

Maize farmers acquire early-maturity seed across production environments

Pieter Rutsaert, Jason Donovan, Hanna Willwerth, Colleta Nabwile, Hope C. Michelson, John Muthee

Abstract

The primary factor used by CIMMYT to distinguish seed product market segments for maize in East Africa is the production environment (i.e., where the crop is grown). For each environment, it was assumed that farmers used the maturity level suited for that environment. The largest segment, according to estimated area under cultivation, is wet lower midaltitude (intermediate maturity), followed by wet upper midaltitude (late maturity), then highlands (late to very-late maturity), and finally dry midaltitude (early maturity). This brief explores to what extent the maturity level of seed products purchased by farmers matches the production environment where they are sold. We collected a panel of maize-seed sales data from 722 agrodealers in Kenya during two short-rains seasons and three long-rains seasons in 2020–2022. These agrodealers were located across all four maize production environments. Results showed strong sales of early-maturity products across the production environments, especially during the short-rains season. The results suggest an opportunity for increased breeding investments in short-maturity maize seed products.

Key Points

- The Market Intelligence Initiative applies eight criteria to identify seed product market segments (SPMSs) for CGIAR crop breeding (see MIB 1 for details). In the application of these criteria to maize in East Africa, two criteria distinguish the segments: production environment and maturity level, since the other criteria do not vary.
- A key indicator for prioritizing breeding investments across segments is the relative size of SPMSs. In the case of maize, and other crops, teams generally use geospatial data to identify the area of production environments, with the assumption that farmers in each production environment would use the seed product with the maturity level designed for that environment. This brief examines the link between product environment and maturity level.
- Results showed that across all production environments, early-maturity products demonstrated strong sales. During the long-rains season, farmers in higher rainfall production environments (wet mid- and high altitudes) purchased early-maturity seed products despite potentially lower yields. The short-rains season, which represents almost one-fourth of total maize seed sales, were dominated by early-maturity products.
- We propose revisions to the maize segmentation for East Africa so that production environment and maturity level are applied independently. We also estimate the size of these new segments in Kenya based on current maturity market shares in each production environment.



INITIATIVE ON
Market Intelligence

This Initiative aims to maximize CGIAR and partners' returns on investment in breeding, seed systems and other Initiatives based on reliable and timely market intelligence that enables stronger demand orientation and strengthens co-ownership and co-implementation by CGIAR and partners.

Introduction

The transition toward demand-oriented crop breeding by CGIAR and the national agricultural research and extension systems (NARES) requires a better understanding of the current and future requirements of farmers, processors, and consumers across different regions of the global South than is currently available. CGIAR, initially through the Excellence in Breeding Platform and more recently through the Initiative on Market Intelligence, has identified about 450 seed product market segments (SPMSs) across the global South that cover all crops for which it currently has breeding investments.¹ The Initiative on Market Intelligence defines an SPMS as a group of growers with common crop variety needs including both grower requirements (where and how the crop is grown) and end-user requirements (what the crop is used for) (Donovan et al. 2022).

This brief explores the SPMSs for hybrid maize in East Africa—a region where maize provides an essential source of nutrition and economic activity. Hybrid maize seed in the region is sold mainly via networks of thousands of small-scale agrodealer shops (Mabaya et al. 2021). We use data on retail seed sales to deepen our understanding of farmers' requirements based on the actual seed products² that farmers purchase. The following section on current segmentation explains how SPMSs for maize were identified and how sales data can be used to refine our understanding of segmentation and the size of the segments. The third section, on agrodealer tracking data, presents insights from the sales data, and in the last section, we discuss proposed

changes in the application of the production environment criterion for segmentation and the estimated size of segments for hybrid maize in Kenya.

Current segmentation for hybrid maize in East Africa

The Excellence in Breeding Platform (EiB) and the International Maize and Wheat Improvement Center (CIMMYT) collaborated in 2021 to define SPMSs for hybrid maize in East Africa (table 1) based on eight criteria (see column headings for table 1). These criteria were applied systematically to all crops relevant to CGIAR crop-breeding programs. For maize, two criteria determined the breakout of the segments: production environment and maturity level.³ CIMMYT applied geospatial data to identify the production environments and estimate the acreage of each segment. The optimal maturity level was assigned to each environment, resulting in the following four segments for East Africa, all of which are present in Kenya:

- Early-maturity maize for dry lowland and midaltitude environments (Maize 13 EAF)
- Intermediate-maturity maize for wet lower midaltitude environments (Maize 5 EAF)
- Late maturity-maize for wet upper midaltitude environments (Maize 6 EAF)
- Late-/very-late maturity maize for highlands environments (Maize 8 EAF)

Table 1. SPMSs for maize in East Africa

	Crop	Hybrid	Subregion	End use	Color	Production environment	Production system	Maturity
Maize 13 EAF	Maize	Yes	East Africa	Food	White	Dry midaltitude	Rainfed	Early
Maize 5 EAF	Maize	Yes	East Africa	Food	White	Wet lower midaltitude	Rainfed	Intermediate
Maize 6 EAF	Maize	Yes	East Africa	Food	White	Wet upper midaltitude	Rainfed	Late
Maize 8 EAF	Maize	Yes	East Africa	Food	White	Highlands	Rainfed	Late/Very late

Note: Available at <https://ebs.excellenceinbreeding.org/wp-content/uploads/2023/03/MS-public.html>.

¹ These segments, identified based on extensive interactions with CGIAR breeding teams, are presented in the SPMS Database. For each segment, various descriptors are included (e.g., area under cultivation) to facilitate discussion on the potential development opportunities for investments in breeding and seed-systems development.

² Once an improved variety or cultivar is released and available to farmers, we consider it a seed product.

³ There are three main categories for maize seed maturity, i.e., for a plant to reach physiological maturity: early maturity (3.0–3.5 months), intermediate maturity (4–5 months), and late maturity (6–7 months). Longer-maturity seed requires a longer period of favorable growing conditions and generally has a higher yield potential. Shorter-maturity varieties reduce the risks of yield loss due to an early end to the rainy season but have lower yield potential.

The estimated volume of seed sold in each market segment in Kenya is calculated based on the area under maize production. Segment Maize 13 EAF (dry midaltitude, early maturity) accounted for less than 10 percent of the market share and segments Maize 6 EAF (wet upper-midaltitude, late maturity) and Maize 8 EAF (highlands, late maturity) made up more than 50 percent of the share.

This brief reexamines the segmentation for maize in Kenya by looking at the seed products purchased by farmers across production environments. The research was inspired by seed companies in East Africa that perceived a growing tendency for early maturity seed products to be available in production environments where conditions allowed for later-maturing products. We assume that insights from Kenya can inform potential adjustments required for East

Africa, given the similarities in production environments across the region. By examining what seed products are sold across production environments, we can test the reliability of the assumption that farmers seek seed products considered to be optimal for their environments.

Agrodealer tracking data

We used a panel dataset of 722 agrodealers⁴ built by AgNexus. The dataset includes monthly sales volumes and prices for all product categories from June 2020 through December 2022. For our analysis, we extricated data⁵ on agrodealer location and maize seed sales per location for two short-rains seasons and three long-rains seasons⁶. To control for outliers, averages presented are trimmed to include only transactions that fall below the 95th percentile.

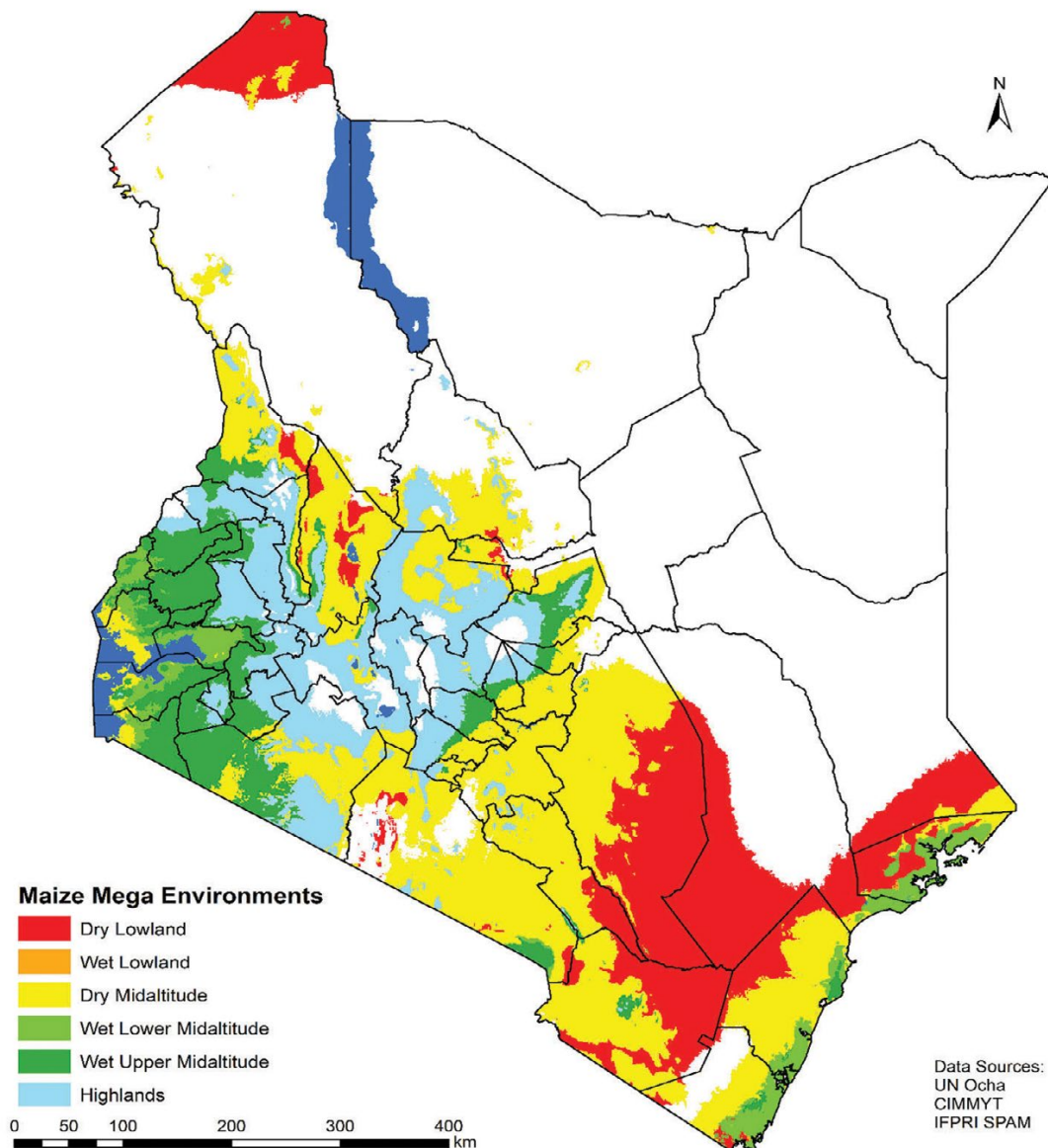


Figure 1. Maize production environments in Kenya.

⁴ The data indicate 1,356 unique shops. However, not all shops have sales data in each month and the size of the sample decreased during the time period. In a given month, the maximum number of shops present was 1,108; the average number was 722; the median number was 582; and the minimum was 465.

⁵ We analyzed seed transaction data only.

⁶ Typically, the long rains stretch from planting in March/April to harvest in June/August depending on planting date and seed maturity level, while the short rains last from planting in October to harvest in January.

Figure 2 presents the distribution of agrodealers across the production environments. The largest share of agrodealers (31 percent) operated in Kenya's wet upper midaltitude environments, a major agricultural production area. A substantial number also operated in the dry midaltitude environment and highlands environment (27 percent and 25 percent, respectively). Less than a fifth are in the dry lowlands and wet lower midaltitude environments. Going forward, the brief combines the dry lowlands with the dry midaltitude region due to their similar agroecological profiles and the smaller number of agrodealers operating in the dry lowlands.

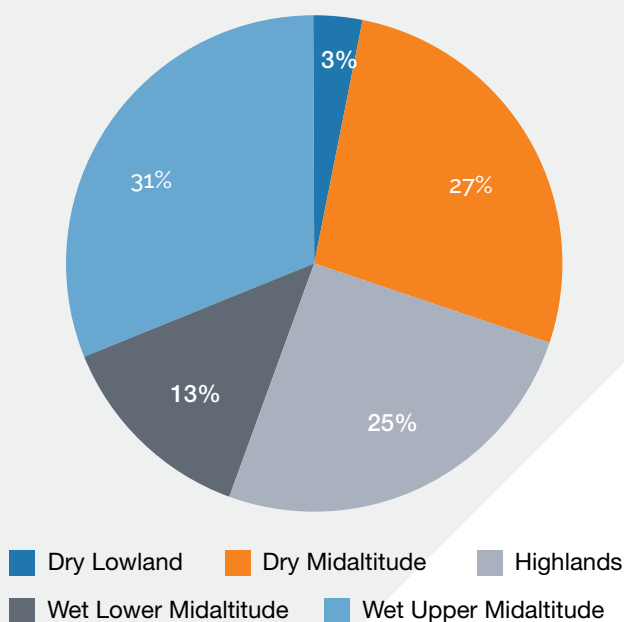


Figure 2. Distribution of sampled agrodealers by production environment.

Maize seed sales per production environment

The long-rains season accounts for more of the agrodealers' maize seed business than the short-rains season (table 2). However, the short-rains season remains important since it represents 23 percent of seed sales in our sample. The total quantity (kg) of maize seed sold per agrodealer increased 40 percent during the long rains relative to the short rains. The total number of product SKUs⁷ stocked per season is also slightly higher in the long rains: 4.5 rather than 3.0. In part, differences across short and long rains are attributable to a larger number of agrodealers reporting zero maize seed sales during the short-rains season compared with the long-rains season.

Agrodealers across all production environments stocked all three maturity types during both the long- and short-rains growing seasons. Figure 3 shows that agrodealers sold substantially more late-maturity products during the long-rains season and more early-maturity products during the short rains. Late-maturity products account for half of the seed sales during the long rains. These sales of late-maturity products occurred mainly in the highlands, followed by sales in the wet upper midaltitude production environment. In the wet lower midaltitude and dry midaltitude production environments, agrodealers sell more early- and intermediate-maturity products than late-maturity products during both the long- and short-rains seasons.

The share of early and intermediate products increases across all production environments during the short rains, including in the highlands. In the wet upper midaltitude region, farmers purchased products of all three maturity types in significant amounts. In the wet lower midaltitude and dry midaltitude and lowland regions, both early- and intermediate-maturity products had large market shares in the short-rains season.

Table 2. Average maize seed product sales per agrodealer, by growing season

Mean (standard deviation)	Long rains				Short rains			
	Dry midalt./ Lowlands	Wet lower midalt.	Wet upper midalt.	Highlands	Dry midalt./ Lowlands	Wet lower midalt.	Wet upper midalt.	Highlands
Total market share	77%				23%			
Number of maize seed products	3.3 (2.3)	6.7 (5.0)	5.4 (4.0)	4.2 (2.4)	3.4 (2.0)	5.4 (4.1)	4.3 (3.5)	2.9 (2.1)
Number of maize seed product SKUs	3.5 (2.6)	7.1 (5.6)	5.8 (4.6)	4.7 (3.1)	3.6 (2.1)	6.0 (4.9)	4.6 (3.9)	3.1 (2.3)
Number of maize distributors	2.2 (1.2)	3.9 (2.0)	3.0 (2.0)	1.7 (1.0)	2.5 (1.3)	3.4 (2.1)	2.8 (1.7)	1.8 (1.2)
Total quantity of maize seed sold (kg)	1,584 (2,172)	3,139 (3,947)	2,299 (3,558)	3,501 (3,237)	1,765 (1,935)	2,380 (3,310)	2,069 (3,024)	1,693 (2,245)

⁷ Stock-keeping unit, or SKU, is used by retailers to identify and track their inventories. It is a unique code consisting of letters and numbers that identifies characteristics about a product, such as producer, brand, style, color, and size.



Graphs by (firstnm) season

Figure 3. Distribution of maize seed product sales by maturity and production environment.

Implications: Greater opportunity for early-maturity products

This brief reexamines the identified maize market segments and their description in Kenya based on variation in production environments and maturity levels. CIMMYT's initial application of the segmentation criteria for hybrid maize in East Africa used estimates derived from geospatial analysis to identify the production environments and estimate their size in terms of area and seed demand. The maturity level of products sold in each environment was assumed to match the optimal maturity level for that environment. The approach advanced a sensible discussion on how to segment maize seed product markets without the need for investments in large-scale data collection. The data presented in this brief confirms that, in a general sense, early-maturity maize is the most important product (in terms of seed sales volumes) in the dryland areas and late-maturity maize is the most important product for the highlands and wet upper midaltitude environments.

Our analysis, derived from more than two years of primary data collection from more than 700 agrodealers in Kenya provides evidence for a recalibration of the maize segments in the subregion. Following agrodealer sales over time allowed us to independently apply the criterion

for production environment and maturity level, as well as examine differences in seed demand across the short- and long-rains seasons. The brief highlights two important points that should be considered in future maize segmentation for the East Africa subregion. First, it recognizes the importance of the short-rains seasons in shaping maize seed demand. Farmers purchased maize seed for the short-rains season in all the production environments, and these sales represented 23 percent of total annual seed sales. The most important products for this season were early-maturing products. Second, the assumption that maize farmers in a given production environment choose seed products designed for that environment may lead to an underestimation of the demand for products with shorter maturity levels. Farmers in Kenya, and elsewhere in the subregion, have faced multiple years of unreliable rainfall patterns and drought conditions that seem to have incentivized their willingness to purchase seed products with shorter maturity (Wainwright et al. 2019, Kipkemboi-Kogo et al. 2022). Our analysis highlighted the penetration of early-maturity products in all production environments during the long-rains season, despite the potential for higher yield from later-maturing maize in more favorable growing environments. Based on these two points, table 3 presents a proposal for adjusting the current maize segments in Kenya.

Table 3. Proposed new SPMSs for maize in East Africa

Crop	Hybrid	Subregion	End use	Color	Production environment	Production system	Maturity
Maize 13 EAF	Yes	East Africa	Food	White	All production environments, long and short seasons	Rainfed	Early
Maize 5 EAF	Yes	East Africa	Food	White	Wet lower and upper midaltitude, long and short seasons	Rainfed	Intermediate
Maize 6 EAF	Yes	East Africa	Food	White	Wet upper midaltitude, long season	Rainfed	Late
Maize 8 EAF	Yes	East Africa	Food	White	Highlands, long season	Rainfed	Late/Very late

The proposed change in the production environment criterion would result in a significant increase in the estimated size of the Maize 13 EAF segment. Figure 4 presents the proposed recalibration of the market segment size. This recalibration is based on the percentage of early-, intermediate-, and late maturity maize products sold within each production environment. The result is that Maize 13 EAF would go from the smallest to the largest market segment, with a market share of 36 percent. Maize 5 EAF would lose a significant share to Maize 13 EAF, which would also take a sizable portion of Maize 6 EAF.

Our results apply to Kenya but are likely to hold for the rest of the subregion where maize seed distribution is highly commercialized. Researcher engagement with agrodealers can provide important insights on changing farmer needs (Rutsaert, Donovan, and Kimenju 2021). A stronger focus on using sales data to inform breeding decisions in maize, and potentially other crops where retailers play an important role in seed distribution, should become a priority for market intelligence. Future work will engage stakeholders in maize seed systems in other countries of East Africa about the changes in demand for earlier-maturing products and the implications for segmentation.

Market segment share in Kenya

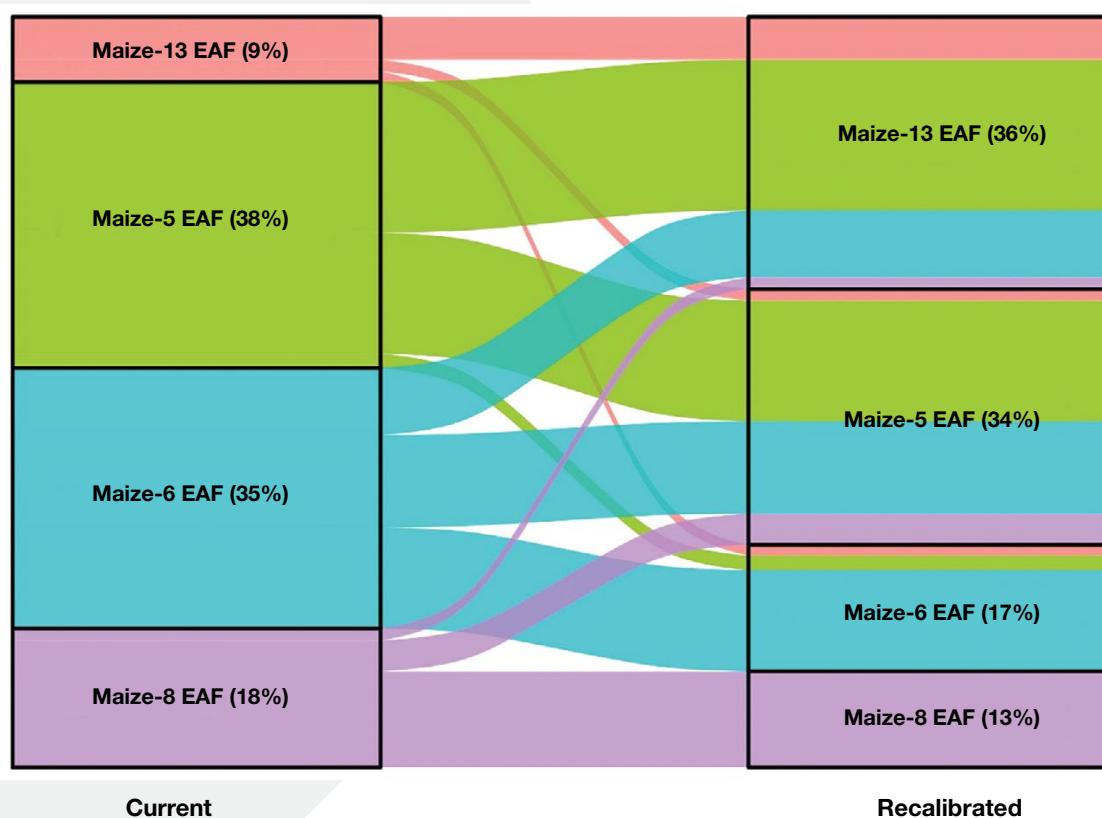


Figure 4. Proposed recalibration of market segment shares in Kenya.

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