

Unpacking ‘Demand’ for GLDC Crops

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End uses

The demand for GLDC crops covers a swathe of end uses, details of which are available in household expenditure and value chain studies, many of which were commissioned during Phase 1 of the Dryland Cereals and Grain Legumes CRPs. The information was disaggregated to show the major end uses for each crop. The importance of these uses varies by region. The results, summarized in Table 1, are followed by the relevant evidence for each crop.

The results show that:

1. All 9 crops have multiple end uses. Three crops – sorghum, pearl millet and groundnut – have five separate uses
2. All 9 crops (except soybean) are grown for subsistence as well as for sale
3. Grain from four crops – sorghum, pearl millet, cowpea and groundnut – is sold to manufacturers of livestock feed
4. Four crops – sorghum, pearl millet, groundnut and soybean – have growing markets for fodder
5. Five crops – finger millet, pigeonpea, cowpea, groundnut and chickpea – have sizeable export markets
6. Sorghum and pearl millet are the most versatile crops with five end uses
7. Pigeonpea and sorghum are important for fuelwood which is scarce in some dryland regions.

Table 1. Spectrum of current end uses of GLDC crops.

Crop	Non-market		Domestic market				Export market
	Subsistence	Fuelwood	Fodder	Food/food processing	Feed	Alcohol	
Sorghum	X	X	X		X	X	
Pearl millet	X		X	X	X	X	
Finger millet	X			X			
Pigeonpea	X	X		X			X
Cowpea	X		X				X
Groundnut	X		X	X	X		X
Chickpea	X			X			X
Soybean				X	X		X
Lentil	X			X			

Sorghum: Rainy-season sorghum in India is a cash crop with 64% of the production sold (Kumara Charyulu et al. 2016a). Ninety percent of postrainy season sorghum is used as food by low-income consumers, with 10% for food processing and a small share for poultry feed (Basavaraj and Parthasarthy Rao 2012). Sorghum stover constitutes 40% of the total value of sorghum production (Bhagavatula et al. 2013). Sweet sorghum for ethanol is unprofitable without higher extraction rates and administered prices (Basavaraj et al. 2012). In WCA, sorghum is used almost entirely for domestic consumption and stover. In Nigeria, 70% is used for subsistence and 15% for processing (Gourichon 2013), including 5% for making clear sorghum beer (Ndjeunga and Nelson 1999). In ESA, about 94% of sorghum is used for subsistence and 6% for flour processing and clear beer (Orr et al. 2017). Sorghum grain is not used for poultry feed in ESA (Orr et al. 2017) nor for feed in WCA.

Pearl millet: In India, pearl millet is used for food by poor consumers. Only 8% is used for industrial purposes, including alcohol and feed, although this share has been rising slowly (Kumara Charyulu et al. 2016b). Chopped pearl millet straw is traded in urban markets and dry stover is often traded in Haryana, Punjab and from Uttar

Pradesh to Rajasthan whenever stover is scarce due to drought (Bhagatavula et al. 2013). In WCA, pearl millet is almost entirely used for domestic consumption and stover, with a limited share entering the market.

Finger millet in ESA is primarily a cash crop in Tanzania, Kenya and Uganda, sold for food processing (flour) but used for domestic consumption in Ethiopia (Orr et al. 2017; Gierend and Orr 2015). Its higher price makes it unsuitable for industrial uses or livestock feed.

Pigeonpea in India is primarily sold as a cash crop for processing into *tur dhal*. India's growing demand for *dhal* is met by imports from Myanmar and ESA. In ESA, pigeonpea is also a cash crop, with 35% of the produce sold in Malawi (Simtowe et al. 2011), 50% in Tanzania (Shiferaw et al. 2005) and 60% in Kenya (Shiferaw et al. 2008). Green pigeonpea is used for domestic consumption (Shiferaw et al. 2008). ESA exports *tur dhal* to the Indian diaspora, but exports to India are limited by tariffs that protect the Indian milling industry (Orr et al. 2017). In 2015, ESA exported 44% of total grain produced, mostly to India (Abate et al. 2012).

Cowpea: In SSA, Nigeria and Niger are the biggest producers of cowpea (Abate et al. 2012). In Nigeria, 56% of the cowpea produced is sold (Rusike et al. 2013) and may be considered a luxury good since consumption rises with income (Ning and LaRochelle 2016). Sale of cowpea fodder in Nigeria accounts for 44% of total value and 56% of the grain (Kristjanson et al. 2005). In Nigeria, 3.5 bundles of cowpea haulms are worth 1 kg of grain (Samirereddypalle et al. 2017). Niger is the major exporter and Nigeria the biggest importer of cowpea (Langyintuo et al. 2003).

Groundnut: In India, about 80% of groundnut is processed into food (60%) or oil (40%). India exports groundnut to SE Asia for processing into edible oil. Demand for groundnut cake as livestock feed is negligible (Birthal et al. 2010). In WCA, 55% of groundnut production is used for subsistence and 33% is processed, mostly for oil (Ntare et al. 2004; Rusike et al. 2013). Groundnut haulms are used as fodder for livestock (Ndjeunga et al. 2010). In Nigeria, a bundle of haulms has the same value as 1 kg of groundnut grain (Samirereddypalle et al. 2017). In ESA, domestic consumption accounts for 60% of the production in Malawi (Tsusaka et al. 2016) and 80% in Uganda (Shiferaw et al. 2010). Malawi exports about 10% of the total produce (Tsusaka et al. 2016).

Chickpea in India is mostly a cash crop (Suhasini et al. 2012). Seventy five percent is consumed as *dhal* and flour and the remaining 25% as whole grain (Joshi et al. 2001). In ESA, chickpea is most widely grown in Ethiopia, where 20% is used for subsistence and 80% is sold (Kassie et al. 2009). Chickpea is a staple since consumption does not increase with income (Ning and LaRochelle 2016). Ethiopia exports about 10% of production (Kassie et al. 2009) and accounts for over 70% of African exports (Abate et al. 2012).

Soybean: In SSA, soybean is a cash crop (Rusike et al. 2013). About a third is consumed as food and two-thirds is processed, mostly into edible oil, cake for feed, or processed into flour (Birthal et al. 2010). Nigeria is the biggest producer and exporter of the crop (Abate et al. 2012). In Nigeria, 51% of soybean is sold (Rusike et al. 2013), about 53% of the produce is used for oil while 41% is used for domestic consumption and 6% for processed food products (USDA 2011). Soybean cake is used for livestock feed in both WCA and ESA (Rusike et al. 2013). Both Nigeria and Kenya import soybean cake to make livestock feed (Ibid.).

Lentil: In SSA, Ethiopia is the biggest producer. About 41% of Ethiopian production is consumed by growers and 39% is sold. An export ban since 2008 limits opportunities for trade (FAO 2015).

Traits

A spectrum of end uses implies a spectrum of traits, reflecting user preferences. GLDC crops must have the traits required to meet these different end uses. In addition, they must be adapted to generic and crop-specific environmental stresses and contribute to societal goals like reducing malnutrition and conserving the environment. Table 2 identifies the important traits for each crop.

Table 2. Traits required by the GLDC crops to meet environmental stresses and end uses.

Crop	Societal	Resistance to environmental stresses		End uses	
	Nutrition and health	Biotic	Abiotic	Market	Non-market
Sorghum	High Fe, Zn, folate	Anthracoise, Striga, birds	Drought (early maturity), low P	Yield, taste, colour, low tannin, stover yield, digestibility	Fuelwood
Pearl millet	High Fe, Zn, folate	Downy mildew, smut, head miner, birds	Drought (early maturity)	Yield, taste, starch content, stover yield, digestibility	
Finger millet	High Fe, Zn, folate	Blast	Drought (early maturity)	Yield, taste, colour	
Pigeonpea	Cooking time, protein, Ca	Fusarium wilt, pod borers	Drought (medium maturity), insensitivity to photoperiod and heat	Yield, colour, grain size and shape, ease of de-hulling	Fuelwood
Cowpea	Cooking time, protein, Ca	Insects (aphid, thrips, pod-sucking bug, maruca), Striga	Drought (early maturity), low P	Yield, colour, haulm yield, digestibility	
Groundnut	High oleic oil	Rosette virus, aflatoxin, Early and late leaf spot, foliar and fungal diseases, bud necrosis	Drought (early maturity), low P	Yield, taste, oil content, haulm yield, digestibility	
Chickpea	Cooking time, protein, Ca	Fusarium wilt, pod borers	Drought (early maturity)	Yield, colour, grain size, haulm yield and digestibility, machine harvestable, herbicide tolerance	
Soybean			Drought (early maturity)	Yield, indigenous inoculation, oil content	
Lentil	Cooking time, protein	Wilt, root rot, Stemphylium blight	Drought (early maturity)	Yield	

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