

# Pack 111, Item 7

# Type: Backgrounder

May 2019

# \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Backgrounder: Rice production and post-harvest activities**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

***Introduction***

* Rice is a cereal crop in the grass family and belongs to the genus\* Oryza, which includes two cultivated species of rice: *Oryza sativa*, from Asia, which is the most cultivated rice in the world, and *Oryza glaberrima* or African rice, which originated in Africa, and was first domesticated and grown in the Central Delta floodplains of the Niger River near Mopti in Mali.
* In Mali, more than 60% of the rice produced is *Oryza glaberrima*.
* In sub-Saharan Africa, Mali is considered a country rich in land and water resources. Many countries and private companies are investing in rice production in Mali, especially in the Office du Niger area, where as much as two million hectares of land could be available for irrigated rice production.
* There are two types of rice production in Mali:
  + Rice production in developed areas: In these areas, water is managed through irrigated systems connected to the Niger River. There are large irrigation systems in some areas, smaller irrigation systems in other areas, and also systems on the Senegal River.
  + Traditional rice production in flooded areas of the Central Delta of the Niger, in the southern lowlands, and rainfed rice grown in the Sikasso, Koulikoro, and Kayes regions, and some parts of Segou region.
* Total production of paddy rice in Mali rose from 727,140 tonnes in 1999 to 2,076,423 tonnes in 2012, with 650,000 tons from the Office du Niger.
* Though Mali has developed less than 15% of its potential for rice production, the country already supplies many markets in West Africa, including Burkina Faso, Mauritania, Senegal, and Côte d’Ivoire, a sign that Mali could become West Africa’s rice granary.
* African rice is golden in colour, and the rice grains are long before they ripen and are husked. When husked, most rice varieties are white.
* Rice contributes greatly to Mali’s economic growth, especially in the Segou, Mopti, and Gao region, and part of Sikasso region.
* The average height of a rice plant is 0.4-0.5 metres, though the plant can reach one metre. The growing season is three to six months. Unlike other food plants, rice grows well in very wet soil conditions.
* Rice occupies a special place in Malian grain production, accounting for about one-third of all grain produced in the country by weight. It also has a special place in national eating habits, especially in urban areas and major rice production areas. Annual production has varied between 1.5 and 2 million tonnes in recent years, and accounts for around 93% of domestic needs.

***Why is this subject important to listeners?***

By implementing the practices described in this document, small-scale rice farmers can improve their production and livelihoods. The most important practices include:

* Using seeds that are resistant to climate stresses and other harsh conditions.
* Using fertilizer (organic manure, mineral fertilizers) at the right time and at the right dose.
* Row planting with effective microdoses of fertilizers.
* Using a hitch for weeding and hoeing.
* Using methods that mitigate the impact of climate change, including adapting the cropping calendar to the weather, establishing reservoirs with bunds around the perimeter of the field, and rehabilitating damaged lands with *zai\** methods.
* Combining lowland rice production with market gardening crops can help fertilize the soil and reduce the impact of erosion and weeds.
* Mechanizing rice farming and training producers.

Globally, 95% of Asian rice is produced in paddy fields with irrigation, while 80% to 85% of the rice grown in Africa is rainfed. Wild African rice can even grow in temporary ponds, and represents a reservoir of genetic characteristics that can be used to improve resilience in genetic rice gene improvement programs. Of the more than 40,000 varieties of rice grown throughout the world, more than 100 are African rice.

***What are some key facts?***

* Rice production accounts for 5% of Mali’s GDP, or 220 billion CFA Francs per year (US $380 million).
* Annual domestic consumption rose from less than 30 kilograms per person in the 1990s to 69.7 kilograms in 2010, 79.4 kilograms in 2013, and 83 kilograms in 2016/17. This increase is mostly linked to the growing local market, with strong demand in both urban areas and rural areas.
* The rapid growing population in Mali strongly influences rice demand, which was estimated at slightly more than one million tonnes for 2018.
* Mali’s Strategic Framework for Poverty Reduction considers rice to be the driver of economic growth, especially for export diversification. This Framework and the increased trade flow toward urban areas can help producers gain ownership of their farmland.
* Mali’s agricultural sector, which grew by an average of 7.3% annually from 2002 to 2006, is mainly based on rice and maize.
* Rice is the main cereal consumed in urban areas and consumers strongly prefer local rice. This preference influences domestic prices, supports rice farmers, generates jobs, and helps maintain the rural environment. Local rice has sensory characteristics (taste, smell, visual appearance, etc.) that are preferred by consumers.
* Rice is one of the most heavily consumed cereals in the world and plays a valuable role in West African countries’ economy, mainly through urban and rural consumption. It is a source of protein, energy, carbohydrates, fats, and sodium, and contains vitamins B1, B2, B6, and B9, plus potassium and magnesium.

***What are the big challenges of rice farming?***

* Most rice production systems face problems related to pest pressure, decreasing soil fertility, and growing weed pressure.
* Most rice in Mali is produced in irrigated areas, but yields in these areas have been decreasing because of soil salinity.
* Rice farmers in rainfed lowlands rely on managing rainwater. This is the traditional method of rice production, and it is affected by problems linked to poor soils and weather hazards such as droughts and floods.
* Income from rice production in lowlands is low due to erratic rainfall (floods or drought).
* All land used to grow rice in Mali is subject to erosion and drought, whether upland or lowland.
* In some communities, lack of access to land or having too little land hinders the development of rice farming.
* Other challenges include poor water management, poor access to and use of inputs, diseases such as rice yellow mottle virus, lack of access to improved varieties, and the high cost of seeds and farm inputs. Across sub-Saharan Africa, severe infestations of rice yellow mottle virus cause great losses in rice production.

***Gender aspects of rice farming***

* In Mali and across Africa, women are responsible for most of the labour in rice production, including transplanting, weeding, marketing, and steaming paddy.
* Despite their strong involvement in rice farming, women have limited access to:
* Land: Because of traditional customs in some regions, women only have access to damaged land granted to them as a loan. In some traditions, women have no right to land whatsoever. Since 2013, a committee has been working on eliminating discrimination against women related to access to land and resources such as agricultural tools and equipment, farm inputs, and improved seeds.
  + Financial resources (access to and control of income and loans).
  + Knowledge and skills: training and agricultural extension services.

***Predicted impact of climate change on rice production***

Like other crops, the changing climate adversely affects rice production.

* Temperature increases can result in spikelet\* sterility and reduced seed quality, and thus reductions in yield.
* Though rice grows well in wet conditions, flash floods caused by rising levels of water following the opening of dams and channels for flood control make rice farming difficult. There are strong seasonal variations in rainfall, and receding water levels affect production that relies on irrigation water from dams in Sélingué and Markala.
* Climate change—which results in water shortages and erratic rainfall patterns—increases the frequency and intensity of rice diseases and pest issues. Also, weed infestations could worsen and increase competition between rice plants and weeds.

***Key information about rice farming***

1. **Land preparation**

In rice-growing areas with large populations of perennial weeds (for example, *Cyperus* species, *Paspalum distichum*, and *Cynodon dactylon*), disc plough immediately after harvest to expose weed roots to the sun. Alternatively, use a rake or hoe. (*Note: Before broadcasting, radio hosts should research the prevalence of local weeds and their names in the local language*.)

* To destroy weed plants and seeds, as well as the eggs and larvae of some pests:
  + use physical controls such as mulch and trapping,
  + use mechanical techniques (weeding, obstacles), and
  + burn crop residues after harvest when necessary—for example, to manage a serious outbreak of diseases or pests.
* Build dikes after ploughing. This reduces weed recovery or regrowth. Use a hoe or animal-drawn plough.
* To reduce pest damage, rotate with legume crops in irrigated areas and with cereal crops and tubers in lowlands.
* Amend poor soils as necessary with chemical or organic amendments.
* Irrigate the field for puddling\* before transplanting:

1. **Planting**:

The best variety is the one that is best adapted to a particular area, including the weather conditions and the soil type, and that best meets farmers’ and consumers’ needs. A good-yielding variety is not always the best one for the producer. The choice of variety depends on the following factors:

* water availability (rainfed or paddy rice);
* soil type;
* geographic location;
* whether the crop is raised for home consumption or marketing;
* germination rate;
* time till maturity;
* plant size;
* seed quality;
* resistance to pests and diseases;
* potential yield;
* taste and nutritional qualities;
* yield after post-harvest handling (husking, steaming, sieving, etc.);
* ability to meet market quality standards;
* colour of the grain (white or golden);
* increase in kernel size after cooking;
* cost.

Use good quality seeds not damaged by insects and free of foreign material (weed seeds, stones, residues, etc.). Before planting, ensure that seeds have a high viability rate (above 80%). Test viability by adding water to seeds. Discard seeds that float.

In Mali, the Rural Economy Institute’s (IER) National Research Program on Rice has developed high-yielding varieties that are adapted to social, economic, and agroecological\* conditions. These include:

* *Irrigated rice*: medium duration (130-135 days) and high-yielding varieties (9-10 tonnes per hectare) such as Sahélika, Jama Jigi, and NERICA L – IER – 2.
* *Double-cropped rice*: medium duration varieties (120-135 days) with a yield of six tonnes per hectare (Nionoka) and short duration varieties (110-125 days) with a yield of 5-6 tonnes per hectare, including Sambala Malo and NERICA L – IER – 1.
* *Lowland and rainfed rice*: Short duration varieties: ADNY-11 (120 days), Wassa (110 days), Nianoka (120 days), NERICA L1 (125 days), and NERICA 4 (100 days) at various water depths in lowlands. Short duration varieties (95-120 days) under exclusively rainfed conditions. The potential yield for these varieties varies from 3-4.5 tonnes per hectare.

The most common varieties planted in Mali include:

* Kogoni 91-1: 135 days and a yield of 6-10 tonnes per hectare
* Adny-11: 120 days and a yield of 4-7 tonnes per hectare
* Wassa: 110 days and a yield of 5-7 tonnes per hectare
* Nionoka: 120 days and a yield of 5-9 tonnes per hectare
* NERICA L1-IER: 125 days and a yield of 6-8 tonnes per hectare
* NERICA L2-IER: 135 days and a yield of 6-10 tonnes per hectare
* NERICA 4: 100 days and a yield of 3-4 tonnes per hectare
* ARICA 3: 2 tonnes per hectare in lowlands

1. **Nurseries**

Rice can be planted in two ways: through direct seeding or through transplanting.

In direct seeding, seeds are usually broadcast in the field. With transplanting, farmers first produce seedlings in a nursery before transplanting them to the field. There are two types of nurseries:

* + *Non-irrigated nurseries*: Water beds regularly to maintain moisture while preventing puddles from forming. Prepare the plot to ensure good drainage and avoid flooding.
  + *Irrigated nurseries*: Choose fertile, well-drained soil exposed to direct sunlight. To avoid rotting, it is important to drain excess water in beds when forming the plot. For best quality seedlings, apply fertilizer and cover beds with rice husk mulch. Keep birds, insects, and reptiles away.

1. **Cultural practices**

*Direct seeding:* Prepare land first, then divide the field into plots not exceeding 50 x 100 metres. Then, build dikes to retain water. Sow seeds at 20 centimetres between rows and 15-20 centimetres within rows.

*Transplanting:* Transplant 14 to 21 days after sowing in nursery. Place two or three seedlings in each seed hole. The recommended spacing is either 20 cm x 20 cm, 30 cm x 30 cm, or 20 cm x 30 cm between holes and rows, respectively. Spacing at 20 cm x 20 cm enables an optimum population of plants and rapid growth of plant cover to prevent weed growth. Plant seedlings 3-4 centimetres deep in the soil.

When transplanting, it is important to:

* Avoid seedlings that are too old (slow revival and reduced yield).
* Avoid seedlings that are too young (losses from injured leaves).
* Avoid using compacted soils in nurseries. Seedlings are likely to lose their roots during transplanting. Use a hoe or shovel to remove seedlings from nurseries.
* Manage water and ensure good drainage.
* Prepare the land well, including levelling\*, puddling, and ensuring that there are no large clods.
* Maintain shallow water (five cm) after tillering\* when uprooting seedlings.
* Avoid damaging seedlings, especially at the root level.
* Ensure quick revival after transplanting by removing off-types\* and weak or diseased seedlings during thinning.
* Avoid flooding transplanted seedlings.
* Ensure good puddling of the land.
* The ideal depth for transplanting seedlings is 2-3 centimetres. When transplanting is too deep, revival is slow, tillering is impacted, and there is a risk of disease and rot.
* When transplanting is too shallow, irrigation may dislodge seedlings.
* Space transplanted seedlings as mentioned above.
* If seedlings are too close together, tillering will be poor and plants may be stunted.
* If there is too much space between planting holes, the soil will not be covered and there could be weed competition.
* Limit time between seedling removal and transplanting to less than two days to prevent seedlings from dying.

Apply appropriate doses of herbicides to control weeds. If not using herbicides, maintain water at 2-5 centimetres deep in the field to minimize weed emergence and reduce weed pressure. If there is enough water, fields can be continuously flooded from transplanting until plants fully cover the soil.

*Gap filling:*

To maximize yield, fill gaps with remaining nursery seedlings 5-10 days after transplanting.

1. **Soil fertility:**

* Apply phosphorus- and potassium-rich fertilizers one week before transplanting. Bury fertilizers deeply in the soil.
* Three to five weeks after transplanting, bury urea deeply (2-3 centimetres).
* Malian farmers who prefer to use organic fertilizers can apply PNT (natural phosphate from Tilemsi) as a basal dressing, as well as Elephant vert products and others.
* The recommended dose of urea is 220 kilograms per hectare. The recommended dose of DAP is 100 kilograms per hectare. Apply DAP just after germination. Apply the first dose of urea when plants have three to five leaves, and the second dose at the panicle stage.
* Fertility can be improved by ploughing in rice straw after threshing, which also reduces the alkalinity level of the soil. Organic fertilizers made with legumes (for example, cowpea, groundnuts) also reduce alkalinity in sandy soils.
* Planting woody and forage species as living hedges in rice farming areas will help reduce the impact of climate change.

1. **Weeds:**

* Weed manually 14-20 days after transplanting. Weed again manually about 30-40 days after transplanting.
* Inspect the field on a regular basis to weed.

1. **Pest and disease management:**

* Place scarecrows at random intervals in the field to keep away birds.
* Sow at the same time as your neighbours (or within two weeks) to minimize pressure from insect pests, diseases, birds, and rats.
* To reduce the impact of rice yellow mottle virus, use the following practices:
  + plant tolerant or resistant varieties (for example, NERICA, NERICA-L-39, and TGR-48),
  + plant nurseries in disease-free places,
  + remove sick seedlings in the nurseries before transplanting,
  + weed frequently, and
  + clean bunds and irrigation channels regularly to eliminate any host plants.
* Using a combination of tolerant or resistant rice varieties and good cultural practices will considerably reduce the impact of rice yellow mottle virus.
* For stem borers such as the African rice gall midge (*Orseolita aryziyora*) and the Diopsidae fly (*Disopsis* species), use the following practices:
  + plant early-maturing varieties at the beginning of the season to help plants mature before pests arrive,
  + maintain fields to eliminate weeds, and.
  + use moderate quantities of fertilizers continuously throughout the plant growing cycle. This enables the plant to grow rapidly, which helps it withstand borer attack when borer populations rise.
* For defoliator\* insect pests such as bagworms (*Nymphula depunctalis*), armyworm caterpillars (*Spodoptera*), campestral grasshoppers, and grasshoppers, natural enemies like birds usually maintain these insects’ population below the level where farmers’ income is reduced, especially in well-maintained fields. Less persistent and biodegradable contact insecticides and resistant varieties can be used to prevent economic losses.
* To manage insect pests with sucking mouthparts such as leafhoppers, planthoppers, and bugs:
  + plant early-maturing varieties early in the season,
  + weed regularly, and
  + apply fertilizers appropriately.

1. **Harvest:**

* Rice is ready for harvest when kernels are firm and yellow or brown (about 30-45 days after flowering).
* Cut stems with a sickle about 10-15 centimetres above the ground.
* Make vertical piles of harvested rice stems and leave to dry for at least one week before threshing.

1. **Threshing:**

* To reduce losses, dry stems in the field for at least one week, then thresh.
* Avoid threshing rice stalks on bare ground to prevent sand, stones, and other impurities from contaminating the rice.
* Thresh rice carefully to avoid removing the husk.

1. **Winnowing:**

* Winnow the rice to separate the husk and empty seeds from well-formed, mature grains.
* Remove impurities (for example, weed seeds, debris, and straw).
* Recommended winnowing techniques include:
  + Put the seeds in a winnowing basket.
  + Cover the ground with a basket, mat, or tarpaulin.
  + Tilt the winnowing basket against the wind.
  + Pour the seeds slowly into the basket or mat from a height of more than one metre.
  + The wind will separate light grains from heavy ones.
  + Keep heavy grains only.
  + Repeat the process if needed.
  + Use a fan or a blower if it is not windy enough.

1. **Drying:**

* After harvest, dry rice in direct sun on a tarpaulin or concrete floor for about two or three days, until it reaches a moisture content of 13-14%. Stir occasionally. If farmers do not have a moisture meter, they can test the rice by biting the grains. If it is difficult to crush the grains by biting, the rice is sufficiently dry.
* Avoid drying rice on bare ground or by the roadside because the rice can be contaminated.

*How to improve sun drying*

* Spread rice in a thin layer 2-4 centimetres deep. If the layers are too thin, the kernels heat too quickly, leading to an increased number of broken grains. If the layers are too thick, drying will not be uniform from top to bottom, and kernels will re-absorb moisture after stirring, causing them to crack.
* Turn grains over every 30 minutes.
* During very hot days, kernel temperature may exceed 50 or 60o C. Cover kernels in the heat of the day to prevent overheating.
* Cover kernels immediately if it starts raining. Exposing drying kernels to moisture increases breakage and generates a high level of cracks during milling.
* Avoid contaminating kernels with other materials; keep animals away.

1. **Milling and storage:**

* Milling helps remove husks and bran.
* Generally, rice to be used for food should be stored raw rather than processed because the husk protects it from insect pests and helps avoid deterioration in quality.
* Store the rice:
  + in 40- or 80-kilogram jute bags or plastic woven bags,
  + in bulk (on the farm or in commercial warehouses), or
  + in airtight containers.
* Keep only rice that is clean and hygienic. Inspect stored rice every week to ensure that there are no pests (for example, insects and rodents).
* Ensure adequate ventilation to maintain a uniform moisture and temperature level in storage.

***Definitions***

*Agroecological:* Agroecology is the study of ecological processes applied to agricultural production systems. Bringing ecological principles to bear on agroecosystems can suggest innovative management approaches that would not otherwise be considered*.*

*Defoliator:* An adult or larval insect that strips all the leaves from a plant.

*Genus: Genus is the level above individual species names and below the names of plant families. For example, the scientific name of African rice is Oryza glaberrima. Oryza is the genus name and glaberrima is the species name.*

*Levelling:* Using tools such as draft animals and harrows or levelling boards to ensure that land to be irrigated or flooded is uniformly flat.

*Off-types:* Not true to type, deviating markedly from the normal or desired standard.

*Puddling:* Tilling rice paddies while flooded during land preparation. Can be done by dragging a weighted harrow across a flooded paddy field behind a buffalo or ox, or with mechanized equipment.

*Spikelet:* Flower clusters in plants in the grass family.

*Tillering:* Side shoots in plants in the grass family.

*Zai:* Holes or pits that are typically 20-30 centimetres in diameter and 15-20 cm deep and dug in lines along the contour line of a hill to reduce water runoff and soil erosion. Because *zai* capture soil and water, farmers often plant trees and other crops in *zai*.

***Where can I find other resources on this topic?***

1. Amandine A., Burnod P., Papazian H., Coulibaly Y., Jamin J. Y., Tonneau J. P., 2010. *Investments in irrigable land for large‐scale agricultural production in Mali*. <https://agritrop.cirad.fr/560297/1/document_560297.pdf> (188 KB)
2. Baris, P., Zaslavsky, J., Perrin, S., 2005. *La filière riz au Mali : compétitivité et perspectives de marché*. <https://www.afd.fr/sites/afd/files/imported-files/005-document-travail.pdf> (in French only) (521 KB)
3. Boutsen, S. and Aertsen, J., 2013. *Peut-on nourrir l’Afrique de l’Ouest avec le riz?* <https://www.alimenterre.org/system/files/ressources/pdf/575_mo-paper74_riz_fr.pdf> (in French only) (971 KB)
4. Coulibaly, M.Y., Ouologueme A., 2014. *Etude sur les chaines de valeur riz au Mali : Rapport Final* 82p. <http://www.inter-reseaux.org/IMG/pdf/Etude_sur_les_chaines_de_valeur_riz_au_Mali_VF_corrigee_Novembre_2014.pdf> (in French only) (2.44 MB)
5. Fall, A. A., 2016. *Synthèse des études sur l’état des lieux chaîne de valeur riz en Afrique de l’Ouest : Benin, Burkina Faso, Mali, Niger et Senegal*. <http://www.inter-reseaux.org/IMG/pdf/rapport_final_synthese_regionale_riz_finale.pdf> (in French only) (1.79 MB)
6. Ministère de l’Agriculture, République du Mali, 2012. *Guide de production de semences de riz*. <http://www.fao.org/docrep/017/ap771e/ap771e.pdf> (in French only) (973 KB)
7. Moussa, A., 2013. *Contrôle des femmes et des jeunes sur les ressources foncières agricoles : Expérience de la Coopération Suisse au Mali: AVAL et APEL, dans la région de Sikasso*. <https://www.eda.admin.ch/dam/countries/countries-content/mali/fr/resource_fr_222224.pdf> (in French only) (1.44 MB)
8. Overseas Development Institute, non daté. *La riziculture au Mali*. <https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/4148.pdf> (in French only) (248 KB)
9. Sawadogo, W.M., 2008. *Criblage de variétés et lignées iso-géniques pour la résistance à Xanthomonas oryza pv. Oryzae et étude du développement de l'épidémie du flétrissement bactérien du riz sur le périmètre irrigué de Bagré (Burkina Faso*). Mémoire de fin de cycle, Institut du Développement Rural, Université Polytechnique de Bobo-Dioulasso, Burkina Faso, 74p. <http://www.beep.ird.fr/collect/upb/index/assoc/IDR-2008-SAW-CRI/IDR-2008-SAW-CRI.pdf> (in French only) (2.82 KB)
10. SPID, 2011. *Guide pratique pour la gestion intégrée de la production du riz irrigué*. [http://www.fao.org/fileadmin/user\_upload/spid/docs/Mali/APRAO\_GIPD\_GuideProductionRizIrrigue.pdf](http://www.fao.org/fileadmin/user_upload/spid/docs/Mali/APRAO_GIPD_GuideProductionRizIrrigue.pdf\) (in French only) (205 KB)
11. World Bank, 2012. *World Development Report 2012: Gender Equality and Development*. <https://siteresources.worldbank.org/INTWDR2012/Resources/7778105-1299699968583/7786210-1315936222006/Complete-Report.pdf> (25.83 MB)
12. SPID, 2011. *Guide sur la gestion intégrée du riz de bas fond*. <http://www.fao.org/fileadmin/user_upload/spid/docs/Mali/APRAO_GIPD_GuideProductionRizBasFond.pdf> (in French only) (477 KB)

## Acknowledgments

Contributed by: Mrs. Coulibaly Adama Aïssa Tall, Engineering technologist, Promoter CFAARJEF (Training, Facilitation, and Reintegration Centre for Youth and Women)

Reviewed by: Dr. Ibrahima Zan Doumbia, Scientist, Plant Breeder, Cinzana Agronomic Research Station, Rural Economy Institute (IER), Mali

*This story was produced with the support of Lux-Development, the Luxemburg Agency for Development Cooperation, acting on behalf of and in the name of the program MLI/021, within the project “Community radio as tools for development” in Mali.*

*.*