypes of the crops, which calls for investment in crop improvement and in the seed sector, to produce quality seed. Farmers have limited knowledge on packaging and value addition for supplying their products in market. Farmer's organizations need to be strengthened and sensitized on what the market requires. Support is required to highlight the role of Bambara groundnut and amaranth for food security and adaptation to climate change. Exhibition of developed products should be organized. Finally, the role of champions was noted, both to make researchers interested and for promoting the use of the NUS curriculum guide in the education systems.

Zimbabwe

Prof Albert Chiteka, Africa University, Zimbabwe, briefed participants on the National Action Plan for upgrading grain amaranth and Bambara groundnut value chains in Zimbabwe. The following key focus areas were identified: i) Research on value added products, ii) Erratic supply and unknown quantities; iii) Branding and intellectual property; iv) Promotion of formal supply agreements to guarantee prices, and; v) Development of markets.

In Zimbabwe, the lessons learnt were the following:

- Value added product availability is key is in promotion and marketing.
- Cost competitiveness of products is critical in driving the value chain adoption.
- Data collection and analysis from informal market information systems can be achieved.
- Products are available; a key step to drive the value chain is in promotion and marketing.
- Promotion efforts need to be funded in order to stimulate demand for NUS products.

Benin

Finally, Dr Innocent Dossou Aminon and Dr Faouziath Sanoussi, two scientists from the Benin project team, presented the developed Action Plan for Bambara groundnut and amaranth in Benin. They highlighted value-adding and also sensitization activities done in the country during this project's implementation.

The promotional activities were many, including development of posters and sensitization activities throughout the country, sensitization of Benin food processors on using and promoting NUS, development of NUS curricula for secondary school, development of policy briefs on Bambara groundnut and amaranth value chains, and promotion of NUS through media, etc.

At the academic level the Benin team has also created an International Journal of Neglected and Underutilized Species (IJNUS), and introduced NUS to the Benin National Academy of Sciences, Arts and Letters.

Session 3. Developing human and institutional capacity for NUS research and development

Chair**: Christine Onyango**
Rapporteurs: **Albert Chiteka and Olusegun Yerokun**

Research capacity for supporting NUS value chain development in sub-Saharan Africa

Ingrid Leemans

The International Foundation for Science (IFS)'s mission is to strengthen the capabilities of young scientists in developing countries. The aim is to support excellent individual and collaborative research, to build scientific capacity of early career scientist in developing countries and to facilitate the process of innovation for the sustainable use, conservation and management of biological and water resources. The strategy 2011—2020 of IFS uses three approaches including: Individual approach, collaborative research, and contributing innovation.

In terms of IFS's contribution to the 'NUS Value Chain' project, the following key actions can be identified:

- Supported three sub-regional NUS project proposal writing workshops.
- Supported three training workshops on scientific writing and communication.
- Provided expert evaluation for proposals that were submitted during the supported workshop.
- Imparted skills to scientists on conducting 'elevator pitch' to potential donors, partners.

In return, IFS has gained from the partnership in the NUS Value Chain project in the following manner: IFS has gained more experience in how to work with partners and collaborators. Its network in the area of NUS has been widened. The relationship has also provided IFS a learning opportunity for advocacy and policy issues. It can be concluded that while supporting NUS project, it has also contributed to the mission and vision of IFS.

Comments on the presentation

- It was suggested that the large number of scientists that IFS has supported (alumni) could be a big 'army' to mobilise in terms of promoting NUS interests.
- Elevator pitch is an important skill to enable scientists market themselves and position their work.

Integrating NUS into higher education curricula

Wilson Kasolo

Membership

The African Network for Agriculture, Agroforestry and Natural Resources Education (ANAFE), was established in 1993 by 29 tertiary agricultural education institutions. It is now composed of 146 member institutions–universities and technical colleges–in 36 African countries (Figure 1). It is registered in Kenya, Tanzania and Niger as an international organization.

Figure 1. ANAFE's presence in Africa, 2016

Mission and objectives

ANAFE's mission is 'to build capacity in tertiary institutions in Africa for quality education, training, research and extension in Agriculture, Forestry, Agroforestry and other Natural Resources for improved livelihoods'

The general objective of ANAFE is '*to improve in a sustainable manner, the contribution of agricultural and natural resources education and training to social and economic development of the African peoples*'.

The specific objectives are:

1. To facilitate/guide the transformation of land use education programmes as well as teaching and learning processes into a more integrative and effective approaches to solving development problems.
2. To strengthen the capacity of institutions of learning in land use sciences and technology in Africa, and develop mechanisms that enhance and sustain collaboration between institutions, and with other stakeholders.
3. To enhance the understanding and application of working principles and practices that promote synergy among experts in all branches of land use and facilitate better reach to stakeholders.
4. To put in place effective mechanisms for participatory monitoring and evaluation of Africa's agricultural capacity and develop and implement responsive strategies.

Focus and structure

Over the past years, ANAFE's major areas of focus have been:

- Promoting sustainable agriculture and management of natural resources through developing skills of managers, entrepreneurs, and other stakeholders
- Enhancing the appeal and relevancy of agriculture and natural resources management education
- Retooling lecturers, researchers and development workers with relevant skills and knowledge for socioeconomic transformational initiatives in Africa through agriculture and sustainable natural resources management.
- Empowering youths and women to engage in sustainable agriculture and agribusiness
- Improving institutional governance and learning environment

Structurally, ANAFE is composed of a Secretariat in Nairobi, Kenya, at the World Agroforestry Centre (ICRAF), the General Meeting of members, a continental Board, and four Regional Chapters called RAFTs (Regional Fora for Training): Eastern and Central Africa (ECA), Southern Africa (SA), the Sahelian countries (Sahel) and the African Humid Tropics countries (AHT). ANAFE members are universities and colleges of agriculture, agroforestry, forestry and other natural resources management areas. Members in each country are organised in national chapters.

Further information on the network is available at http://anafe-africa.org/

Role in the NUS project

ANAFE is the lead organization of the ACP-EU project's key result on strengthening NUS education. Availability of human resource with the right skills will be crucial for improving the management and use of NUS, which in turn contributes to the socio-economic welfare of African people.

In the current NUS project, ANAFE has developed a NUS Curriculum Guide (in English and French) using a participatory approach. The Guide has five modules: 1. Introduction to NUS; 2. Fruits and nut tree species; 3. Vegetables; 4. Insects for food and feed, and; 5. Neglected and underutilized rodents. The purpose of the guide is to provide a flexible framework that helps institutions plan and deliver NUS training curricula at various levels of learning,

whether the universities and technical colleges wish to integrate NUS topics into existing courses, or develop new courses or programmes on NUS. This tool can be modified to suit the specific situations of each institution.

The Guide gives an introduction to why neglected and underutilized species are important. Other sections cover:

- Demand for human and institutional capacity
- Education disciplines where NUS modules could be included
- Role of education in strategic development of NUS

Each of the five modules are introduced using the following sections

- Preamble
- Learning objectives
- Practicum, including assessment methods
- Module synopsis
- Useful references

Comments on the presentation

- There is a challenge to introduce NUS in higher education institutions because the traditional grains (maize, rice, wheat) are used to solve the world's food problem and so are perceived very important. Funding support is in their favour.
- The Kenyan experience of including all value chain stakeholders in priority setting discussion in one country is a good example of how to get NUS recognized.

Group work on lessons learned

Working in three groups, the participants analysed the lessons learned regarding human and institutional capacity for NUS R&D:

Group 1. Education
Group 2. Demand, value chains and private sector involvement
Group 3. Policy influence

The groups were asked to consider capacity at both the individual and institutional levels and reflect on 1) What positive change has happened in the past 5-10 years?, and 2) What priority needs and opportunities are emerging?

Group 1: Education

Individual level

Positive changes in the past 5 – 10 years

- Students trained at various levels e. g MSc and PhD
- Thematic research on NUS
- Relevant innovation technology
- Access to information dissemination
- People are more open to collaboration.

Priority needs and opportunities emerging

- Need for monitoring
- Need to have value chain approaches (more wholesome trainings).

Institutional level

Positive changes in the past 5 – 10 years

- Recognized the need for the curriculum guidelines and joint development of NUS
- More research being done on NUS
- Networking among institutions.

Priority needs and opportunities emerging

- Information sharing /dissemination to institutional managers
- Integrating the NUS in curriculum
- Contextual training/learning materials
- Opportunity for research along the value chain of NUS
- Improving the knowledge/skills of lecturers in NUS
- Rewarding excellent works done on NUS
- Opportunity to insert NUS in the growing climate change funding
- Opportunity for partnerships along the value chain.

Comments on the report from the Education Group

- There is need to monitor project activities and undertake surveys of scientists trained, to understand the real impact of the project's capacity development. Under the current NUS project, about 150 scientists have been trained (another 250 were trained in Phase I) but no follow-up of the impact has yet been made. Monitoring would help determine future needs.
- Changes brought about by social media provide a lot of opportunities: there is need to take advantage of the social media to connect and share information, methodologies and data, publication, theses, etc.
- There is need to harness the wealth of information in all publications or thesis on NUS. They should be scanned and digitized – lot of interesting information can be made available this way. Use 'big data' for reporting.
- There is need to encourage excellence in NUS research by recognizing or rewarding NUS scientists every year for contributing the most.

Group 2: Demand, Value Chains, and Private Sector Involvement

At individual level

Case Study 1: Production of *Bissap*, and Tiger nut as business entrepreneurship in Ghana

- Half-year old business
- Distributes to supermarkets, offices, etc.
- Small-scale business but makes enough income
- Sources sorrel, tigernut and other additives (ginger, spice, milk, etc.) from markets
- Challenges of perishable commodities
- Research needed on sorrell (varieties, color, recipe, etc).

Case Study 2: Production of guava and cape gooseberry for jam and baking as business entrepreneurship

- Started with small kids selling on roadsides
- Collection of wild gooseberry and planted (long shelf-life)
- Gooseberry jam produced in a hygienic way and moved to community level
- East African trade involving youth entrepreneurs
- Lots of sampling, baking and tasting by kids
- Gooseberry pie in supermarkets (priority for men and women).

Priority needs

- Technology sitting on the shelf needs to reach out to the farmers/consumers
- Best processing practices/post-harvest handling
- Proper packaging
- Multi-stakeholder involvement from scientists, processors, private partners, policy makers.

Positive change

- TV Shows (wider exposure)
- Lot of enquiries
- Sold in supermarkets.

Questions

- What happens when someone with more funds takes over?
- There is need for recipes with standards.

At Institutional level

Case Study 1: Production of cassava flour, biscuits from grain amaranth

- Lot of on-going research
- Production at research scale but not as a regular business model
- Knowledge or technology remains with the scientist or on the shelf or as publications.

Case Study 2: Production of cassava bread, yellow garri, yam chips and yam ice-cream

- Research at institute level
- Championed by the President of Nigeria to reduce import of wheat by blending cassava flour up to 30%

- Yellow garri using yellow-fleshed cassava thus reducing the usage of palm oil to white cassava flour making it more nutritional (B-carotene)
- Yam chips by reducing oxidation. Export to supermarkets in Europe by a private partner
- Natural purple ice cream using purple variety of yam.

Priority needs

- Technology sitting on the shelf needs to reach out to the farmers/consumers
- Best processing practices/post-harvest handling
- Proper packaging
- Multi-stakeholder involvement from scientists, processors, private partners, policy maker.

Opportunities

- Train farmers to take up technologies
- Private partners to make investment in research
- Demand-driven research and training across the entire value chain
- Innovation platforms – research for development

Comments on the presentation

- Clarification of standards, which could include variety selection, quality assurance of the products, producing a particular product following certain procedures
- Standards/patents may be applied in terms of geographic origin. NUS are often produced in specific areas by small communities with geographical identification
- Small producers need good labelling, packaging and information on nutrients contents of the products, to meet consumers' needs etc.
- Capacity needed for developing standards and trade marks
- Studies of demands at local, national and international levels
- Development of market at all levels
- Sustainable organizations of supply at all level, based on strategies of production. Small-scale producers should be well sensitized on the incentive to get involved in such business.
- Policies around agribusiness/value chains. The market channels may be easy to develop but they may not be sustainable. Farmers need to organize themselves to meet the demand so that the supply to the market is consistent.
- Need to create agribusiness incubation centers for youth to ensure processing, storage, etc.
- Need for champions for policy changes at high levels. Championing by ambassadors makes a huge difference
- Is there a demand in the international market and do we target this market enough? Has there been any demand study done?
- Issue of patents and intellectual property rights need attention; many people are involved in these activities at 'grass root' level and lack capacity in this area
- Need for support for innovation initiatives that benefit business owners.

Group 3: Policy influences

To be given priority, any strategies to promote and advance NUS must fit within the objectives for sustainable development. So connecting NUS work to the broader development agenda, including the SDGs, is essential.

The working group on policy influences covered a wide range of issues of relevance to the mainstreaming of NUS.

Nutrition

- Awareness of food diversification and how it influences nutritional status is increasing. This is an opportunity to promote a diversity of NUS. In turn, this requires better understanding of varieties to be promoted.
- Policy should give higher priority to nutritional value and quality of food (rather than prioritising only quantity), for example in state-supported food programmes
- Encourage local buying of foods, because communities know where their food comes from.

Value chains and business

- Finding market channels to interest producers, processors
- Compare the starting and ending returns in the context of the promotion of the NUS
- Develop a value chain policy that takes into account all NUS
- Develop policies for family consumption and for mass consumption
- Governments to promote transformation and agro-food processing of NUS, as they do for major species.
- Organize producers of NUS, to increase NUS productivity, production and improve regular supply. Especially by organizing producers in associations as it is done for cotton, cashew nut and other major species.
- Undertake community-based transformation of products
- Develop policy that takes into account improved varieties of NUS species.

Science and technology

- Train researchers to research in the field of NUS
- Encourage researchers' publications on NUS
- Develop a policy for using the results scientific research
- Creating Centers of Excellence on NUS (similar to that of the universities of technological sciences that exist in seven countries)
- Involving the African Union in integrating the NUS into its agricultural development policy.

Capacity development

- Create a policy of integrating NUS from primary to higher level of education.

Local benefits

- Support the sharing of benefits among all actors involved in NUS activities
- Retain strategies that will lead communities to be attentive to the value of traditional, local foods.

Promotion

- Promote NUS adapted to the ecological, natural environment
- Provide evidence-based information
- Encourage and support traditional treatments (natural medicines) in hospitals.

Funding

- Encourage states to fund research studies on NUS (allocate a budget for the NUS at the higher and even secondary level)
- Develop a policy to guide institutions that finance the NUS.

Comments on the presentation

- Policy decides what should be done, where, by who and when. So policy's role is very important. It can influence the success or failure of an initiative.
- Involving different actors and viewpoints is critical.
- The on-going adoption of the Sustainable Development Goals (SDG) is an opportunity for NUS. This includes addressing the complexity of nutrition.
- Make policies that take into account all elements of benefits: yield, pricing, nutritional quality, and value contribution through environmental sustainability.
- Policies of relevance to NUS issues are cross-cutting, weather in education, research, extension and developmental issues.
- There is a need for trans-disciplinary policies to address complex future challenges relating to NUS. Provide options in a more multi-agency and multi-stakeholder fashion.
- The process of developing policies for NUS has not been addressed. It takes a long time to mainstream biodiversity, conservation and processing. It is extremely complex, costly and cumbersome, lengthy process.
- There is a need to create centres of excellence that hosts a body of expertise for capacity building, etc., on NUS.
- NUS have unique characteristics including drought tolerance, resistance, and 'climate smart'.
- There is need to improve facilities in remote areas for small-holder producers working on NUS crops.
- NUS involve regional and ethnic issues, and should be championed at African Union level such as via CAADP. The process of including NUS in African union policy needs to be looked into.
- There is need to convince African Development Bank (AfDB) to finance NUS development and promotion activities.
- White paper from this meeting to be submitted to AfDB and African Union, highlighting what NUS crops can provide in the light of climate change, food security, and nutritional quality.

Session 4. Mainstreaming NUS in agricultural policies and programmes

Chair: ***Lusike Wasilwa***, Kenya Agricultural and Livestock Research Organization (KALRO)
Rapporteurs: ***Ranjana Bhattacharjee***, IITA and ***Amadou Sidibe,*** Institute of Rural Economy (IER) Mali

Mainstreaming NUS for enhanced nutrition and resilience: Lessons from Bioversity-led projects in Latin America and south Asia

Stefano Padulosi and Danny Hunter

The presentation covered experiences from two Bioversity-led NUS projects:

- IFAD-NUS Project (2011-2014). '**Reinforcing the resilience of poor rural communities in the face of food insecurity, poverty and climate change through on-farm conservation of local agrobiodiversity'**, covering Bolivia, India, Nepal.
- BFN UNEP-GEF Project (2012-2017). '**Mainstreaming biodiversity for nutrition and health',** active in Brazil, Kenya, Sri Lanka and Turkey.

Lessons from the IFAD-NUS Project (2011-2014)

Bolivia

To address the loss of genetic diversity in target species, the project promotes an integrated approach that combines *ex situ* conservation and *in situ* conservation. Here, working with 'custodian farmers' -- specific farmers maintaining a high number of crop varieties – is a key strategy for conservation of agrobiodiversity in Bolivia. The custodian farmers were given recognition by the government who considers them as important as *ex situ* gene bank managers. The building of custodian networks is being promoted by INIAF to other parts of the country, with the intention of creating a National Network of Custodian Farmers. Networks around the Titicaca area which have been established by the project, have been empowered through visits to the INIAF national ex situ genebank, organization of joint seed fairs with INIAF and an important National Event that has officially Recognized the role of Bolivian Custodian Farmers in conserving Bolivia' s agrobiodiversity heritage.

India

The second example from the IFAD NUS Project was from India and regarded the successful inclusion of minor millets in **India's Public Distribution System (PDS).** Launched in 1997 to fight food insecurity, it procures and distributes subsidized food and non-food items (e.g. wheat, rice, sugar, and kerosene) for India's poor. The scheme is managed by the Food Corporation of India. Intense lobbying by MP Prof M.S. Swaminathan and the National Advisory Council (NAC) used the following arguments for broadening the crops included in the PDS:

- Importance of diversifying the food basket with very high nutritious crops
- Inclusion of millets would expand the quantum of food that can be procured and at the same time
- Promotion of climate resilient farming would more appropriately cater to the food habits of different regions

- Inclusion of nutritious crops would strengthen Integrated Child Development Services (ICDS), mid-day meals, community canteens and other similar programmes.

The IFAD NUS Project supported Prof. Swaminathan in his campaigns by providing informed documentation on the role of minor millets in nutrition resilience and empowerment of farming communities. The policy change came through the 2013 India's **Food Security Bill,** which included: "coarse grains" (millets, sorghum and maize) in the PDS. This is the first time a government includes NUS species in one of its most strategic policies and it is even more relevant considering that the policy refers to the food security of a country with more than 1 billion people! The magnitude of impact on Indian households is huge: In 2010-2011 for instance, 31.8 million households cultivated coarse grains in India, which not have a new market, benefitting up to 153 million persons (x4.8 persons in each HH).

Lessons from the BFN UNEP-GEF Project (2012-2017)

The project's general objective is to strengthen the conservation and sustainable use of agricultural biodiversity by providing evidence of its benefits for nutrition and well-being and mainstreaming into national/global nutrition policies and strategies. Specific objectives:

- Widen knowledge base of how underutilized native species can contribute to food security
- Increase awareness on how biodiversity can contribute to food and nutrition

Brazil

- Nutritional composition data of mostly NUS were assessed and compiled for 49 of the 70 species targeted by the project. This is an important contribution since availability of such data in literature is very limited especially with regard to fibre, vitamin and mineral content).
- Data generated seems to indicate Brazilian underutilized native fruits have superior nutritional content compared to more commonly consumed fruits.
- BFN is developing regional capacities and creating a network of researchers to better promote nutritious native species.
- One of the achievements so far is that the program is informing public policies involved in school feeding, for example, by providing a list of nutrient-rich native species for possible inclusion in their menus and therefore in procurement.
- The National School Feeding Program (PNAE), one of the project's partner initiatives, has a critical food procurement component which ensures that 30% of produce is bought from small-scale producers. This is resulting in the empowerment of producers not only through this income stream, which also pays a premium of 30% on sustainably produced local foods, but through the creation of cooperatives which often include marginalized producers, such as indigenous communities.
- This work also encourages diversified production on the farm which in turn increases resilience, for example to extreme weather events such as drought, which can destroy an entire harvest of a single crop.

- This work also increases awareness on how biodiversity can contribute to food and nutrition: different events were organized including cultural gastronomic events, cooking demonstrations and tasting of native and nutritious biodiverse foods.
- The country's 'New Ordinance on Sociobiodiversity' – a public policy approved by the federal government, was signed in June 2016 by the Brazilian Ministry of the Environment and Ministry of Social Development and Fight Against Hunger. The ordinance is the first policy to define and support nutritionally important native species of the country. Both Ministries consider it will help to increase knowledge and promote sustainable use of species of sociobiodiversity and its consequent conservation in Brazil.

The final reflections regarding the mainstreaming of NUS were the following:

- Mainstreaming requires time and constant commitment over the years by researchers and policy makers.
- Policy makers play key role and need to be engaged from the onset in R&D projects
- Mainstreaming NUS needs champions.
- Successful policies in one country can be of guidance to other countries, hence better sharing of experiences and lessons in mainstreaming NUS is necessary.

Following the presentations the main issues and comments raised were:

- The above were practical examples and policy processes for scaling up NUS.
- Impact and replicability of case studies need to be understood.
- Identify ways to expand the different actions and their effects and impacts.
- Analysis of data are taking place to know yield, production of millet in India.
- Monitoring; partnerships involving IFAD, GEF and national partners to monitor the undertaken activities for sustainable use of NUS.
- A case from Kenya also was shared by the Chair of the session: Competition/exhibitions of food diversity and tasting of important food crops were used to create public awareness and sensitization of different actors.
- Bambara groundnut is commonly used as natural medicine, influencing its price.
- Propagation techniques of different underutilized species need attention (seeds vs. vegetable propagation process of crop like sweet potatoes).
- Monitoring of impact helps create awareness among different stakeholders.
- Food festivals and competitions with awards can be effective ways to promote NUS, generate interest and influence policy, as reported from Kenya.
- Conservation efforts for NUS genetic resources needs safety duplication and attention to on-farm conservation.
- Participatory documentation and monitoring: if species disappear, farmers will tell which varieties are lost. Farmers needs to take part and play a fundamental role in documentation of varieties and also loss of certain species.

Mainstreaming nutrition in community development: Catholic Relief Service

Bio Ozias Domagui

A presentation by Catholic Relief Service (CRS), Benin informed about the organizations work on mainstreaming nutrition through primary and secondary education.

A range of tools are being used by CRS:

- Associations of teachers, parents and children – gardening tools and seeds/seedlings for plantings, watering of gardens.
- Mainstreaming of agriculture in the curriculum
- Establishing school gardens for improved livelihoods, nutrition and food security. Various garden crops are cultivated, diversifying the school feeding program. The approach is replicated to many households.
- The school garden project presented to the government for inclusion in the school curriculum.
- A manual was developed – both learners and trainers manual developed that included terminologies such as germination test, planting, etc. These were handed over to teachers, parents and children of grade 5, 6 and 7.
- Using school gardens for teaching other subjects, e.g. give exercises on spacing between plants, calculate the number of plants per bed based on the size of bed, children are asked to read texts from the manuals or draw the description of the plants.
- Competition between various schools on garden techniques and implementation of gardens. The model gardens will serve for exchange visits of other schools and learning – validated by department of education and state agencies.
- Promotion of *Moringa olifera* – how germination is tested.

Questions and answers

Participants' questions to the presenter covered:

- choice of priority plants for the school gardens,
- promotion of such plants in areas where they may not be popular
- background to the project idea, and project implementation challenges,
- children's perception of gardening and the benefits they get from the school garden project.

In response, CRS informed that school gardens existed before that project, although they were largely used as punishment for various offences! CRS further informed that commitment of children depends on commitment of teachers and head masters along with rewards. As motivation, after harvests from garden, they sell the produce to the canteen and the money helps in arranging festivals for all to participate in.

Participants were further informed that:

- Challenges related to project implementation included increasing poverty within local communities, and environmental related issues.

- Plant species used differ between the northern and southern parts of Benin. There is need to adjust priority plants for the programme to suit local conditions.
- Curriculum on gardening for school feeding, and for generating interest among children has been developed. A document looking at the schools' food system has been developed and is used across schools in the north and the south of Benin.
- Launching of the project was difficult but was finally done with USAID and the Ministry of Agriculture, Livestock and Fisheries, Benin.
- Creating business involving the school gardens provides market channels for selling the products, which ensures greater impact and long-term sustainability.
- Fruits were also being promoted besides the traditional agricultural crops.
- A GIZ initiative on food security and resilience organized cooking sessions to promote food diversity.
- Scientifically described nutritional aspects of NUS would be of added value, and help mainstreaming them in NARS.

It was pointed out that children are the next generation of professional agriculturists, although they may not want to take agriculture as profession in the universities as a first choice. It is important that children get excited and motivated take up agriculture as a profession. It was suggested that agriculture should be included in secondary-level education to develop interest among the children. There is also need for mentors who could explain the benefits of a balanced diet with nutrition-rich food, etc.

In the discussion, the following points were made:

- Conservation of NUS and availability of data on them is an issue (different cases have been raised especially community gene banks, biodiversity registers, field diversity in Mali etc.)
- Genetic erosion of NUS was raised as a concern.
- A training manual was produced with the agreement of Ministry of Education and its branches; the elaboration of such document should involve farmers' contribution
- Recognition of NUS in CRS activities is growing, from ground level to government officers and policy makers at high levels.
- CRS's school garden activities since 1970 included only agriculture species. CRS now recognizes the need to also include animal, fruit, and tree species important for children's nutrition.
- Development of strategies for including NUS and other crops in CRS's children feeding activities, was pointed out as necessary.
- School-feeding activities should be based on local views since feeding is cultural and varies from one place to another.
- A project on food security and resilience, based on diversity of foods was recommended.

Plenary discussions on key cross-cutting issues

NUS can help address a number of key cross-cutting issues including food and nutrition security, value chains/ income generation, and climate change. But the tendency to work in 'silos' was noted as a weakness which hampers an integrated approach – ministries of agriculture, education, environment, etc. work separately. It was advocated that, as

scientists, we have to demonstrate the links between these three interventions for successful NUS mainstreaming.

The participants of this Expert Meeting made the following observations regarding the role of NUS vis-à-vis such cross-cutting issues.

Food and nutrition security

- Clarity is needed regarding the impact areas and focus among stakeholders and scientists on NUS. In addressing food security and nutrition it is necessary to take integrated, complementary actions involving all actors.
- In Benin, the National Council on Food Security is an entry point, which should be contacted to seek to integrate NUS in the National Plan, putting together universities and researchers from other institutions.
- The need for NUS awareness creation, availability of information on nutritional properties of NUS, and data on health benefits were pointed out, and an appeal was made to scientist for help.
- The need for collective action (beyond science) including parents, children, socio-economists, etc. was also highlighted as important.
- There is a need for good extension services for NUS crops and their values.
- Food that farmers produce locally should be promoted among consumers.
- Some limiting issues at local level were also pointed out, such as farmers lacking access to basic resources such as water.

Value chains

- Value chain actions are cross cutting; one needs to think of how to involve politicians and all actors to deal with production, supply, market availability, commercialization, consumers' access to products, quality assurance, etc.
- Products from paprika and *Aloe vera* have international demand and value chains have more of 'pull' from consumers. There is need for evidence-based market data.
- Along the value chains, who is going to commercialize the NUS products? What is the role of politicians in supporting NUS?
- Clarity on stakeholders' roles and responsibilities regarding commercialization of NUS products is needed, including the role of politicians in supporting NUS.
- We underestimate how beneficial NUS are, and what business opportunities they have. Capacity on how to exploit this is urgently needed.
- For NUS that have already reached international markets, such as quinoa, other issues emerge, such as maintaining competition in a large market, and ensuring that benefits go back to the producers in local communities.

Climate change

Regarding climate change, the following was noted:

- Climate change, and its mitigation and adaptation measures, is a huge challenge at national and regional levels.
- How to demonstrate to decisions makers, using real data, the negative effect of climate change? Several examples were mentioned, such as the development of models predicting climate change effects.

- Studies done on genetic erosion of agricultural biodiversity in relation to climate change were pointed out as useful, especially prediction studies on loss of biodiversity because of climate change, impact on populations' genetic diversity, and loss of species diversity.
- CIAT's work and studies in Kenya were cited, pointing at the need for climate change activities to consider farmers' local crops and associated knowledge to reduce negative effects of climate change.
- The need for governments to take climate change issues seriously was emphasized, to send a clear message to academics, students, farmers, etc., who may consider climate change a fuzzy word.
- Studies are needed at community level to document the impact of climate change.
- In Kenya, the spread of the invasive *Prosopsis juniflora* in dryland areas was pointed out as a climate related development which needs attention.
- There is need for open accessible data. Agriculture cannot stand alone but needs integration of platforms including multi-sector, multi-disciplinary and multi-stakeholder platforms.
- Although CIAT has done prediction studies globally, the availability of such data at national and regional levels is still a challenge. Data on plant and animal species that can easily adapt to climate change is insufficient or difficult to access.
- Policy makers also need data on the robustness and resilience of NUS crops, to justify their actions. Funding is not enough to provide on NUS crops, even though farmers list them as most resilient.
- Most NUS are traditional species, well adapted to local agro-ecological conditions, drought and pests. There is need to improve management regimes of NUS crops and provide farmers with up-to-date information on such crops.
- The involvement of several ministries – agriculture, environment, economics, etc. – is required; and there is a strong need for public awareness especially among decision makers.

Session 5. Future outlook for NUS: the way forward at national, regional and international levels

This session was Chaired by **Stefano Padulosi**, and the rapporteurs were **Wilson Kasolo** and **George Chemining'wa**.

Advancing NUS research and development internationally: experiences, challenges and recommendations

Sayed Azam-Ali

The session started with a keynote presentation by Prof. Sayed Azam-Ali, Chief Executive Officer of Crops For the Future (CFF), who talked about advances in NUS research and developments Internationally, highlighting various experiences and challenges. He also suggested some recommendations regarding some of the challenges identified.

The key issues highlighted on the international scene by Sayed Azam-Ali included:

- A general overview of climate change world-wide, including the global warming rate vs. population increases. He noted that 65% of the world population will be born in environments with above normal temperatures, and underscored the challenges of feeding the burgeoning human population in the face of global warming and climate change.
- General crop production decline, and the relationship to climate change, and the corresponding decreases in nutritional content of crops. He noted that, by the middle of this century, increasing levels of CO_2 levels will lead to reduction of minerals, such as Fe and Zn, in C_3 crops, thus threatening human nutrition.
- Failure of new crop varieties of the four major crops (maize, rice, wheat and soya bean) to keep up with global warming. He noted that even the current huge investments in maize breeding and development are unlikely to increase maize yields much in the face of climate change. The NUS, such as Bambara groundnut, that are highly drought- and heat-stress tolerant have a great potential in the current climate change context.
- SDGs and the role of NUS in their achievement: He noted that SDG Goal 1 (End poverty in all its forms everywhere by 2030) cannot be made by only four crop species, but by crop diversification.

A comprehensive chronology of the research and development projects and programmes conducted on Bambara groundnut (*Vigna subterranea* L. verdc) for from the days when the crop was not noticeable (since 1988) to-date when it has become an important NUS. The highlighted research activities included:

- Investigation of day length, drought and temperatures effects on Bambara groundnut productivity in glasshouse experiments in the UK and parallel field experiments in Africa
- BAMGROW (1992-96): Evaluated the potential for Bambara groundnut as a food crop in semiarid Africa. This approach assessed the yield potential and ecological

requirements for Bambara groundnut based on field experiments in Botswana, Sierra Leone and Tanzania in Africa and experiments in the UK and the Netherlands.

- Evaluation of market potential of Bambara groundnut in Africa (DFID) (2000-2001). This was a postharvest project based in Zimbabwe and Swaziland that assessed opportunities for increased utilization of Bambara groundnut in Southern Africa.
- First global assessment of Bambara groundnut: The University of Nottingham (UK) and FAO (2001) incorporated the BAMnut crop yield model into a Geographical Information System (GIS) to predict for the first time Bambara groundnut potential production for the world,
- BAMFOOD (2001-2004): Increasing the productivity of Bambara groundnut sustainable food production in semi-arid Africa (BamFOOD) EU project. This project conducted the initial molecular, physiological and agronomic studies in Africa (Botswana, Swaziland and Namibia) and Europe (University of Nottingham, UK and Technical University of Munich, Germany) (2001-2004). This led to the development of a blue print (strategy) for plant breeding strategy. Pure lines were developed through single seed descent and wild type genotypes and cultivated genotypes were successfully crossed to achieve intraspecific hybrids.
- BamLINK (2006-2011): This research focused on molecular, environmental and nutritional evaluation of Bambara groundnut for food production in semi-arid Africa and India, with studies conducted in India, Botswana, Ghana, Namibia and Tanzania.
- BamYIELD is a multidisciplinary research programme for underutilised legumes using Bambara groundnut as an exemplar species. The programme spans the entire research value chain, from research on genetics, physiology and agronomy to product development and policy.

Sayed Azam-Ali also highlighted developments at his organization (Crops For the Future) which included:

- Investigation of various agronomic aspects of Bambara groundnut
- Investigation of Bambara groundnut tolerance for drought and cold
- Establishment of The International Bambara Groundnut Network (BAMNET) – a network approach for partnership in research and development of the neglected and underutiilized Bambara groundnut for dissemination of research data on Bambara groundnut projects.
- Development of a data base for information on Bambara groundnut
- Development of CropBASE, an application for identifying suitable NUS crops for planting for various ecological areas.
- Development of ASSESSCROP – a programme for assessing composition, nutrition and functionality of NUS.
- Investigating regional potential for NUS ideotypes.

Finally, Sayed Azam-Ali highlighted global development initiatives regarding NUS which included:

a) Declaration on Agriculture Diversification – calls for a global action plan for agricultural diversification. The declaration was signed by world leaders during the United Nations Framework Convention on Climate Change (UNFCCC COP 21) in Paris in December 2015.

b) Roundtable Forum on SDG12 – launch of the Global Action Plan for Agricultural Diversification (GAPAD) in (Kuala Lumpur 2016).
c) Roundtable discussion by Agricultural experts and leaders on 25-26 October in Nairobi, Kenya to develop an ambitious plan to transform global agriculture as part of the GAPAD. The roundtable responded to the challenge of climate change and real threats to the production of the planet's major crops in a hotter world. Dr. Rhoda Peace Tumisiime, the African Union Commissioner for Rural Development and Agriculture, actively participated in the roundtable. African Union and Islamic Development Bank committed to support GAPAD.

Major Recommendations and suggestions made by Sayed Azam-Ali included:

- Keep long term focus and commitment, and keep things moving even when funds dry up. CFF started initially by a small research group conducting basic research on a crop but moved on to work with communities and have given 146 crop options for farmers in Malaysia (farmers choose own crop) and B/nut is one of them; Farmers make decisions and then we share knowledge with them
- Crop diversification can address SDG2, 13,17, 7,12 and 15 (Global action plan for Agricultural Diversification-be a global effort to address the 6 goals).
- There is need for horizontal integration across crops and disciplines (challenges are similar and lessons learned in major crops can be applied to NUS).
- Evidence based approach to development of NUS which emphasize big data, Standards (metrics) in analysis agreed across crops, education at all levels, business model for each crop and outcome mapping.
- The narrative for promoting NUS has to be accurate and convincing to consumers and policy makers for change to occur. It should shift from shift from sustenance to nourishment, from value chains to nutritional, sustainable and 'bioverse', and from climate change adaptation to climate smart nutrition.
- Strong collaborative efforts and partnerships at the local, national and regional levels are critical in seeking funds. Do not justify the case for NUS to donors as an institution on its own, but collectively as an effective consortium with potential for great impact.

Annex 1. Programme

Expert meeting on neglected and underutilized species (NUS) value chains in sub-Saharan Africa: agricultural diversification, Agenda 2030 and climate change responses

Tuesday 29 November 2016

08.30 Registration

Session 1. Opening

Chair: **Faouziath Sanoussi,** Scientist, Laboratory of Biotechnology, Genetic Resources and Animal and Plant Breeding (BIORAVE), University of Abomey-Calavi
Rapporteur: **Innocent Dossou Aminon** Scientist, Laboratory of Biotechnology, Genetic Resources and Animal and Plant Breeding (BIORAVE), University of Abomey-Calavi

09.00 Welcome remarks
Alexandre Dansi, Director, Laboratory of Biotechnology, Genetic Resources and Animal and Plant Breeding (BIORAVE), University of Abomey-Calavi
Enrico Baccioni, Initiative Manager, Bioversity International
Bachtiar Lorot, Chargé de Programme, Section Coopération, EU Delegation
Honnorat Satguina, Director, National Fund of Scientific Research and Technological Innovation
Per Rudebjer, Scientist, Capacity Development, Bioversity International

10.30 Coffee/tea

11.00 Introduction to the NUS Value Chain project
Per Rudebjer, Project Coordinator, Bioversity International

Session 2. National Action Plans for NUS value chains in Benin, Kenya and Zimbabwe: lessons learned

Chair: ***Matilda Dzomeku***, Food Research Institute of Ghana
Rapporteurs: ***Faouziath Sanoussi***, BIORAVE, University of Abomey-Calavi and ***Innocent Dossou Aminon***, BIORAVE, University of Abomey-Calavi

11.20 Upgrading value chains of Bambara groundnut and amaranth in Kenya
George Chemining'wa, Associate Professor and Chairman of the Department of Plant Science and Crop Protection, University of Nairobi

11.40 Upgrading value chains of Bambara groundnut and amaranth in Zimbabwe
Albert Chiteka, Dean, Faculty of Agriculture, Africa University, Zimbabwe

12.00 Upgrading value chains of Bambara groundnut and amaranth in Benin
Alexandre Dansi, Director of the Laboratory of Biotechnology, Genetic Resources and Animal and Plant Breeding (BIORAVE), University of Abomey-Calavi, Benin

Questions & Answers

12.30 Lunch

Session 3. Developing human and institutional capacity for NUS research and development

Chair: Christine Onyango, Taita Taweta University/ANAFE RAFT ECA
Rapporteurs: ***Olusegun Adedayo Yerokun***, Zambia Open University/ ANAFE RAFT Southern Africa and ***Albert Chiteka***, Africa University

14.00 Research capacity for supporting NUS value chain development in sub-Saharan Africa
Ingrid Leemans, International Foundation for Science, Sweden

14.20 Integrating NUS into higher education curricula
Wilson Kasolo, African Network for Agriculture, Agroforestry and Natural Resources Education (ANAFE)

Questions and Answers

15.30 Coffee/Tea

16.00 Synthesis of lessons learned regarding human and institutional capacity for NUS research and development (group work & plenary discussion)
1. Education
2. Use enhancements, value chains, partnership with private sector
3. Policy influence

17.00 End

Wednesday 30 November 2016

Session 4. Mainstreaming neglected and underutilized species in agricultural policies and programmes

Chair: ***Lusike Wasilwa***, Kenya Agricultural and Livestock Research Organization (KALRO)
Rapporteurs: ***Ranjana Bhattacharjee***, IITA and ***Amadou Sidibe,*** Institute of Rural Economy (IER) Mali

08.30 Presentations & discussion Group Work 1.
09.00 Mainstreaming nutrition in community development.
Bio Ozias Domagui, Catholic Relief Service

09.15 Mainstreaming NUS for enhanced nutrition and resilience: Lessons from Bioversity-led projects in Latin America and south Asia
Stefano Padulosi, Bioversity International

09.45 Group work 2: Mainstreaming NUS
Areas of intervention:
- Group 1 - Food and nutrition security
- Group 2 - Value chains
- Group 3 - Climate change adaptation

10.30 Coffee

12.00 Group work presentations & discussion

12.30 Lunch

Session 5. Future outlook for NUS: the way forward at national, regional and international levels

Chair: ***Stefano Padulosi***, Bioversity International
Rapporteurs: ***Wilson Kasolo***, ANAFE and ***George Chemining'wa***, University of Nairobi

13.30 Advancing NUS research and development internationally: experiences, challenges and recommendations
Sayed Azam-Ali, Chief Executive Officer, Crops For the Future

14.00 Plenary discussion. Way forward: practical steps for promoting and advancing NUS

15.00 Coffee/tea

15.30 Plenary discussion: recommendations and way forward

16.30 Closing

17.00 End of Expert Meeting

Annex 2. Participants

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Kouton armelle	Biscara sarl		Benin
Honnorat Satguina	Director, National Fund of Scientific Research and Technological innovation		Benin
Dossa Colombe	Vice President, Association of the Vegetables Producers of Sèmè		Benin
Dagba Gisele	Soleil Divain		Benin
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Annex 3. ACP-EU NUS value chain project 2014-2016

Crops: Amaranth and Bambara groundnut

Countries: Benin, Kenya and Zimbabwe. Activities also target other countries in each sub-region.

Expected Results:

1. National action plans for value chain upgrading of Bambara groundnut and amaranth in Benin, Kenya and Zimbabwe
2. Strategies and tools for integrating NUS into higher agricultural education curricula
3. Enhanced capacity in three African sub-regions for research on NUS value chains, and effective communication of results
4. Strategies, tools and methods for strengthening NUS research, education and policy communicated to stakeholders

Project coordinator: Bioversity International, Italy

Partners:
Benin: Laboratory for Agricultural Bioversity and Tropical Plant Breeding (LAAPT)
Kenya: African Network for Agriculture, Agroforestry and Natural Resources Education (ANAFE); University of Nairobi
Sweden: International Foundation for Science (IFS)
Zimbabwe: Africa University

Associates:
ExcelHort Ltc, Uganda
Global Horticulture Initiative, Germany
CORAF/WECARD, Senegal

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