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Extension-led early-generation testing for faster, demand-driven bean breeding in East Africa

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Abstract

Crop improvement is constrained by a mismatch between the environments in which breeding decisions are made and those in which new varieties are grown. Research-station trials remain essential, but they cannot capture the diversity of soils, climates, management practices and market preferences that shape crop performance. Consequently, some varieties are released without sufficient evidence of farmer or market demand and remain on the shelf rather than reaching farmers' fields. Here we describe an extension-led platform that brings farmers, agronomists and market actors into selection at the early-generation stage. This differs from conventional participatory variety selection, in which farmers are commonly engaged when candidate varieties are close to release and the scope for changing breeding decisions has narrowed. In this model, farmer preferences are treated as breeding criteria, influencing which lines are advanced, discarded or redirected earlier. The platform links breeding teams, agronomists, research institutions, district authorities, extension officers, lead farmers and farmers. Breeders provide seed, protocols, digital tools and oversight; extension officers establish and monitor trials, collect phenotypic and agronomic observations, and facilitate farmer evaluations; and farmers manage trials under local farming conditions. Observations on crop establishment, soil fertility, moisture stress, pests, diseases and management help explain why genotypes perform differently across locations. In the first phase, 426 early-generation yellow bean lines were deployed across 309 farmer-managed sites in Tanzania. The platform later expanded to 575 lines and 503 farmers in Tanzania and Kenya, supported by more than 50 extension officers. Open Data Kit forms, GPS records, plot photographs and standardised protocols support traceability and data quality. Continued training and field coaching are central because early-generation testing requires skills beyond routine extension delivery. The study will assess trial retention, data completeness, timeliness, workload, costs and agreement among farmer, extension, on-farm and on-station assessments. By embedding farmer preference, agronomic learning and market relevance earlier, the platform aims to shorten the breeding cycle from 7–10 years to approximately 3–4 years and increase the likelihood that released varieties are adopted. More broadly, it tests whether public extension systems can become decentralised research infrastructure for faster, more inclusive and demand-driven crop improvement.

Keywords: Agricultural extension, agronomy, common bean, decentralised research, demand-driven breeding, early-generation testing, farmer preference, farmer-managed trials, participatory breeding, variety adoption