



Girl with fonio in Mali.

# Review of the African millet diversity

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## Essentials

The millets [small seeds] represent a diverse group of cereal crops that typically produce small seeds. They comprise about a dozen crop species, belonging to different genera, that originated, were domesticated, and are cultivated by small farmers in Africa and Asia. Distinctive attributes of the millets are their adaptability to adverse agroecological conditions, requirement of minimal inputs, and good nutritional properties. Millets represent critical plant genetic resources for the agriculture and food security of poor farmers that inhabit arid, infertile, and marginal lands.

Africa is home to important centres of origin, diversity and cultivation of millets (see Annex). The genuinely African millets comprise the two global millets (pearl millet and finger millet), which are widely cultivated in Africa and elsewhere, and three West African millets (fonio, black fonio and guinea millet), which are characteristic of West African drylands. African farmers are custodians to an enormous genetic diversity of these millets, including many cultivars adapted to adverse agroecological conditions.

In Sub-Saharan Africa, millet biodiversity constitutes both a unique ecological heritage and a critical food security component among millions of small-scale farmers. In particular, pearl millet and the West African millets have a superior adaptation to drought and poor soils, providing a reliable harvest under such conditions, growing where no other crops succeed, requiring minimal inputs, and providing good nutritional sources. Although the African millet agriculture requires minimal material inputs, it relies on extensive cultural dynamics, including indigenous knowledge, customary genetic resource management systems, and local food habits. Accordingly, the maintenance of millet biodiversity depends on agricultural, food

and livelihood dynamics at the farmer level, since every community holds local cultivars to address their agroecological conditions, farming practices, livelihood concerns, and food needs. As it matters nutritional aspects, the African millets are not just a good source of energy, as cereals typically are, but surpass most cereal and grain crops in protein quality and in some key micronutrients. They are thus a nutritionally valuable crop group.

Millets represent a unique biodiversity component in the agriculture and food security systems of millions of poor farmers in Sub-Saharan Africa. However, they suffer large neglect in science, agricultural programmes, and policies, despite the increasing global awareness on plant genetic resource conservation and the concerns on local food security. Accordingly, innovative and integrative efforts to strengthen the interface between millet biodiversity and food security are required, with a focus on empowering small farmers as privileged custodians and primary beneficiaries of such agricultural genetic diversity. That is most urgent in the case of the West African millets (fonio, black fonio and guinea millet), because they have received the least recognition and attention, despite their fundamental roles in the agricultural dynamics, food security, and cultural identity of many poor farmers in marginal rural areas of West Africa, including the Sahel and dry savannas.

The conservation, use, and availability of millet genetic diversity is increasingly important in the view of the evolving needs and manifold challenges of small-scale farmers in arid and semi-arid lands throughout Sub-Saharan Africa. Millet biodiversity represents extraordinary genetic resources, available at the grassroots level, to address and cope with unpredictable climatic conditions, desertification processes, household nutrition concerns, and socio-economic marginalisation. It constitutes a reliable basis for enhancing food security and developing crop diversification in the most challenging agroecological areas of Africa, through the optimal valuation and use of local agrobiodiversity and the associated indigenous knowledge.

The conservation and effective promotion of the African millet diversity requires the integration of gender equality aspects, so to adequately address and merge with three key dimensions of the African rural dynamics, as follows: (a) the prominent contribution of rural women in genetic resource management, especially in traditional crops such as the West African millets; (b) the critical role of rural women in household food security and nutrition; and (c) the expanding feminisation of small-scale and subsistence agriculture in Sub-Saharan Africa.

## **Global African millets**

The two major millets at worldwide level are pearl millet (*Pennisetum glaucum*) and finger millet (*Eleusine coracana*). Their centre of origin is Sub-Saharan Africa: the West African drylands for pearl millet, and the East African subhumid uplands for finger millet. They represent "global" millets because they are cultivated in different geographical areas, they account for most world millet production and trade, and they have received most of the research and agricultural programmes devoted to millets. Their cultivation is widespread throughout Sub-Saharan Africa, representing important crops, often staple crops, among millions of small-scale farmers. They are also widely cultivated in some rural areas in Asia, particularly in India, China and Nepal. Therefore pearl millet and finger millet can be regarded as two African millet crops that have spread and have reached importance worldwide.

Pearl millet is the 6<sup>th</sup> most important world cereal. It is also a fundamental crop in the drylands of Sub-Saharan Africa, including the Sahel region. It contributes to both rural food security and livelihood systems, as it provides good nutritional supplies and income sources to small-scale farmers. However, pearl millet does not receive the scientific and political support that a crop of such global importance and critical food security significance deserves. This neglect is largely due to its socio-ecological condition, as it is a crop of poor farmers in marginal agricultural areas. However, pearl millet is highly adapted to drought, representing an essential component of the food security and livelihood of many million poor farmers that inhabit drylands and semi-arid ecosystems throughout Sub-Saharan Africa. Small-scale farmers conserve and cultivate innumerable cultivars of pearl millet, often adapted to local agroecological factors, livelihood needs, and cultural values. For instance, some local pearl millet cultivars provide excellent energy, protein and micronutrient supplies under adverse agroecological conditions and with low input requirements.

Finger millet is generally cultivated in uplands and subhumid areas, being rather adapted to cooler and wetter climates than pearl millet. It is an important cereal for many rural communities in East and Central Africa, where it contributes to their nutritional well-being. In particular, the protein quality of finger millet constitutes a critical complement to diets based on starchy foods, such as cassava and plantain, which are frequent among the rural poor in many parts of Sub-Saharan Africa. Despite its valuable role and potential in the food security and nutrition of many poor farmers in Africa, it is a crop largely neglected. Its cultivation seems to be even declining in some countries.



Finger millet field cultivated with the farmer variety "walye", recognised as drought-resistant, in Tigray region, Ethiopia. [above]



Woman from a Gogo community, in the central drylands of Tanzania, sowing a field with the *chihali* (gourd recipient), which contains a seed mix of pearl millet varieties, sorghum varieties, two legume crops, and a rich diversity of *Cucurbitaceae*. [right]

## West African millets

West Africa is home to three unique millets: fonio (*Digitaria exilis*), black fonio (*Digitaria iburua*), and guinea millet (*Brachiaria deflexa*). They are often classified as "minor" millets because their cultivation is limited to specific geographic areas, they have no relevance in international agricultural trade, and they are highly neglected by science, agricultural programmes and policies, and almost every sector beyond the farmer grassroots. However, they represent an excellent set of genetic resources for the agriculture and food security of many poor farmers in arid and semi-arid ecosystems of West Africa. For instance, fonio is cultivated in the Sahel region, where rainfall is unreliable and generally about 200-500 mm annually, as well as in lands with poor and low-fertility soils, such as in the Fouta-Djallon plateau of Guinea. The West African millets often grow in lands and under conditions where the other crops fail.

West African farmers are custodians of a rich diversity of cultivars of fonio, black fonio and guinea millet. This agrobiodiversity provides them with a wide range of strategies and options for agriculture, food, and livelihood in view of their agroecological conditions, socio-economic marginalisation, and evolving food security and livelihood needs. The West African millets is a neglected crop group in biodiversity conservation and rural development programmes, yet they represent fundamental crop genetic resources for the food security, agricultural systems, and sustainable development prospects of rural communities in the dry and harsh lands of West Africa.

Fonio is the most important and widely cultivated among the West African millets. It is cultivated in the Sahelian and savanna environments of many West African countries, from Senegal to Lake Chad. It represents a staple crop in many poor rural communities. Black fonio and guinea millet are however cultivated in very limited areas of West Africa: black fonio cultivation is reported in the Jos-Bauchi plateau of Nigeria and in northern areas of Togo and Benin, whilst guinea millet cultivation is characteristic in the Fouta-Djallon plateau of Guinea and in nearby areas of Sierra Leone. Where cultivated, black fonio and guinea millet overlap and complement with fonio.

Fonio is one of the ancient African crops, possibly the oldest West African crop as its cultivation seems to have started about 7,000 years ago. It is highly adapted to drought and low-fertility soils. It is characterised by a short production time, about 10 weeks for the earliest maturing cultivars, which enhances its drought resistance and represents a fast source of food. It is a key, though largely ignored crop in the agricultural dynamics and household food security in the Sahel and savannas of West Africa. Among some of the Sahelian peoples, fonio is considered a sacred crop. It has excellent nutritional and culinary properties. Fonio requires very minimal labour inputs in its cultivation, but it is labour-demanding in post-harvesting, particularly in the processing of grains (threshing and husking). Overall fonio has unique agroecological, nutritional, healthcare, and cultural values among many rural populations in the Sahelian and savanna areas of West Africa, including the poorest and most marginalised communities. Most of these features and roles of fonio seem shared by the other two West African millets: black fonio and guinea millet. However, there is a substantial lack of information on the agroecological and human dimensions of these latter millet species.

Fonio suits a wide range of agroecological, food security and livelihood conditions throughout West Africa. For instance, in the Sahelian and savanna agroecological areas of Mali, fonio is a key complement to the staple crops pearl millet (*Pennisetum glaucum*) and sorghum (*Sorghum bicolor*), if not a staple crop itself. It is cultivated as soon as rainfall

arrives, providing a fast and reliable food source in a critical food insecure period, since just in the dry-wet seasonal interface the grain food reserves among poor rural households are low or already depleted. Fonio is thus critical to arrest or alleviate famine, especially in agriculturally adverse seasons, and during food-insecure periods before major crops can be harvested. In some rural areas of Guinea, fonio is a staple crop, with significance in both the household food security and as rural income source because there is a relevant market space and value. Overall fonio is a subsistence crop with fundamental food security and nutrition roles at the household level in drought-affected rural areas of West Africa. In addition, fonio has a limited market space at national and international levels, mostly in the elite gastronomic sector, though current levels and prospects are not fully promising to the entire fonio farming community in West Africa. However, malnutrition concerns in the growing urban populations in West Africa raise greater prospects for the promotion of fonio cultivation and commercialisation at national levels. Hence, adequate policies and programmes could effectively link food security action with increasing the incomes in poor rural households. Overall, the versatility of values, uses and potential of fonio suggests the promising prospects of this crop to address the evolving needs and challenges of farming peoples in the Sahel and savannas of West Africa.

Fonio is recognised for its superior nutritional properties among cereals, excelling in protein and micronutrient qualities. It is thus a fundamental component in the household food security and nutrition of poor and marginalised farmers in arid and semi-arid lands of West Africa. For instance, it provides a reliable and balanced nutritional source in the Sahel. Fonio is also regarded as a grain with medicinal and healing properties, in line with the local integral view on nutrition and healthcare. In fact, fonio is considered the most digestive cereal of the West African drylands. It is also highly recommended for diabetic people, and often used in diets of sick people. For instance, a farmer woman from the village of Kolle (Kati District), in Southern Mali, where agroecological conditions even favour pearl millet and maize to the detriment of fonio, claims the wide range of nutritional and healthcare values of fonio, including as follows: providing adequate diets for people affected by diabetes and stomach diseases, feeding sick people, enhancing nutrition and health levels in children, providing foodstuff for old people that cannot eat and digest other cereals, and keeping an overall strong health status so to arrest blindness diseases (personal communication, 2001).

Fonio has also rich cultural values and significance among the dryland peoples of West Africa. For instance, it plays a central role in social events and celebrations. Fonio is largely recognised for its excellent culinary values. In fact, it is attracting some interest in elite gastronomic markets at national and international levels. In addition, fonio is regarded as a sacred crop among some rural peoples of West Africa, owing to its excellent agroecological capacities, its critical food security roles, its nutritional and healthcare properties, and its culinary uses.

Among many dryland peoples of West Africa, fonio is a women's crop, as its cultivation and processing relies on women. Rural women often use marginal and almost infertile lands to grow some fonio. They thus optimise subsistence agriculture and enhance very significantly the household food security and nutrition. In fact, women devote significant labour efforts to fonio grain processing, as this crop is highly relevant for the nutrition and food habits of many rural households. Women roles in the cultivation and use of fonio is a highly ignored yet priority dimension of this crop. Their adequate consideration is essential for the goals of biodiversity conservation, sustainable agriculture, food security, and gender equality.



Farmers conserve and use diverse varieties of West African millets, which differ in maturing time, drought resistance, productivity capacity, grain size and colour, processing aptitudes, and culinary values, among others. Conserving and using this genetic diversity is essential to improve household food security and nutrition, as well as to explore appropriate livelihood strategies. In addition, the genetic diversity of West African millets represents a critical resource base for poor farmers to address their evolving needs and challenges in the Sahel and savannas of West Africa, such as drought conditions, nutrition concerns, and new livelihood opportunities.

The biodiversity of West African millets and the associated indigenous knowledge represent a critical component of the agricultural systems, food security, livelihood, and cultural identity of many poor farmers in West Africa. However, these small-scale farmers, who maintain a rich biodiversity of millets, face extreme poverty and social marginalisation. This paradox requires integrative and cross-scale efforts, linking effectively indigenous agrobiodiversity, food security and rural development. Furthermore, the agroecological and nutritional qualities of the West African millets suggest their promising potential in agricultural and rural development in the vast drylands of Sub-Saharan Africa, where agriculture is severely constrained and food security is a major concern. There is thus an unexplored space for South-South and farmer-to-farmer cooperation for sharing millet biodiversity to enhance food security in arid ecosystems.

In summary, the West African millets altogether constitute neglected agrobiodiversity with enormous importance in the agriculture and food security of poor farmers that inhabit arid, harsh and marginal areas. The rich genetic diversity of these millets represents a unique ecological heritage of poor African farmers, and thus a privileged basis for advancing ethno-ecological development modes in the rural areas of Africa.



Farmers with fonio in Kollé village (Kati), Mali.



Woman husking fonio near to River Niger, Mali.

## Wild millets

Africa is home to an enormous diversity of wild grasses, particularly in arid ecosystems and savannas. Some of such wild grasses have evolved into the cultivated millets through an extensive process of domestication and crop improvement during the last millennia. Wild millets comprise a diverse range of wild grasses that are related to the cultivated millets, including wild millet relatives and wild millet-like grasses.

Though largely neglected, and even threatened, wild millets play important roles in local food security and in agricultural development. Small farmers hold knowledge on wild millets, which contribute to their agricultural and livelihood systems, especially in arid ecosystems. On the one hand, some wild millets are sometimes harvested and consumed by rural people, especially during drought crisis and famine periods, thus playing a critical role in local food security. On the other hand, wild millet relatives contribute to millet crop evolution and diversification through wild-crop gene flows. In fact, farmers are normally observant to the evolving genetic diversity of millets, occasionally selecting and cultivating new landraces. Traditional crop selection and improvement strategies accelerate genetic diversification and evolution, providing farmers with new genetic resources to improve agriculture and cope with evolving needs. In essence, the wild-domesticated interface of millets is permeable and dynamic, constituting a space for the interaction between ecological processes and indigenous knowledge. In addition, wild millets represent potential genetic resources for millet improvement, through both formal and farmer-based breeding means.

In conclusion, wild millets represent fundamental genetic resources that deserve consideration and integration in biodiversity conservation and rural development programmes, because of their role and potential in both food security and agricultural development.



The Sahel and drylands of Africa are rich in wild cereals and wild crop relatives:  
Wild grasses in the Sahel, Mali [*left*] / Dry savannas in Dodoma, Tanzania [*below*]



## Prospects and recommendations

Millets constitute neglected agrobiodiversity with enormous importance and potential in the agricultural systems and food security of poor rural communities in Sub-Saharan Africa, particularly in arid and semi-arid ecosystems. Accordingly, the conservation and promotion of the African millet biodiversity represent an essential component for rural development in Sub-Saharan Africa. In particular, the West African millets deserve specific and priority support as they represent indigenous genetic resources under overwhelming neglect, yet fundamental importance among poor farmers in West Africa.

In essence, the case of African millets demand concerted efforts to strengthen the interface between agrobiodiversity, food security and rural development. Suggested policy and programme action comprises:

- Promote millets as a fundamental crop group for the food security of rural people in Sub-Saharan Africa, particularly in drylands and marginal areas.
- Recognise the dignity of, and promote West African millets, including the associated genetic diversity, indigenous knowledge systems, and cultural aspects.
- Support the conservation *in situ* and cultivation of millet genetic diversity through initiatives like community seedbanks, seed fairs, and farmer networks, with a focus on the West African millets.
- Advance participatory programmes for conservation, research, and optimal use of the West African millets as a whole, focusing on the associated indigenous knowledge, the farmer genetic resource dynamics, the critical roles of millet genetic diversity in food security, and the cultural values involved.
- Establish farmer-based millet crop selection and improvement.
- Empower rural women in the conservation and use of millet biodiversity, in view of their prominent and growing roles in agriculture, genetic resource management, and household food security throughout Sub-Saharan Africa.
- Explore the potential of expanding the cultivation of millets throughout West Africa, the Sahel and other drylands of Sub-Saharan Africa, with a focus on enhancing South-South cooperation on biodiversity for food security.
- Promote the conservation and use of wild millets, as they represent both wild food sources for poor farmers and untapped genetic resources for millet crop improvement.
- Promote local strategies that address and overcome the technical and socio-economic constraints for the cultivation, use and commercialisation of West African millets.

## Concluding remarks

Millet biodiversity constitutes the ecological heritage of millions of small-scale and traditional farmers in Sub-Saharan Africa, playing a vital role in their agricultural systems, food security, livelihood, and cultural identity. However, it is largely neglected and depreciated at the national and international levels, particularly in the case of the West African millets. Adequate support from science, agricultural programmes, and rural development policies is urgently required, so to launch ethno-ecological development modes in rural communities throughout Sub-Saharan Africa.

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❑ **Pictures by Josep A. Garí** (taken during year 2001, with the permission of local people).



## Annex: The African millet diversity

	Common name	Scientific name	Centre of origin	Main areas of cultivation	Comments
GLOBAL MILLETS	Pearl millet	<i>Pennisetum glaucum</i>	West Africa	Sub-Saharan Africa, Asia	The 6 <sup>th</sup> most important world cereal, though not accordingly supported from science, agricultural programmes, and policies. Staple crop in the African Sahel. Highly resistant to drought. Adapted to poor soils. Low vulnerability to diseases and insect pests. Good nutritional values, including a superior protein quality among cereals.
	Finger millet	<i>Eleusine coracana</i>	East Africa	East and Central Africa, South Asia	Adapted to uplands and subhumid tropical areas. Its protein content represents a critical complement to diets based on starchy food (e.g. cassava, plantain), which is the case of millions of poor people in Sub-Saharan Africa. Excellent long-term seed storage, which is a relevant feature in food insecure areas.
WEST AFRICAN MILLETS	Fonio (white fonio)	<i>Digitaria exilis</i>	West Africa	West Africa (Sahel and semi-arid savannas)	Cultivated in the Sahel and savannas of West Africa, where it plays a critical role in the agriculture and food security of many poor rural communities. It is adapted to arid ecosystems (200-500 mm annual precipitation), is tolerant to poor fertility soils, and requires minimal inputs. It even grows where other crops fail. Its genetic diversity grounds an excellent adaptation to a wide range of agroecological conditions, including drylands, subhumid lowlands, uplands, and infertile soils. Good nutritional properties, superior to most cereals and grain crops, including a fair energy-protein balance. Key crop during food insecure periods in the West African drylands, as it represents a fast and reliable food source in the critical dry-wet seasonal interface before main crops can be harvested.
	Black fonio	<i>Digitaria iburua</i>	West Africa	Nigeria, Togo, Benin	Cultivated in the Jos-Bauchi plateau of Nigeria and in northern areas of Togo and Benin. Agroecological and nutritional characteristics similar to white fonio ( <i>Digitaria exilis</i> ). Adapted to drylands, uplands, and poor soils. Nutritionally superior among cereals and grain crops.
	Guinea millet	<i>Brachiaria deflexa</i>	West Africa	Guinea, Sierra Leone	Cultivated in the Fouta-Djallon plateau of Guinea and Sierra Leone. Some cultivars are very early maturing and thus suited for cultivation in drylands under unreliable rainfall. Relevant in intercropping practices with other grain crops.

Compiled by J. A. Garí from diverse sources.