

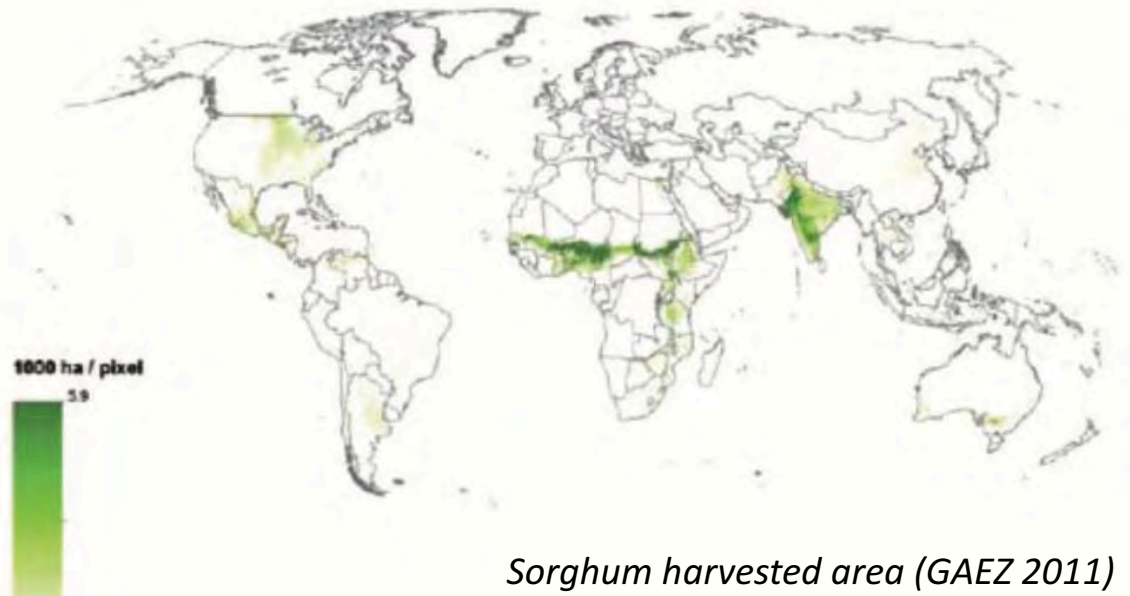
Sorghum Production under Spate Irrigation Systems


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December 14th, 2016




- **Sorghum** is fifth most important cereal globally and **feeds around 500 million people**;
- Particularly important for rural communities in arid regions, and is one of the main crops cultivated under spate irrigation;
- It grows on a **large range of soil types**. It is **drought and heat tolerant** and more **efficient in water and nutrient use** than other crops.



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- Sorghum has many different uses:
 - **Household consumption:** boiled like rice and used to make porridge and bread. Also, sorghum yields sugar, syrup and even biofuel;
 - **Livestock consumption:** sorghum produces larger amounts of fodder than other grains;
 - **Construction material:** the stems are used for building, fencing and weaving;
 - **Windbreaks:** living plants are used as windbreaks and to cover other crops.



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- Important feature is that sorghum can be grown as a **ratoon crop**.
 - Ratooning is to **cut the stem at ground level after the first planted crop reaches maturity**. The plant regenerates and a second harvest of the crop is possible. If enough moisture is available, sorghum can be ratooned for another two months.
 - Ratooning provides a high return on investment. Unlike new seedlings, a **ratoon crop can extract remaining moisture** that is located deep in the soil profile.
 - As land does not require preparation or sowing, ratooning saves on material and labour.



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- **Farmers' criteria to choose sorghum varieties** includes a number of parameters:
 - a) germination rate,
 - b) vulnerability to pest and diseases,
 - c) vulnerability to water stress,
 - d) uniformity in emergence,
 - e) uniformity in size,
 - f) panicle size and yield,
 - g) thickness of stalk,
 - h) palatability of stalk,
 - i) colour,
 - j) ease of grinding the grains with a stone.

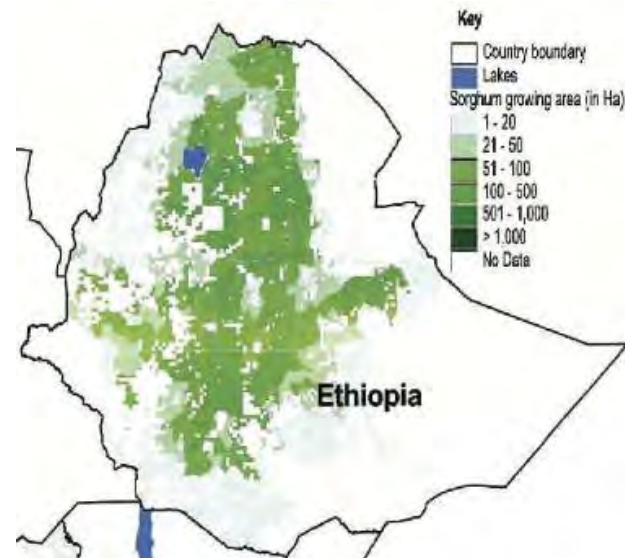


Differences in panicle size and yield between varieties

Country	Sorghum usage	Yield (kg/ha)
Ethiopia	Sorghum (grain)	1000-1500 (Steduto et al. 2012)
Eritrea	Sorghum (grain)	800-3750 (Van Steenberg et al. 2010)
Pakistan	Sorghum (grain)	360-550 (Van Steenberg et al. 2010)
	Sorghum (fodder)	1500-4800 (Van Steenberg et al. 2010)
Sudan	Sorghum (grain)	600 (Steduto et al. 2012)
Yemen	Sorghum (grain)	600-3500 (Van Steenberg et al. 2010)
	Sorghum (fodder)	810-11500 (Van Steenberg et al. 2010)

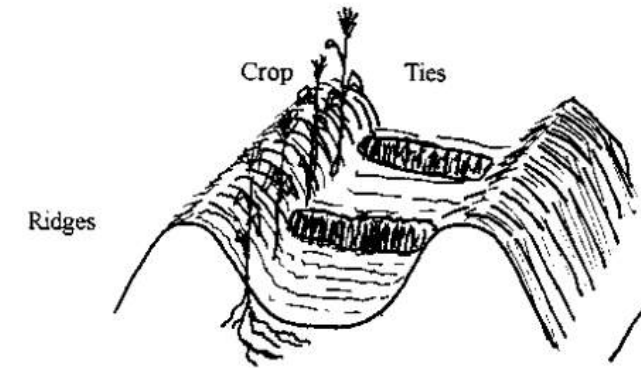
Sorghum yield per country (kg / ha)

- In the past 15 years, cultivating sorghum is becoming popular in countries like Ethiopia.
- There, sorghum is the third most important crop after teff and maize in area, and second in total production next to maize.
- It covers 20% of the area allocated to cereals.



Sorghum in Ethiopia

- Sowing in rows and broadcasting are the two common planting methods for sorghum. Seeding depth is 3-4 cm deep. When sowing in rows, the row-to-row spacing ranges between 60-75 cm. In Ethiopia, tied ridges are used extensively, which help contain soil moisture.
- Seed rate is 9-10 kg / ha and if sowing is done by broadcasting, a higher rate of 15-20 kg / ha is used. However, when sorghum is broadcasted, it is difficult to do weeding and inter-cropping.
- Ethiopian farmers choose varieties depending on weather conditions. When early signs are good and rainfall already begins in June, farmers opt for the long duration variety of sorghum, while they can still grow the short duration variety as second crop. In times of shortage, farmers make exclusive use of their short duration varieties and shift the planting period to September.
- The growth period of sorghum depends on altitude.



Altitude (m)	Growing period	Sowing date	Yield range (Qt/ha)
High (1900-2700 masl)	175-240 days	15 april - 10 may	30-50
Mid (1600-1900 masl)	150-180 days	1-15 may	25-40
Low (<1600 masl)	90-130 days	1-15 june	20-40

Sorghum in Pakistan

- Sorghum is locally called *jawar* in most spate-irrigated lowland areas, and is mostly used as fodder;
- Two varieties of sorghum are cultivated: *ratuk* (red-coloured grain) and *chotiali* (white-coloured grain);
- *Chotiali* is more drought resistant and stronger than *ratuk*.
- Sorghum is normally planted after flood irrigation in June-August and harvested in November-December. One flood before sowing is often enough for sorghum to grow.
- Seed application ratio is 40-50 kg per acre. Some farmers apply more to get green fodder when the plants are 1 meter above ground. Green fodder is taken by thinning the weak plants after the first growing period;
- In warm and moist soils it takes 3-5 days for sorghum seed to emerge, but it may take up to 10 days if the soil temperature is cool.



Threshing sorghum, Pakistan



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- Many farmers **keep a portion of the previous harvest** to be used as seed in the following season. So, the same variety is under cultivation in many areas for centuries.
- Sorghum has **many varieties**. In the last 40 years, institutes under the National Agricultural Research System (NARS) of Pakistan have developed sorghum varieties.

Variety	Researchers	Year	Characteristics
DS-75	ARI, DI-Khan	1975	Short Season
Pak SS-2	MMRI, Yousafwala	1976	Fullseason, dual purpose, stay green
Ghiza-3	ARI-DI-Khan	1981	Short season, dual purpose drought tolerant variety
DS-97	ARI, DI-Khan	1997	Short season, stay green, dual purpose, drought tolerant variety
YSS-98	MMRI, Yousafwala	1999	Full season, stay green, dual purpose, drought tolerant variety
DS-2003	ARI-DI-Khan	2003	Short season, dual purpose, drought tolerant variety
Johar	NARC, Islamabad	2006	Short season, stay green, dual purpose, drought tolerant variety





Drying red sorghum, Eritrea.



- After the harvest, the remaining parts of the sorghum are used as dry fodder. The majority of livestock keepers chop the dry sorghum and mix it with green fodder.
- In the Kachi Plains of Baluchistan and Dera Ghazi Khan, the stubble and left over dry leafs are sold to pastoralists who migrate from the highlands to the lowlands in winter, to feed their sheep and goats.

Opportunities to improve yields

- Wide array of **untapped variety** in grain and plant types (red, black and white sorghum), adaptability and productive capacity. This variety does not receive the attention it deserves.
- Intercropping with millet, tetak, guar and mung beans is practiced for additional harvest and to improve nutrient retention capacity of soil.

Further recommendations

- **Share varieties:** many different and outstanding sorghums can be found throughout spate irrigated areas. Most types are only locally known. Exchange of varieties is important way to improve long-term stability of farm production.
- **Improve infrastructure for seed production:** now production is mainly based on traditional seeds. Farmers sometimes demand for improved seeds. Main reason is that viability of sorghum is poor if stored for 2 years or more, and there may be years with insufficient floodwater for cultivation. Need for cooperatives among farmers that can manage seed production.
- **Breed better sorghum:** crop-breeding objectives for stable yields include raising pest and disease resistance, boosting tolerance to drought, and improving grain quality for storage and processing.
- **Apply water conservation techniques:** making productive use of water within the command area through improved field water management and moisture conservation in the soil.



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Mung bean intercropping with sorghum



- **Introduce improved farming tools:** in spate areas, there is often labour shortage in period when intense labour is required (planting, harvesting and threshing). Labour shortage can be mitigated by introducing improved scythes, etc.
- **Improve local grain storage:** protection is needed from 1) high temperatures and temperature changes, 2) insects and rodents, 4) domestic animals, and there is a need to 5) control moisture levels.

Concluding

- Sorghum is a **neglected crop**, despite its importance as a food security crop for populations in spate irrigated areas.
- However, sorghum is a **nutritious and tasty crop** and a good alternative to highly water demanding staple crops.
- Sorghum is eminently **suitable to harsh semi-arid conditions** and relatively fail-proof.

Thank you for your attention



Marketing green sorghum as fodder in Yemen.