

**CROPS
4HD**

SWISSAID 75
ON THE GROUND. AGAINST HUNGER. YEARS



Agrobiodiversity on the Plate

**Securing healthy food
in times of climate crisis**

Content

| | |
|--|-----------|
| 1. The Global Decline of Agrobiodiversity – Neglected and Underutilized Species (NUS) | 4 |
| Decreasing Diversity | 4 |
| Meagre Monocultures | 6 |
| NUS – another Word for Hope | 6 |
| 2. The Importance of Agrobiodiversity – Food Security, Nutrition and Climate Change | 7 |
| Agrobiodiversity Enriches our Diets | 7 |
| Agrobiodiversity Safeguards our Agriculture | 7 |
| Agrobiodiversity can Boost Livelihoods | 8 |
| Agrobiodiversity as a Response to Climate Change | 8 |
| Agrobiodiversity Maintains Traditional Knowledge | 8 |
| 3. NUS – Eating Healthy and Tackling Climate Change | 10 |
| High Potential of NUS | 10 |
| Food Decisions | 12 |
| Interview Zainabu Bakari Namituli | 13 |
| Consumers can Change | 14 |
| Interview Sina Nasir | 15 |
| 4. Excursus: The International Year of Millets | 16 |
| Millet's Demand Depending on Cultural Context | 16 |
| Adaptation to Climate Change – the Case of Chad | 17 |
| Overview of the Various Millet Species | 18 |
| 5. Some Selected 'Superfoods' | 20 |
| Bambara – Voandzou (Chad) | 20 |
| Recipes: Dumplings Voandzou Boule Bambara Stiff Porridge (Ugali) | 21 |
| Finger Millet – Petit mil (Chad, Niger) – Ragi (India) | 22 |
| Recipes: Finger Millet Pancakes Finger Millet-Oat Pancakes with Fruits | 23 |
| Finger Millet Soup Finger Millet Sprouted Idli | 24 |
| Fonio (Niger) | 25 |
| Recipes: Fonio Dish Fatty Fonio with Vegetables | 26 |
| Amaranth (Tanzania) | 27 |
| Recipes: Amaranth Fritters Amaranth-Carrot Dish Beef-Amaranth Stew | 28 |
| Coconut Amaranth Pudding | 28 |
| Moringa (India) | 29 |
| Recipes: Moringa Leaf Korma Moringa Lemonade | 30 |
| 6. What are the Solutions? | 32 |
| 7. Call to Action | 33 |



Editorial

Welcome to this publication, designed for all of us: consumers in the North and South, political decisionmakers, project managers and researchers in development cooperation. Why is this publication targeting all of us? Because we all share the desire to eat well today while ensuring a healthy future without hunger for generations to come. However, for this to succeed, a profound transformation is needed, as climate change and the extinction of species and varieties are just two of the challenges of our current food system.

In this publication, we look at the reasons behind the dwindling diversity on our plates and explain why agrobiodiversity must play an increasingly important role in the future of a sustainable food system worldwide, particularly as climate change increases the challenge for many to consume a nourishing diet.

The good news is that the preconditions for coping with climate change and allowing for healthy food still exist: rare, neglected species and varieties that have great advantages for farmers in the Global South, but also for consumers, including you, are still grown in many fields worldwide.

In the technical literature, these plants are called NUS: Neglected and Underutilized Species. This term and its meaning are explained on p.6.

We explore how consumer's food choices can influence what is cultivated in the fields (p.12) and highlight five 'Superfoods' that are grown and consumed in our project countries: Bambara groundnut, Finger millet, Fonio, Amaranth and Moringa, and present you with tasty recipes (p.20)!

We are certain that agroecology is the right approach to make our food system more democratic, climate-resilient and sustainable and to ensure that future generations – women, men and children – will find enough diverse food on their plates to live healthy, dignified and self-determined lives free from hunger. Help us to make this change possible!

Enjoy reading, cooking and eating!

Sarah Mader,
Thematic Advisor Agroecology

1. The Global Decline of Agrobiodiversity – Neglected and Underutilized Species (NUS)

Why do we need to care about agrobiodiversity? And what is agrobiodiversity anyway? We answer these questions in detail on the following pages. But we can already say that if we don't take care of it, it will be very difficult for humanity to guarantee its food supply in the long term.

The general situation regarding agrobiodiversity does not look good. It is not only a matter of the disappearance of animal and plant species, but also of the disappearance of certain cultivars (e.g., a plant variety produced by selective breeding), that are well specifically adapted to the places and conditions in which they are grown.

Through the years, farmers around the world have created and explored diverse agricultural systems such as those rich in plant species and varieties, those supporting a variety of animal breeds, as well as diverse cultivation systems and techniques. In addition to the diversity of cultivated species, a large range of accompanying plants, animals and microorganisms have co-developed and do co-exist in these agricultural systems as well. While some of these species – like pollinators and beneficial soil organisms – are appreciated, others are considered pests or weeds. However, all of them are part of agrobiodiversity (see p.5). The presence of all these elements contributes to high agrobiodiversity, locally adapted agroecosystems that lay the foundation for resilient and sustainable food systems that can both nourish our bodies and connect us to our cultural heritage (see p.8).

Decreasing Diversity

However, globally agrobiodiversity is under threat. Over the past century, the loss of agrobiodiversity has accelerated due to several factors, including population growth, urbanization, climate change and industrialization. The ongoing industrialization of agriculture is a particularly important reason for dwindling agrobiodiversity. Where there were once diverse agricultural systems, integrated into the local landscape and ecosystems, today our huge standardized production units have been creating highly specialized value chains. Such value chains promote monocultures – e.g., endless fields of corn and soya – leading to drastically decreased diversity of crops and animals on the fields. The few remaining areas where one still finds higher levels of agrobiodiversity are farm ecosystems run by smallholder farmers and indigenous populations.

The situation has worsened over the last twenty years as the pace of industrialization has accelerated. It is estimated that throughout human history 6000 to 7000 plant species have been cultivated. From this huge diversity, farmers today only grow 170 of these on a large scale, and we rely on only 30 species to cover our daily requirements of calories and nutrients. Even more strikingly, more than 40 percent of our daily calories are provided by as few as three staple crops – rice, wheat, and maize. The diversity of crop varieties (on the difference between 'species' and 'varieties', see p.5) has also drastically decreased, with the result that large areas are dominated by only a few varieties (see p.5).

Agrobiodiversity

Biodiversity for food and agriculture – short agrobiodiversity – is all the plants and animals (wild and domesticated) that provide food, feed, fuel and fibre. It is also the myriad of organisms that support food production through ecosystem services – called ‘associated biodiversity’. This includes all the plants, animals and micro-organisms (such as insects, bats, birds, mangroves, corals, seagrasses, earthworms, soil-dwelling fungi and bacteria) that keep soils fertile, pollinate plants, purify water and air, keep fish and trees healthy, and fight crop and livestock pests and diseases. (FAO 2019)



The biodiversity that is crucial for our food and agriculture is disappearing by the day. Article by FAO. Scan to read.

On the Difference between Plant Species and Varieties

A plant species is a group of plants that share similar characteristics and can breed with each other to produce viable offspring. For example, tomatoes are a species of plant, and all tomatoes share certain traits that make them tomatoes.

Within a species, there can be many different varieties. A variety is a specific type of plant within a species that has unique characteristics, such as different colour, size, or flavour. For example, there are many different varieties of tomatoes, such as cherry tomatoes, heirloom tomatoes, and beefsteak tomatoes. Each variety has its own set of unique traits that make it different from other tomato varieties.

In short, plant species are larger groups of plants that share similar characteristics, while plant varieties are subsets of a species that have distinct characteristics.

+/- 6500



plant species have been **cultivated** through human history

170



species are cultivated on a **large scale** today

30



species cover our **daily requirements** of calories and nutrients

3



species cover **40% of our daily calories**

Meagre Monocultures

Following in the footsteps of the major staple crops, other crops are now going down the so-called Green Revolution pathway to create meagre monocultures (e.g., one variety grown on a large scale that is often not the most adapted local variety). For example, in Tanzania, cassava is a crucial staple crop for many smallholder farmers. Over many generations, farmers developed and maintained a diverse range of cassava varieties adapted to different soil types, rainfall patterns, and other local conditions. However, as industrial agriculture expanded, many farmers switched to planting high-yielding hybrid cassava varieties promoted by the government and some international agencies. This focus on a few high-yielding varieties has led to the loss of traditional cassava varieties that have unique flavours and nutritional qualities and are better adapted to local conditions.

Industrialization and globalization of agriculture have led to the replacement of diverse crops and varieties with a few input-dependent high-yielding monocultures. Due to this change, we are now witnessing the loss of genetic diversity and the erosion of traditional knowledge and practices. Many local and traditional varieties that are better adapted to local conditions have already disappeared. This loss of diversity puts the food security and livelihoods

of smallholder farmers at risk, as their crops become more vulnerable to pests, diseases, and climate change (cf. chapter 2). Further, the exclusive focus in agriculture on intensified calorie intake rather than a diverse and healthy diet has resulted in hundreds of millions of people who suffer from a lack of essential vitamins and micronutrients in their diets.

NUS – another Word for Hope

However, there is hope. Neglected and underutilized species (NUS) are plant and animal species that have been overlooked by modern agriculture and food systems. NUS have the potential to contribute to food security, nutrition, and environmental sustainability. Small-scale, indigenous farmers are often the keepers of NUS, and are currently maintaining a great deal of the remaining agrobiodiversity.

One example of NUS are some varieties of millet. Millets are a cereal crop that are a staple food in many regions of Niger and Chad. They are hardy crops that can thrive in poor soil and under harsh weather conditions, making them an important source of food and income for smallholder farmers (cf. chapter 3).

In addition to improving food security, the promotion of NUS can contribute to increasing agrobiodiversity, as these diverse species represent a significant source of genetic diversity. Thus, they can help to address some of the challenges facing sustainable agriculture and food systems. By investing in research, policy, and innovation that supports the conservation and use of agrobiodiversity, we can ensure that our food systems remain resilient and sustainable for generations to come.





2. The Importance of Agrobiodiversity – Food Security, Nutrition and Climate Change

Why is agrobiodiversity important? Agrobiodiversity is critical for safeguarding global, regional, and local food security, underpinning healthy and nutritious diets, improving rural livelihoods, and enhancing the resilience of people and communities. The following sections outline the key reasons why agrobiodiversity and in particular the promotion of underutilized and neglected species (NUS) are important.

Agrobiodiversity Enriches our Diets

Traditional crops and NUS are often very nutritious and can contribute to a well-balanced diet. As alluded to in the section on ‘meagre monocultures’, considering nutrient quality as well as food quantity is a critical issue in food security, as evidenced by the approximately 1.5 billion people in the world who are currently affected by one or more forms of micronutrient deficiency. Deficiencies in iron, zinc, iodine, vitamins A, B12 and D are widespread in both underdeveloped and developed countries, especially among women and children. These deficiencies occur not only in people who are underweight but also

in people who are overweight and obese. NUS have a great potential to enrich our diets and provide both quality and quantity to ensure balanced nutrition. The Bambara groundnut, for instance, offers a great source of protein (cf. chapter 5) and millets are high in calcium and iron (ibid.). Amaranth, Moringa and Fonio are additional so-called ‘Superfoods’ that are presented in chapter 6.

Agrobiodiversity Safeguards our Agriculture

A high level of agrobiodiversity makes our agricultural systems more resilient. Farms that cultivate a variety of crops can cope better with external shocks, such as extreme climate events or pests. This contrasts with monocropping, which is prone to devastation from pests and climate events and runs the risk of reduced yields if soil degrades over time. With only one or a few crop species and varieties on huge fields, pests and diseases can spread easily, affecting the whole crop. In other words, less agrobiodiversity at farm level means that plants and animals are more susceptible to pests and diseases. This is a risk for each individual farmer as he/she risks losing

an entire yield and therefore their own food and products to sell. The loss of income in the event of a crop loss is massive. In the case of large regional pest outbreaks, as we have seen in the past with the locust plague or the fall armyworm in Africa, the results are not only losses for farmers, but also a steep increase in the prices of the affected food products for local consumers, making them even more dependent on imported food. Thus, compounded by our reliance on fewer and fewer species to feed ourselves, the increasing loss of agrobiodiversity puts food security and nutrition at risk.

Agrobiodiversity can Boost Livelihoods

By basing their production on a greater number of crops that are valued and appreciated on the market, farmers can increase their income. Some traditional crops have good commercial potential and can be excellent income sources for small-scale farmers. Quinoa, as one example, used to be a subsistence crop in Bolivia, Peru and Ecuador, but because of increased visibility and attracted interest, farmers now grow quinoa in over 70 countries. In addition, through the cultivation of different species on the same field – for example through intercropping – the yield of the crops can be increased, as the different crops can be beneficial for each other. For example, legumes (such as beans and peas) store nitrogen in the soil, which neighbouring plants can then absorb, boosting their growth. Finally, these intercrops farmers can sell on the market and generate additional revenue.

Agrobiodiversity as a Response to Climate Change

As an effect of the climate crisis, rainfall patterns in many parts of the world are changing: rain is becoming erratic, scarcer, and farmers can no longer rely on the rain coming at the usual time of year. This makes it increasingly difficult to grow food in these regions, for instance in the Sahel region in Africa below the Sahara Desert, where people are already severely affected by hunger.

In these types of situations, the availability of diverse seeds that are well adapted to adverse climatic conditions can mean the difference in the success and failure of a harvest. Luckily, well adapted traditional crop varieties in

Africa and other parts of the world exist that can cope relatively well with the changing weather patterns. For example, several species of millet (more on millets, cf. chapter 4) can grow with little water and withstand mild droughts. Further, some species are early and fast maturing as a response to a shorter rainy season. Some native legume species, such as the Bambara groundnut (cf. chapter 5), are also adapted to drought and enrich the soil with additional nitrogen. With climate extremes becoming more frequent, these crops can be ready-made solutions for places where it is difficult to grow any other food.

Farmers are also proactively searching for crops that can thrive in changing local conditions. For example, farmers in Guinea-Bissau in West Africa bred new rice varieties that can withstand salt water. This is an important advantage because with rising sea levels, soil salinization is an increasing problem.

Agrobiodiversity Maintains Traditional Knowledge

When agrobiodiversity decreases in favour of monocropping, it is not just the traditional crops that are being ignored, but also the traditional farming techniques that may provide the most sustainable option in that landscape. Indigenous people, for example, have used many agricultural methods, including terracing, that are naturally sustainable i.e., making better use of water, requiring little to no fertilizers or helping replenish the soil. ‘Improved’ agroecological practices promoted today, should build on these traditional knowledge and practices, and not ignore them in favour of ‘easier’ industrial methods. We are facing a future where we need not only to grow more food for more people on the planet but also to grow diverse and nutritious food. This can only be achieved by steering the transformation of currently unsustainable food systems toward resilient and sustainable models. In so doing, traditional knowledge can be a valuable tool.





3. NUS – Eating Healthy and Tackling Climate Change

The project CROPS4HD focuses on underutilized products called ‘neglected’, ‘orphan’, or ‘underutilized’. These are plants with excellent nutritional properties, but which have somehow been abandoned due to a lack of market demand or a lack of deeper understanding of their nutritious properties, health benefits and valuable use in local dishes.

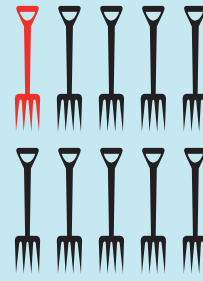
High Potential of NUS

Limited agrobiodiversity on consumers’ plates results in a less diverse diet and is both a cause and an effect of genetic diversity loss at the farm level. Farmers today rely on a narrow gene pool for food, nutrition, and income. CROPS4HD’s recent baseline study has revealed that while most of the NUS crops are still cultivated by farmers, the number of farmers growing NUS is highly disproportionate to those cultivating major crops. For example, in the studied regions of India, only 6.7 percent of farmers in Karnataka grow Finger millet, 5.9 percent in Odisha and 1.7 percent in West Bengal. Similarly, only 10 percent of farmers grow Bambara bean in Chad, only 9.7 percent of farmers cultivate

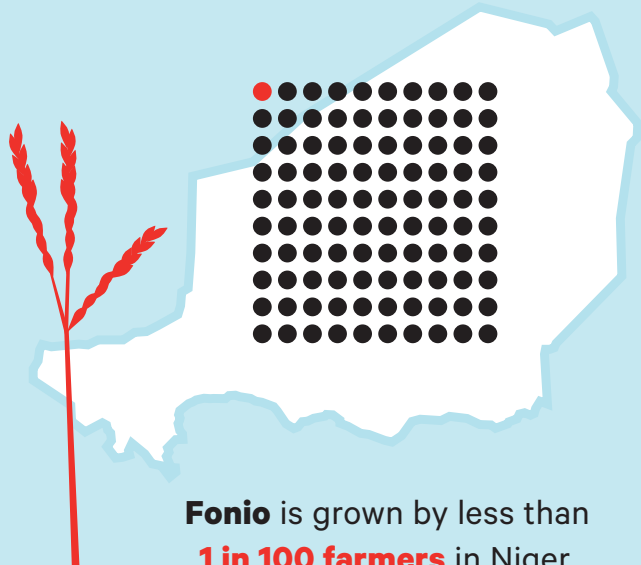


Amaranth for leaves in Tanzania, and less than 1 percent grow Fonio in Niger. Moreover, farmers are not fully exploring the genetic diversity available in any given crop, as most of them only grow one or two varieties. For example, more than 100 varieties of Bambara bean exist in Chad, but most farmers plant only one variety per farm per year.

In most of the regions surveyed, farmers experienced moderate or severe food shortage at some point in the year (37% in Odisha, India; 58% in Tanzania; 52 to 93% in Chad; 89% in Niger). In these areas, food shortage in a year does not relate to the agrobiodiversity on the field but rather coincides with the cropping seasons, where less food is available in the months before the main sowing season. The data shows that the food insecurity index is higher for all rural areas surveyed than for the national average. Interestingly, our data reveals that food shortage experiences do not differ between male and female farmers in these areas. This can be explained by the fact that food supply decisions at the house-



Finger Millet, Bambara bean and Amaranth (leaves) is grown by **less than 1 in 10 farmers** in the studied areas.



Fonio is grown by less than **1 in 100 farmers** in Niger.

100 varieties of **Bambara bean** exist in Chad

but most farmers only plant **variety per farm / year.**

1

hold level are mainly made by women; they decide what to cook, thereby making use of their knowledge of nutrition.

Nevertheless, the provision of a nutritionally rich and diverse diet for all family members can still be very difficult. Often, additional time is required for the cooking of traditional recipes using a variety of food crops based on NUS. For instance, the cooking time for millets is higher compared to other cereals.

Expert estimate that approximately 5000 potential food crops exist around the world, known collectively as 'neglected and underutilized species' (NUS) – plants, animals and fungi whose contributions to sustainable food systems are severely under-valued due to a general lack of awareness and information.

NUS are typically native to the environments in which they are grown. As such, they are better adapted to local conditions, and require fewer external and economic inputs than conventional crops. Many NUS can also thrive in marginal areas, in arid soil or on land considered unsuitable for other purposes. This makes them an important part of climate-change adaptation strategies, and economically viable for smallholder producers. Moreover, many NUS are highly nutritious and rich in micro-nutrients and bioactive compounds.

Because usually rural women and indigenous peoples tend plant NUS, most of them they grow at home, often in kitchen gardens, or harvest them from forests. As NUS enter mar-

kets, whether local, national or international, they have the potential to create earnings for the communities who hold the keys to understanding how to cultivate, use and process these plants.

Food Decisions

On average, a food consumer makes around 221 food-related decisions every day. How consumers make these decisions and what factors influence food choices and consumption volume are highly debated. However, it is widely agreed that our food habits are significantly contributing to climate change on planet Earth. Consequently, climate change is becoming a defining factor for food security and future diets. We know that a narrow range of food choices leads to highly specified value chains, less diverse farming, and makes current food systems a significant contributor to biodiversity loss and climate change. These factors together exacerbate the threat of hunger and malnutrition, widening social inequalities and hindering sustainable development globally.

Despite this, the awareness and consumption of NUS crops are quite limited in the CROPS4HD-target areas. For example, from selected NUS including millets, over 50 percent of the consumers in rural areas of Karnataka, India only eat green gram and groundnut, while less than 10 percent of consumers eat other NUS crops. Similar trends we noticed in Africa, where more than 50 percent of rural consumers include Amaranth leaves and





Zainabu Bakari Namituli (54 yrs.)

She is a farmer, based in Mbuo, Tanzania. She has four children and two grandchildren. Her husband passed away. She lives with her youngest son (15 yrs.) in the same household. For six years, she has been involved in SWISSAID projects, first in ALCE, then CROPS4HD.

Zainabu Bakari Namituli has been benefiting from various training courses on improved agricultural practices for the last six years. These trainings have caused her to change her way of farming from conventional to organic. “I changed my farming practices because the taste of the products is much better than before”, Zainabu Bakari Namituli explains. Before she received the trainings, she applied chemical pesticide, mainly on sesame, but sometimes also on other crops. From SWISSAID she learnt how to optimize the seed use, for instance by spacing, but also how to ensure healthy soil. “I can now go to my plot, identify pest and diseases and prepare a biopesticide”, Zainabu Bakari Namituli states. Her farm is more profitable than before the involvement with SWISSAID. She has seen a lot of economic development. “Despite the loss of my husband I can finance the school fees of my son from the income gained on the farm”, she says proudly.

Knowledge has added value to her produce: “I know now what to grow when and can be assured about a market for my produce. I can now cultivate based on demand”. Zainabu Bakari Namituli cultivates cassava, okra, maize, cowpeas, rice and Bambara groundnut. She sells okra and cowpeas mainly in the market. Zainabu has been cultivating Bambara groundnut for over 40 years, primarily for self-consumption. Only if she has a surplus, she brings them to the market. Zainabu is aware of the nutritional benefits of Bambara groundnut: “Bambara groundnut is a complete meal. I don’t have to cook anything else; it is so nutritious. And I only need a small amount of Bambara groundnut for a big meal. Cooking Bambara groundnut saves time and energy!” Her statement is convincing as well as scientifically proven. Bambara groundnut is a ‘Superfood’.

Particularly during the lean season, when food availability is often a problem, Bambara helps to overcome food insecurity. But why is Zainabu Bakari Namituli not producing and selling more of this ‘Superfood’?

“There is demand in the local market for Bambara groundnut, but I can’t expand. I don’t have sufficient land”. Bambara groundnut is not only good for human consumption. Zainabu Bakari Namituli knows that it also enhances soil fertility. She puts the residues of the plant in the soil as green manure. She has also noticed that Bambara is much more resistant to drought than other ground nuts.

Zainabu Bakari Namituli uses Bambara also for medicinal purposes, for an eye disease called ‘mtoto wa jicko’ (cataract). Bambara groundnut can also be used as flour to make baby food. Zainabu Bakari Namituli has several favorite recipes to prepare Bambara groundnut: *Fresh Bambara groundnut*: boiling with the pots and eating as snack. *Dried Bambara groundnut*: She removes the coat of the nuts and boils them for several hours until they are soft. She adds onions and coconut milk and sometimes a little bit of sugar. This dish she eats during Ramadan. As a side dish she adds tomatoes and salt.

Bambara can also be mixed with rice or sorghum and cooked together. In this case, first Bambara groundnut are being cooked until they are soft, then rice or sorghum is being added, then coconut milk and salt.

Zainabu Bakari Namituli’s biggest concern now is water shortage. Irrigation becomes necessary!



sweet potato leaves in their diet. However, less than 10 percent of Tanzania's rural and urban consumers eat other NUS crops like Finger millet, Amaranth grains, African nightshade, spider plant, sugar apple, and Bungo fruit. Similarly, less than 10 percent of rural consumers in Niger eat Amaranth leaves and guava. In Chad, less than 10 percent of consumers eat Bambara bean, Livingstone potato, Finger millet, Pigeon pea, and Country potato.

These findings from indicate that while NUS crops are often available, there is significant work to be done in their promotion to encourage their use on farms for home consumption and to increase their availability on local markets.

Consumers can Change

Consumers can change their food systems by diversifying their diets, leading to more diversified food systems and thus providing economic incentives to producers. In India, for example, a process involving farmers,

processors, retailers, and nutritionists has favoured different varieties of millet, largely replacing rice, which is significantly less nutritious. In Niger and Chad, market players are mobilizing to promote the production and use of Bambara groundnut and Moringa, which are high in protein.

The change of consumer habits needs political backing from the regional to the global level, as the case of organic agriculture shows. As consumers have been sensitized to the advantages of organic agriculture, many now cite specific reasons for choosing organic products such as personal health, children's health, and nutritional value. NUS's have to date not received similar backing and promotion, and data shows that more consumers choose organic over NUS. International bodies such as the WHO have only recently begun to recognize the full potential of NUS, but are now seeking to highlight their potential benefits. For example, the UN declared 2023 the International Year of Millets (cf. chapter 4).

Sina Nasir (56 yrs.)

She is a farmer (crops/livestock) in Mlampama Street, Ng'apa ward, Tanzania. She has five children and 15 grandchildren. She lives with one daughter and four of her grandchildren in the same household. With SWISSAID she has only recently been involved via CROPS4HD.



Sina Nasir has been cultivating Moringa for ten years, mainly for two reasons: as nutritious food and for medicinal purposes. She and her family consume Moringa daily. Babies from the age of six months onwards receive Moringa incorporated in their porridge as vitamins. During the Corona pandemic, she provided Moringa porridge to the infected family members. "None of my family members passed away, however, neighbours not having consumed Moringa, died", Sina Nasir states. She believes this is due to Moringa.

For Sina Nasir, the seeds are also important; they cure malaria and diabetes. "The intake of Moringa for seven days can fight malaria. As for diabetics, if taken at the early stage, diabetics can be cured, later it reduces the symptoms". After Sina Nasir learnt the healing effects and Moringa recipes from her father, she started experimenting and realized that what her father was saying was true. She started with experiments for herself, then involved the family members, and finally experimented with the chickens. From then on, she didn't have to purchase vitamins anymore for the chickens. "Also, for cows Moringa is effective as vitamins", Sina says with conviction. Sina uses the entire plant: the stem, the leaves, and parts of the bark.

Baby porridge: One of her favourite recipes is the powder production for baby porridge: First, she harvests the leaves. Then she removes the leaves from the stems and sets them to dry indoors on cloths on the floor. During the hot season, the leaves dry within three to four days. Then she grinds the leaves with the mortar to a fine power.

In the age of six to 12 months, babies receive following moringa porridge: ½ teaspoon powder is added in the porridge after it has cooked for 30 minutes. The porridge flour is composed of groundnuts, whole grain flour, beans and sometimes sardines. If the weight of the baby is good, one intake per day is sufficient, whereas if the baby is underweight two intakes per day are necessary.

From the age of one year onwards, children receive once a day one teaspoon of moringa powder in the porridge. This recipe is used in her family, and she sends the Moringa powder to her family members by post. However, Sina Nasir doesn't observe the neighbours adopting this practice; she could only convince a few people. "They are lazy", Sina Nasir notes soberly. Most people eat Moringa as vegetable. "You pick the tender leaves only, boil them, add tomatoes, and groundnut butter and eat; the vegetable you eat with ugali". That is the recipe that Sina Nasir uses most.

"Others are using moringa also against snake bites, as the uptake of poison is being stopped if you place the bark on the skin. But you must be careful! The bark should not stay too long on the skin".

Sina Nasir wishes that Moringa could be popularized: "The communities are not yet fully aware of the benefits and the uses of Moringa. Not enough is being done to bring the knowledge to the people". Sina is willing to help. She thinks that in rural areas radio and TV campaigns could be effective. Some people might then pick up the use of Moringa.

Sina Nasir plants Moringa on a very small scale. The market in the rural area doesn't exist as everybody has Moringa. However, she can provide her daughter with Moringa as she works in a peri-urban area in the herbal-medicinal business. "The legal restrictions are not favourable for farmers to process certain crops and species. Moringa is one of them".

Sina Nasir knows of other uses. "Moringa Powder can also be used as water purifier. You add one tablespoon of Moringa powder in 20 litres of water. This creates physical sediments on the bottom of the water vessel. Moringa is also good against constipation: three seeds in a glass of salt water and you need to run". Moringa has also benefits for producers: "Moringa is also used for compost and can improve soil health. Moringa makes the soil fertile and avoids soil cracking; certain pests, like soils worms that damage crops, have disappeared since I put Moringa in the soil" – these are Sina Nasir's observations as a producer.

4. Excursus: The International Year of Millets

The United Nations General Assembly declared 2023 to the International Year of Millets. The FAO is the lead agency for celebrating the Year in collaboration with other relevant stakeholders. IYM 2023 is an opportunity to raise awareness of, and direct policy attention to the nutritional and health benefits of millets and their suitability for cultivation under adverse and changing climatic conditions. Millets can grow on arid lands with minimal inputs and are resilient to changes in climate. They are therefore an ideal solution for countries who wish to increase self-sufficiency in food production and reduce reliance on imported cereal grains.

Millet is a collective term for a diverse group of small-grained dryland cereals including, among others, pearl, proso, foxtail, kodo, browntop, Finger and Guinea millets as well as Fonio, sorghum and teff (see p.18 and 19). While most of the species categorised as millets have been neglected by research and breeding, they are an important source of food for millions of people in sub-Saharan Africa and Asia. Deeply rooted in peoples' culture and traditions, they have enormous potential to guarantee food security in areas where they are culturally relevant.

Millets are highly nutritious grains that are rich in fibre, protein, vitamins and minerals. They are a good source of essential amino acids, particularly lysine, which is lacking in many other grains. Millets are also gluten-free, making them a good option for people



ple with gluten sensitivity. In Asia and Africa, where malnutrition is a significant problem, millets can play a crucial role in improving the nutritional status of the population. Hence, millets have great potential as an affordable nutritious food, as an attractive component for global healthy diets, and as a crop that can withstand climate change.

Millet's Demand Depending on Cultural Context

Millets have a long history of cultivation and consumption in Asia and Africa, as they are an integral part of the local culture and cuisine through a wide scope of traditional dishes. The promotion of millet-based diets supports local food preservation and promotion of cultural diversity.

The local availability of diverse species or the preference for a certain taste have an influence on consumer preference. This is shown at a worldwide level where pearl millet is one of the most produced species and largely appreciated in India for example. In Chad pearl millet is not much produced; rather other species such as sorghum (red or white) are

“When people see the red sorghum, they say that they don’t want it because, if you don’t know it, you don’t consume it. But if you taste it, you will see that it is good and that it is also good for the health”,

Chadian farmer, Guera (2023)

“On the market, if there is the white sorghum, people will buy it first before settling to the red sorghum... It is a question of taste but mostly on a habit and an appreciation that is cultural”,

Chadian farmer, Logone-Oriental (2023)

preferred. More interesting is that the diversity in demand of millets can also be observed at a national level where cultural factors have a strong influence, too. Hence, in one region of Chad, the red sorghum is appreciated by children while in another region the colour and implicit reputation of it has the opposite effect and children don't like this variety.

While the preference related to the taste varies significantly, the nutritional values are emphasized everywhere. For example, it is widely recognised that some millets are advantageous for diabetic people or play an important role in religious traditions, such as Ramadan, where sorghum is prepared as a beverage to break the religious fast.

Adaptation to Climate Change – the Case of Chad

Millets are regarded as resilient crops thanks to their capacity to be adaptable to different production environments. Furthermore, they do not have a high demand for fertilizer and pesticide. Nevertheless, farmers must also adapt their agricultural practices to address the increasingly unpredictable weather conditions. Agroecological practices such as the use of compost to enrich further the soil are examples of some of the adaptation techniques used by farmers to increase their resilience to changing conditions. However,

in southern Chad there is also a trend towards the increased use of short cycle millet varieties by farmers as another way to increase resilience. Short-cycle varieties mature more quickly and thus help farmers to minimize the issues associated with shorter periods of rainfall, which otherwise can complicate the harvest and can often lead to heavy losses in the longer-growing varieties. However, regarding the nutritional values the short cycle productions are not ideal.

“If the weather permits, the long cycle is better than the short cycle. Even the nutritional value is better because it takes time to develop normally. Because when it is developed fast, the value will not be there”,

Chadian farmer, Logone-Oriental (2023)

Millets are just one example of healthy and nutrition-rich food, that is used quite widely as we have seen in the sections above. There are other foods sharing similar qualities to those of millet. To characterise their abilities and market them more successfully they are called ‘Superfoods’, which are the topics of the next chapter.

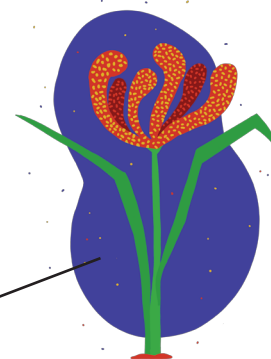




Pearl Millet (*Pennisetum glaucum*)

- The most widely grown of all millets.
- Traditional crop in Western Africa, particularly in the Sahel; in Central, Eastern and Southern Africa; and in Asia, in India and Pakistan and along the southern coast of the Arabian Peninsula.
- Highest yield potential of all millets under drought and heat stress.
- Not very susceptible to pests and diseases, but bird predation can be a problem.
- Plant that forms an erect clump up to 4 meters high.

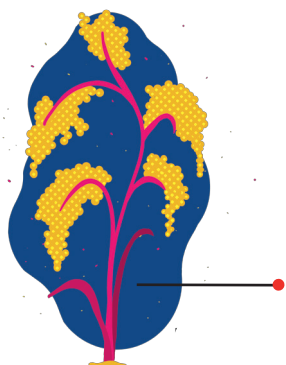
Idea of consumption: porridge, flour, cookies, bread



Finger Millet (*Eleusine coracana*)

- Important staple food in Eastern Africa and in Asia (India, Nepal).
- Slightly higher water requirement than most other millets.
- Short to medium cycle, depending on the variety (2.5 to 6 months).
- Storable for years without being attacked by insects, but harvesting and processing is very laborious. Both have to do with the smallness of the grains and their hard husk.

Idea of consumption: bread, beer and cereal



Proso or Common Millet (*Panicum miliaceum*)

- Is grown in temperate climate.
- Widely cultivated in the Russian Federation, the Ukraine, Kazakhstan, the United States, Argentina and Australia.
- The stem is sturdy, erect and can reach over 1.5 meters in height. Long furry cover all parts of the plant. The roots are fibrous and shallow.

Idea of consumption: bread, flour, pastas, couscous



Overview of the Various Millet Species

Source: FAO (2022) "International Year of Millets 2023, communication handbook and toolkit"

Teff (*Eragrostis tef*)

- Cultivated for grain in the Ethiopian highlands, where its production exceeds that of most other cereals.
- Tolerates heavy soils with poor drainage characteristics.
- Several of its relatives are highly valued forage grasses in the world's arid zones.

Idea of consumption: flatbread, muffins, pastas, injera



Foxtail Millet (*Setaria italica*)

- Adapted to moderate climate.
- China ranks first in the production of foxtail millet in the world. Also grown in India, Indonesia, the Korean peninsula, and some parts of southern Europe. It is not grown to any extent in Africa outside the eastern highlands.
- Interesting properties for diabetes.
- Cycle of approximately two months.

Idea of consumption: salads, pancakes, haleas, khichdi



White Fonio (*Digitaria exilis*)

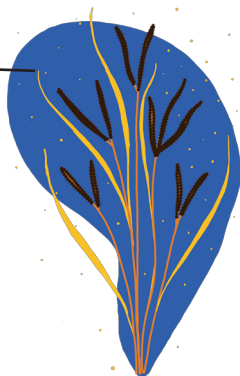
- Minor cereals of dry areas in sub-Saharan Western Africa.
- Is cultivated throughout much of this region, except Liberia.
- Very important crop in southern Mali, northeastern Nigeria, extreme southern Niger, western Burkina Faso, eastern Senegal and northern Guinea.
- Interesting properties for diabetes.
- Some varieties need only 6 to 8 weeks from sowing to harvesting and can therefore help to bridge periods of famine.
- Has very small grains, which makes threshing and polishing (often still by hand) very laborious.

Idea of consumption: porridge, couscous, bread, beer

Black Fonio (*Digitaria iburua*)

- Minor cereals of dry areas in sub-Saharan Western Africa.
- Found in isolated pockets in the Jos-Bauchi plateau of Nigeria and the northern parts of Togo and Benin.
- Interesting properties for diabetes.
- Some varieties need only 6 to 8 weeks from sowing to harvesting and can therefore help to bridge periods of famine.
- Has very small grains, which makes threshing and polishing (often still by hand) very laborious.

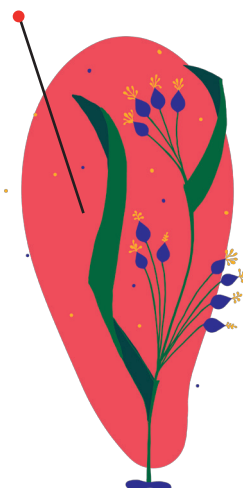
Idea of consumption: couscous, porridge, salads



Job's Tears (*Coix lachryma-jobi*)

- Minor cereal even among the small millets, with production confined largely to Southeast Asia.
- Cycle of 5 to 5.5 months.
- Needs much water, as drought is a major constraint for the development especially of the young plant.

Idea of consumption: soup, porridge, flour, pastries



Sorghum (*Sorghum bicolor*)

- Major food crop in Africa.
- Valued in hot and arid regions for its resistance to drought and heat.
- Strong and long roots allow a good water supply. During drought, the plant goes into «hibernation» until the next rain comes.
- The stalks can sprout again, allowing multiple harvests without the need for replanting.
- Proteins are poorly available and become more available through fermentation.

Idea of consumption: alcoholic beverages, bread, couscous



Guinea Millet (*Brachiaria deflexa*)

- Minor cereals of dry areas in sub-Saharan Western Africa.
- Cultivation is confined to the Fouta-Djallon plateau of Guinea and Sierra Leone.
- Some types mature quickly (between 70 to 75 days and 90 to 130 days).

Idea of consumption: bread, beer, cereal



Barnyard Millet (*Brachiaria deflexa*)

- Important in the tropics and subtropics of India.
- Can grow up to 1.5m and has long, flat leaves.

Idea of consumption: flour, pastries, bread



Little Millet (*Panicum sumatrense*)

- Widely grown in India, Nepal, Pakistan, Sri Lanka, eastern Indonesia and western Myanmar.
- It can withstand both drought and water logging.
- Cycle between two and five months.

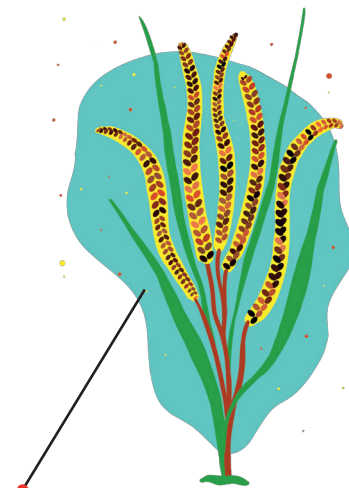
Idea of consumption: can replace staple rice dishes



Kodo Millet (*Paspalum scrobiculatum*)

- Harvested as a wild cereal in Western Africa and India, where it grows abundantly along paths, ditches, and low spots.
- It can be stored for years without being attacked by insects.

Idea of consumption: fermented foods, porridge





Consumer information

This nutrient-dense legume is sometimes termed a <complete food> due to its balanced macronutrient composition. It contains on average 63 percent carbohydrate, 19 percent protein and 6.5 percent fat, making it a very important source of dietary protein. It contains other high-quality minerals and vitamins.

The seeds are used for food and beverages because of their high protein content and for digestive system applications. In West Africa, nuts are eaten as a snack, roasted, and salted, processed into cake, or as a meal, or boiled like other beans. The Bambara groundnut needs to be cooked for a relatively long time.



Note: Any advice given in this chapter is based on traditional knowledge and is not scientifically validated. If you have any health concerns, please consult your doctor first.

Dumplings | Chad

Ingredients:

500 g Bambara groundnut flour (alternatively, you can replace Bambara with chickpea flour),
50 ml vegetable oil,
2 stock cubes (crushed),
1 small onion (chopped fine),
ground chili pepper (to taste),
salt (to taste) and warm water (as needed). Container: bowls, aluminium foil bags or plantain leaves.



Preparation: Pour the flour into a bowl, add vegetable oil and mix thoroughly, until the flour changes from white to orange or yellow. Add the warm water and mix thoroughly, making sure the mixture is not too watery and is without lumps. Add the stock cubes, onions, chili pepper and salt to taste. Mix thoroughly. Pour the mixture into a container and place in a pot of boiling water. Boil for 45–60 minutes, adding water if too dry. Leave to cool and then serve.

Bambara Stiff Porridge (Ugali)

Ingredients:

200 g roasted Bambara flour
200 g white maize flour, water

Preparation: In a pot, add cold water with the Bambara and maize flour mix (50/50) and mix well. Cook to reach a porridge like consistency, and then slowly add more flour by sprinkling over the porridge and stirring vigorously until you reach the desired consistency.



Voandzou Boule | Chad

In Chad, there are several dishes based on the Bambara groundnut. In most cases, the flour of the Bambara groundnut is used to make a paste formed into a ball called <boule>. They use 1 kg of Bambara groundnut flour for a meal of three people. The 'Voandzou Boule' is very appreciated not only for its taste but also for different traditional rites. The variations in the preparation depend on the ethnic group (this recipe is provided by SWISSAID Tchad). For the Sar group (a language group within the ethnic group of the Sara), the preparation of the boule is done in the following way.

Preparation: Boil water in proportion to the amount of the prepared Bambara groundnut flour. After the water boils, take some of it and put it aside. Then add fresh water to the remaining water before adding some of the pea flour and stir for at least 5 minutes. When the dough hardens on the fire, add some of the hot water taken besides and stir for two minutes and cover the pot for 3 to 5 minutes depending on the intensity of the flame. Then stir again and add the remaining hot water, intercalating with the flour. When the dough has a whitish colour, it is ready. If you are not sure, you can taste the dough to make sure that it is well cooked. Then, we make balls with calabashes whose interior is anointed with black shea butter. The ball is ready to be served with a sauce of choice.

**Finger Millet –
Petit mil (Chad, Niger) – Ragi (India)**
Eleusine coracana

General Information

Finger millet was domesticated about 5000 years ago from the wild subspecies in the highlands that range from Ethiopia to Uganda. Later, it was also cultivated in the lowlands of Africa, in South and East Africa, but cultivation is declining. 3000 years ago, Finger millet was introduced into India, with the result that India is now a secondary centre of diversity for Finger millet. Its cultivation is gaining popularity in parts of India, as it can be grown in rice fields during the dry season.

The height of a mature plant ranges from 30 to 150 cm in the cool, high-altitude regions of Africa and Asia. The seeds may be white, light brown, or dark brown.

Advantages for small-scale farmers

Finger millet is an extremely adaptable crop. It grows in the tropical heat as well as in high altitudes on poor or less fertile soils. It can even tolerate a certain salinity. Finger millet can be grown in intercropping systems (with legumes like black gram, pigeon pea, green gram, soya bean) to generate extra income. Also crop rotation is suggested with legumes. Finger millet produces reasonable yields under low input crop production systems and can be stored for years without being attacked by insects, but harvesting and processing is very laborious due to the smallness of the grains and their hard pods. Therefore, it is often not milled and consumed as a whole-grain flour.

Consumer information

Finger millet is a gluten-free cereal thus suitable for people suffering from celiac disease. It is high in calcium and iron and contains proteins of high quality and dietary fibres, particularly if consumed as whole grain. As it can be stored for a long time it acts as a food reserve during the lean season.

The seeds are consumed in a variety of forms including unleavened bread made from milled flour. Various types of porridge and alcoholic beverages are also prepared from the seeds. It is often also used for baby food.



Finger Millet Pancake | Chad

Ingredients:

1 cup of Finger millet flour,
1 medium red onion, finely diced,
1 tbsp oil,
2 tbsp of peanuts (or peanut butter),
1 tbsp of salt (for taste),
1 tbsp pepper,
1/4 cup of water.
Optional: 1 tbsp of curry powder.



Preparation: In a frying pan, heat the oil and fry diced onions until light brown. Add pepper and curry powder and fry for a minute. Add 1 cup of Finger millet flour, salt, peanuts, and fried onions to a dry bowl, and mix well. Add the water and knead the dough. One can make them either to the consistency of pancake batter or bread batter. Heat a skillet. Spread the batter in skillet and cook till brown. It makes six portions.

Finger Millet-Oat Pancakes with Fruits | India

Ingredients:

1/2 cup ragi (aka Nachni, Finger millet, or Wimbi) flour,
1/2 cup oat flour,
1 large overripe banana mashed,
3/4 cup milk, 1 large egg,
1 tbsp baking powder, 1/2 tsp salt,
1/4 cup plain yogurt,
1/2 tsp cinnamon powder.

Topping: 1 cup mixed fruit chopped,
honey, maple syrup or chocolate sauce,
1/2 cup chopped nuts optional,
some butter or oil for cooking.



Preparation: Mix the oat and ragi flour together. Add baking powder, cinnamon and salt to the flour. Mix well. In another bowl whisk the egg lightly. Add mashed banana, yogurt and milk to the egg. Whisk well. Add the flour mixture and mix till the flour mixture is incorporated into the liquid. Don't over mix. Heat a skillet or frying pan over medium heat. Add a bit of butter or drizzle some oil in the pan or skillet. Add about 1/4 cup of the batter, spread it little using a spoon into a round shape. Don't make it too thin. Drizzle oil or add a piece of butter around it. Lower the heat and let the pancake cook. As the top appears a little dry, flip it over. Add a little oil or butter and let the other side cook. Repeat with the remaining batter. Serve pancakes topped with chopped fruits and nuts of your choice. Drizzle chocolate sauce, honey or maple syrup over the pancakes.

Finger Millet Soup | India

Take Finger millet soup before lunch and dinner at regular intervals. It is useful for weight loss and weight management and good for people who have diabetes.

Ingredients:

3 tbsp of Finger millet powder,
1 small, chopped carrot,
1/4 cup of green peas,
2 chopped onions,
1 chopped green chili,
2 or 3 chopped garlic,
small piece of chopped ginger,
small amount of chopped beans,
capsicum cut into very small pieces,
1 or 1/2 tbsp of cooking oil,
1/2 tsp of Cumin seed,
1 piece of chopped tomato and a small piece of chopped cauliflower,
2 cups of water

Preparation:

Step 1: Take two cups of water (room temperature). Put the three spoons of Finger millet powder and mix it well with a spoon for 2 to 3min. Keep it on the side and go for the second step.

Step 2: Take a pan and put it over gas. Put one spoon of cooking oil and heat it. Add the cumin seed and fry it. Then put the chopped onion, then ginger, then chopped chili, and garlic. Mix it well till it turns into a light golden colour. Then put carrots, green peas, beans and capsicum, and other as you want. Give it a good stir. Mix it well. Let it cook. Do it on low flame. Add a pinch of salt and a pinch of turmeric powder. Then stir it. Then put a cup of water and boil it for a few minutes.

Step 3: Now add the Finger millet mix. Then boil and stir it for a few minutes and wait till it is thicker as you want. Put black pepper powder and chopped coriander leaves if you want. Now you can serve it.

Tip:

Do not let the batter rest for too long, as the oat flour will soak up the liquid. Add more if required. Cover the pan with a lid so that the pancakes are cooked well without being burnt.



Finger Millet Sprouted Idli | India

Finger millet is a staple diet in Karnataka, Southern state of India. Sprouted Finger millet Idli is a nutritious and delicious steamed cake made, using Finger millet, black gram (a bean grown in South Asia), and normal rice. Idli is one of the most popular breakfast recipes that is relished in most South Indian households. Sprouted Finger millet Idli is made with sprouted Finger millet grains to make the dish healthier, nutritious, tasty, and easy to make and is a perfect breakfast.

Ingredients:

1 cup whole Finger millet,
2 cups Idli rice or normal rice,
1 cup husked and whole black lentil,
1 cup beaten rice (Poha), loosely packed, salt.

Preparation: Wash the finger millet and soak it overnight. Drain and keep aside to sprout. After sprouting it swells and becomes 1½ cup.

Next day, wash Idli rice or normal rice well and soak in a vessel with 4 to 5 cups of water. In a separate bowl, wash white whole black lentil and beaten rice and soak them separately for 4 to 5 hrs.

Once the rice and black gram are soaked, drain the water and add the soaked lentil to the medium jar of a grinder. First grind the black gram into a smooth paste. Empty into a mixing bowl and then to the same jar add sprouted Finger millet and grind, it takes little longer to grind. While halfway through add soaked Idli rice to grind. Then add beaten rice and salt and blend into a slightly coarse paste. Remove from grinder and mix well with the ground black gram batter. The batter should be thick yet of pouring consistency. Cover the bowl with a lid and keep it in a warm place for 4 to 5 hrs to ferment. You can keep the bowl inside the oven if it is cold outside. The mixture will double in size after it is properly fermented.

After 5hrs, mix thoroughly with the batter. Take an Idli steamer, fill it with water and place over high heat. Grease the Idli plates with ghee (clarified butter) and pour spoonful of the batter into the moulds. Steam the Idli for 15 min on high heat. Once done, take out the Idli from the plate by sliding a butter knife or a spoon by dipping them in water underneath them. Dipping the spoon in water helps in the easy removal of Idli from the mould.

The wholesome homemade soft sprouted ragi Idli are now ready to be served for breakfast, lunch or dinner along with Chutney or Sambhar.





Fonio (Niger) – *Digitaria exilis*

General Information

Fonio is considered a ‘Superfood minor’ cereal compared to ‘major’ cereals such as rice, wheat and corn. However, it is the staple food of many rural families in West Africa. Fonio is an ancient staple food, probably the oldest African cereal. This grain was traditionally reserved for chiefs and their relatives, or was used during Ramadan, holidays, weddings and baptisms. Today it is grown almost exclusively in West Africa. Botanically, Fonio belongs to the same genus as Finger millet (*Digitaria*).

It was recently ‘re-discovered’ by urban consumers in major African cities and has appeared on European and North American markets, where it is mainly sold as a fair trade, exotic ‘Superfood’ product. Well suited to local conditions, this small grain can play an important role in the food security of southern countries, and in soil preservation by ensuring plant cover on ecologically vulnerable land.

Advantages for small-scale farmers

Fonio grows on very poor, sandy soils and needs little water; it can thus grow in drought conditions. It tolerates dry periods as well as heavy rains and grows quickly. From sowing to harvesting some varieties take only six to eight weeks. It is suitable for storage, without the risk of pest contamination. It is therefore ideal in the period after the harvest when there is a shortage of food.

Consumer Information

Fonio is an integral cereal, which means that all three parts of the grain are used – bran, endosperm and germ. Whole grains are widely considered to be nutritionally much more valuable and healthier than refined grains. Fonio be prepared in a variety of ways. The traditional African way is like the preparation of couscous (cooked whole grains with vegetable side dishes) or porridge. It is also used for the preparation of drinks. As with other cereals, Fonio is ground into flour to make bread, pastries, and cakes. In Niger, Fonio is used to replace up to 30 percent of wheat flour in bread.

It is naturally gluten free and a rich source of plant fibres. It is very nutritious, contains very high-quality protein and higher levels of essential amino acids than eggs or meat. Further, it has a high concentration of iron, so it can be helpful against anaemia. Fonio contains the most calcium of all cereals, so it is suitable for the diet of those who do not consume milk.

Rich Fonio with Vegetables and Meat | Niger

This is a dish made of shelled Fonio grains. It is easy to prepare; its preparation is like that of fatty rice. This is the main Fonio-based dish. Local people living along the Niger River and in the Gaya area much appreciate it.



Ingredients:

2 glasses of shelled Fonio grains,
5 tbsp of vegetable oil,
2 carrots and other vegetables
(e.g., cabbage, eggplant),
250 g of chopped meat,
4 tomatoes,
1 large onion bulb,
salt, spices.

Preparation: Pour the oil, onion, tomato and meat into the pot and let it simmer for 15 min. Add spices and salt to season, then add a glass of water and continue cooking for 15 min. Wash the Fonio already shelled and drain it. Add the carrot and other vegetables according to your taste. Pour four glasses of water and bring the preparation to boil for 15 min. After that, add the drained Fonio, cook for 5 min on high heat and 5 min on low heat.

Fonio Dish | Niger

Ingredients:

150 g Fonio,
400 ml water;
2 to 3 tbsp oil or butter;
a stock cube and/or salt;
pepper;
chilli;
spices and herbs to taste: saffron, oregano,
a few mushrooms, sliced;
one onion, chopped;
a few tomatoes, cut into eighths;
various vegetables: cabbage, peas, squash, etc.



Preparation: Soak the Fonio in 150 ml cold water. Stir, cover, and leave to rest until the Fonio absorbed the water (5-10 min). Heat the oil or butter in a saucepan over medium heat. Add the mushrooms and vegetables (except tomatoes), $\frac{1}{3}$ stock cube and spices and herbs. Sauté, stirring occasionally, for 5 to 10 min, then season with salt and spices. Over a low heat, add the Fonio carefully. Continue to cook for 5 min with the lid on, then remove the lid and cook until the Fonio has absorbed the liquid (max. 5 min). Add the tomatoes and peas (if using), stir in, and leave to warm up for up to 5 minutes.





**Amaranth (Tanzania) –
Several Genera of the Family Amaranthaceae**

General Information

It is a native species to the Andean region of South America, including Argentina, Peru and Bolivia. The leaves of the plant are frequently used in countries throughout Africa, the Caribbean, India, and China. Amaranth is a traditional agricultural crop in moderate latitudes as well as in the tropics. Garden orchid or spinach, widespread in Central Europe belong to the same family (Amaranthaceae). There are varieties where leaves can be used as a vegetable, others produce seeds which are used like cereals. The grain type is gaining popularity.

Advantages for small-scale farmers

Grows quickly and leaves can be harvested continuously. It is grown in limited areas, but has good potential as a cash crop, either for the local market or export market. It is very undemanding and quite drought tolerant.

Consumer information

Amaranth is a 'pseudocereal', meaning that though its seeds can be used like cereals and have similar flavour and cooking qualities, it does not fall into the definition of cereals, as it is not grass. It is gluten free and good for cardiovascular diseases, stomach pain, and anaemia.

When grown as a vegetable, cooks usually will pick Amaranth leaves fresh for use as greens in salads or blanched, steamed, boiled, fried in oil, and mixed with meat, fish, cucurbit seeds, groundnut, or vegetable oil. Cooked greens can be used as a side dish, in soups or as an ingredient in sauce and baby food formulations.

Amaranth grain is sometimes mixed with chocolate or puffed like rice, and its use has spread to Europe (for instance in different Mueslis) and parts of North America. It can also be processed into flour and incorporated in baking and baby food such as porridge and soups.

Leaves as well as seeds have a high content of protein of very high quality.



Amaranth-Carrot Dish | Tanzania

Ingredients:

1 big onion,
1 carrot, 500 g Amaranth leaves
(can be replaced by spinach),
1 tbsp salt

Preparation: Wash the leaves thoroughly with running water and chop them into small pieces, fry onions and carrot (you can add tomatoes if you wish to), add Amaranth leaves and cook for two minutes, add salt to taste, serve with Ugali (a corn meal made from maize or corn flour) or rice.



Beef-Amaranth Stew | Tanzania

Ingredients:

500 g minced or chopped beef
1 bunch of chopped Amaranth leaves (about 250g)
1 medium onion
2 tomatoes
1 tbsp salt
cooking oil, coconut milk (optional)

Preparation: Fry onions until brown, add beef, and cook for 5 min, add grated tomatoes and salt and cook for about 3 min or until tomatoes are well cooked, add coconut milk, let it boil for about 5min, then add Amaranth leaves and cook for 2 min, serve with Ugali or rice or any dish of your choice.



Amaranth Fritters

Ingredients:

2 cups Amaranth grains,
4 eggs, 2 tbsp sesame seeds,
8 tbsp crumbled feta cheese,
3 medium sized onions, finely chopped,
1 cup chopped pumpkin leaves (a hand full),
pesto, salt and pepper to taste,
1 very large onion as form (optional).

Preparation: Boil Amaranth grains with water until soft. Mix with all the other ingredients and form balls or fill into very large 2 cm thick onion rings. Bake at 180° Celsius for 30 min until slightly brown. Garnish with salad leaves, mango slices and sprinkle the garnish with vinaigrette (optional). Mix Simmer for 5 min. It makes two servings.



Coconut Amaranth Pudding

Ingredients:

½ cup of Amaranth (grains)
1 can of light coconut milk
4 tbsp sugar

Preparation: Cook Amaranth in coconut milk and sugar for about 20 min, then let it cool; pour the mixture into serving dishes and place in the refrigerator until ready to serve. Once cool, sprinkle with cinnamon and top with fruit.

Moringa (India)

Moringaceae

General Information

Moringa is an important crop in India, Ethiopia, the Philippines and the Sudan, and is being grown in West, East and South Africa, tropical Asia, Latin America, the Caribbean, Florida and the Pacific Islands. Nine species occur in eastern Ethiopia, northern Kenya, and Somalia, of which eight are endemic to Africa.

Moringa is a genus of shrubs and trees with multi-purpose uses: its leaves, roots and immature pods are consumed as vegetables. All parts of the Moringa tree – bark, pods, leaves, nuts, seeds, tubers, roots, and flowers – are edible.

Advantages for small-scale farmers

It is fast growing and drought tolerant (however, it does not tolerate waterlogging). The leaves are used for preparing bio-pesticides for animals and to fight fungi and nematodes in crops. The trees provide wind breaks and reduce soil erosion. As Moringa is also used for medicinal purposes it can be grown as an additional income source for small-scale farmers.

Consumer information

The plant produces leaves during the dry season and during times of drought and is an excellent source of green vegetables when little other food is available. The leaves can be eaten fresh as a vegetable, or dried and ground into powder to add to dishes in sauce, cakes and fritters, and infant flour.

The seed pods are picked while still green and eaten fresh or cooked. Moringa seed oil is sweet, non-sticking, non-drying, and resists rancidity, while the cake from seed is used to purify drinking water. The seeds can also be eaten green, roasted, powdered, and steeped for tea or used in curries.

The leaves are rich in protein (essential amino acids), vitamins A, B, and C and minerals. They are highly recommended for pregnant and nursing mothers as well as young children. The use of leaf powder is particularly recommended for children suffering from malnutrition, or to prevent the onset of malnutrition. It develops as well immune defence and allows to cure some infections or helps stabilize blood pressure. Moringa products have antibiotic, antitrypanosomal, hypotensive, antispasmodic, antiulcer, anti-inflammatory, hypo-cholesterolemic, and hypoglycaemic properties.

The seeds contain oil with essential fatty acids and are used for food and cosmetics. The roots are rich in broad-spectrum antibiotics. The bark secretes an anti-diarrheal resin.



Moringa Leaf Korma | India

Ingredients:

2 cups tender plucked leaves of Moringa;
½ cup split green gram with skin, washed soaked in 2 cups water;
1 carrot peeled, chopped;
5 to 6 French beans chopped;
1 potato, scrubbed, washed, grated;
3 to 4 green chilies;
1 cm ginger grated;
1 stalk curry leaves;
2 pinches asafoetida powder;
¼ tbsp turmeric powder;
½ tbsp each cumin and mustard seeds;
salt to taste; 2 tbsp lemon juice; and 2 tbsp oil.



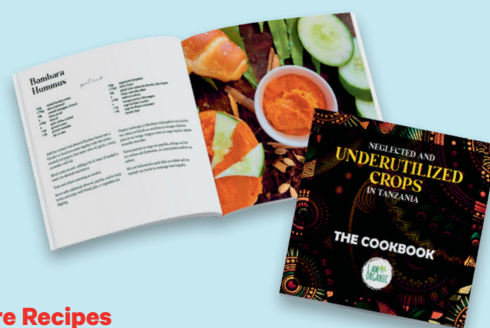
Preparation: Chop, wash and drain the Moringa leaves. Heat half oil in a pressure cooker. Add carrots, drained gram, beans, and the chopped chili. Stir fry for 2 to 3 min. Add potatoes, leaves, ginger, stir, add two cups hot water. Add turmeric and salt, mix well. Put lid, cook for two whistles. Cool cooker, remove lid. Add salt and lemon juice to taste. In a separate pan, heat the remaining oil in a small pan, add cumin and mustard seeds. Once they begin to splutter, add curry leaves, and remaining chilies (halved). Pour into korma while sizzling. Stir gently, serve hot with steamed rice.

Moringa Lemonade | India

Ingredients:

1½ litres of water,
2 tbsp of Moringa powder,
1 lemon,
1 cm fresh ginger,
some leaves of fresh peppermint,
optional: honey, sugar, maple syrup.

Preparation: Cut the lemon into very thin slices, finely chop the ginger, mix all ingredients with the water and stir well, leave to infuse for 1hrs in the refrigerator, serve with ice cubes and shake before drinking if necessary.



More Recipes

You can find more recipes using NUS plants in a cookbook published by «I am Organic» in Tanzania. SWISSAID co-financed the production of this cookbook. You can access it for free with this QR code:






6. What are the solutions?

Given the current multiple crises facing global food systems, we will need diverse genetic resources more than ever to secure sufficient healthy food for a growing population. From the discussions above, we see that a transformation of our agrifood system – from one that favours monocultures to one, which maintains agrobiodiversity and protects a rich variety of traditional crops and locally adapted species and varieties that are well adapted to climate change – is indispensable to safeguard food security in a long run. For this to happen we need to change the way we produce and consume food. This rethinking is slowly beginning. An increasing number of actors in the agriculture and food sector are realizing that separating production from safeguarding biodiversity is a big mistake. One way of integrating these two aspects is through agroecological production.

The holistic agroecological approach – based on 13 principles (see illustration on next page) – aims at transforming the current agriculture and food system and offers a lot to ensure agrobiodiversity on the plate:

Agroecology



Agroecology is an integrated approach that simultaneously applies environmental and social concepts and principles to the design of agricultural and food systems. It aims to optimize the interactions between plants, animals, people, and the environment while addressing the social aspects that must be considered for a sustainable and equitable food system (FAO 2018).

CROPS4HD follows this approach and focuses primarily on strengthening agrobiodiversity, traditional crops and locally adapted species and varieties, while establishing markets for NUS.

www.crops4hd.org/about

Agroecology...

- works **without chemical inputs** that harm biodiversity.
- **uses biodiversity** to work in and with the ecosystem.
- **promotes a diversity** of local species and varieties
- is **responsive to culture and food traditions** and promotes a diversified local diet.
- strengthens **short value chains** and **local food systems**.
- builds on **traditional knowledge** and allows for the co-creation of **new knowledge**.



Support us!
www.swissaid.ch/en/support-us

7. Call to action

Consumers:

Consider what you eat! Your food-related choices can not only enhance agrobiodiversity on the plate, but also strengthen it at the farm level.

Policy Makers:

Break down sectoral silos and put in place food and agriculture policy frameworks that are rights-based, climate sensitive and that foster agrobiodiversity. Develop policies that are based on agroecological principles.

Civil Society:

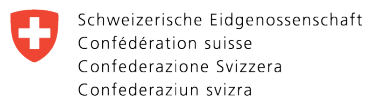
Support mechanisms, movements and projects that transform current unsustainable agrifood systems into agroecological, localized, democratic, agrobiodiverse food systems.

Researchers:

Invest in interdisciplinary agroecological research for food systems which also strengthen agrobiodiversity.

Private Sector Actors:

Do not contribute to unsustainable food systems, but rather support the creation of localized, democratic, agroecological food systems.



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CROPS4HD aims to improve food security and nutrition of smallholder farmers, especially women, through the sustainable use and conservation of peasant varieties and neglected and underutilized species, considering agroecological approaches. The project is being implemented in the countries of Chad, Niger, Tanzania and India. CROPS4HD is an international collaborative project of SWISSAID, FiBL and AFSA with financial support from the Swiss Agency for Development and Cooperation (SDC) and the Liechtenstein Development Service (LED).

For more information, visit www.crops4hd.org/about



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