

# Demand-Led Plant Breeding

## Chapter 1

### *Principles of Demand-Led Plant Variety Design*

Paul M. Kimani



# Chapter 1

## Principles of Demand-Led Plant Variety Design

Paul M. Kimani

Plant Breeding and Biotechnology Program  
Department of Plant Science and Crop Protection,  
College of Agriculture and Veterinary Sciences  
University of Nairobi, P.O Box 29053-00625 Nairobi, KENYA  
[pmkimani@uonbi.ac.ke](mailto:pmkimani@uonbi.ac.ke)

# Chapter 1

## Objectives

1. To understand the current status and challenges facing African agriculture
2. To review modern variety adoption in Africa
3. To understand the principles of demand-led breeding and similarities and differences with current practices

# Chapter 1

## Content

### 1. Introduction

Transformation of agriculture in Africa

Variety adoption in Africa

### 2. Breeding Goals and Objectives

### 3. Principles of Demand-led Plant Variety Design

### 4. Conclusion

# Opening Discussion

- What do you think is the adoption rate of modern varieties in Africa?
- Why is adoption low or high, by crop or country?
- Can you recognize your varieties in farmers' fields?
- What do you want to achieve as a breeder?
- How do you measure your success in breeding improved crop varieties?

# Adoption of Modern Varieties of Food Crops in Africa

Crop	Country observations	Total area (ha)	Adopted area (ha)	% MVs
Soybean	14	1,185,306	1,041,923	89.7
Maize–WCA	11	9,972,479	6,556,762	65.7
Wheat	1	1,453,820	850,121	62.5
Pigeonpea	3	365,901	182,452	49.9
Maize–ESA	9	14,695,862	6,470,405	44.0
Cassava	17	11,035,995	4,376,237	39.7
Rice	19	6,787,043	2,582,317	38.0
Potatoes	5	615,737	211,772	34.4
Barley	2	970,720	317,597	32.7
Yams	8	4,673,300	1,409,309	30.2
Groundnut	10	6,356,963	1,854,543	29.2
Bean	9	2,497,209	723,544	29.0
Sorghum	8	17,965,926	4,927,345	27.4
Cowpeas	18	11,471,533	3,117,621	27.2
Pearl millet	5	14,089,940	2,552,121	18.1
Chickpea	3	249,632	37,438	15.0
Faba bean	2	614,606	85,806	14.0
Lentils	1	94,946	9,874	10.4
Sweetpotato	5	1,478,086	102,143	6.9
Banana	1	915,877	56,784	6.2
Field peas	1	230,749	3,461	1.5
<b>Total/weighted average</b>	<b>152</b>	<b>107,721,630</b>	<b>37,469,577</b>	<b>34.78</b>

DIIVA project  
(2014)

# 1. Introduction

## Transformation of Africa's agriculture

- Africa's agriculture is at a tipping point; moving from subsistence systems to more **market-led** systems
- Smallholder farmers generating **surpluses** of products to sell in local, national, regional and international markets
- **Demand for products** is rising with population growth, urbanization and changing lifestyles
- **A new breed of consumers** – focused, choosy and ready to pay for quality and safety of food

# Transformation of Africa's agriculture

- Enabling small scale farmers to **access** the expanding markets is a critical challenge facing policy makers
- **Participation** of smallholders in markets requires :
  - Identification of market demands
  - Developing products with suitable characteristics to meet market requirements

# Variety Adoption in Africa

- DIIVA study 2014 shows about 35% adoption of new varieties, of 20 crops in 30 African countries over previous 15 years
- Compares with average of 60% new variety adoption in Asia and 80% in Latin America

# Adoption of Modern Varieties of Food Crops in Africa

Crop	Country observations	Total area (ha)	Adopted area (ha)	% MVs
Soybean	14	1,185,306	1,041,923	89.7
Maize–WCA	11	9,972,479	6,556,762	65.7
Wheat	1	1,453,820	850,121	62.5
Pigeonpea	3	365,901	182,452	49.9
Maize–ESA	9	14,695,862	6,470,405	44.0
Cassava	17	11,035,995	4,376,237	39.7
Rice	19	6,787,043	2,582,317	38.0
Potatoes	5	615,737	211,772	34.4
Barley	2	970,720	317,597	32.7
Yams	8	4,673,300	1,409,309	30.2
Groundnut	10	6,356,963	1,854,543	29.2
Bean	9	2,497,209	723,544	29.0
Sorghum	8	17,965,926	4,927,345	27.4
Cowpeas	18	11,471,533	3,117,621	27.2
Pearl millet	5	14,089,940	2,552,121	18.1
Chickpea	3	249,632	37,438	15.0
Faba bean	2	614,606	85,806	14.0
Lentils	1	94,946	9,874	10.4
Sweetpotato	5	1,478,086	102,143	6.9
Banana	1	915,877	56,784	6.2
Field peas	1	230,749	3,461	1.5
<b>Total/weighted average</b>	<b>152</b>	<b>107,721,630</b>	<b>37,469,577</b>	<b>34.78</b>

DIIVA project  
(2014)

# Variety Adoption in Africa

- Constraints and issues in low adoption
  - Awareness
  - Availability
  - Profitability
- Measuring adoption levels
  - Pros and cons of various methods
  - Quality of data is the key requirement
  - Expert opinion, focus groups and survey data

# 2. Breeding Goals and Objectives

- Setting breeding goals and objectives
  - Current approaches – setting broad (biological) objectives
  - Refining current approaches – more input from clients
- Examples of adoption/non-adoption new varieties
  - e.g. Maize – high adoption of some hybrids in eastern Africa, but not others (yield increase did not compensate)
  - e.g. East African cooking banana – low adoption due to consumer issues with taste and color of new varieties

# Breeding Goals and Objectives

- Trait trade-offs
  - Categorize and rank priority traits
- Categories of traits
  - Plant traits; Tolerance to abiotic and biotic stresses; Consumer/market preferred traits
- Balance of: (i) Basic traits all varieties must have; (ii) Traits to increase market share; and (iii) New traits not available in existing cultivars.

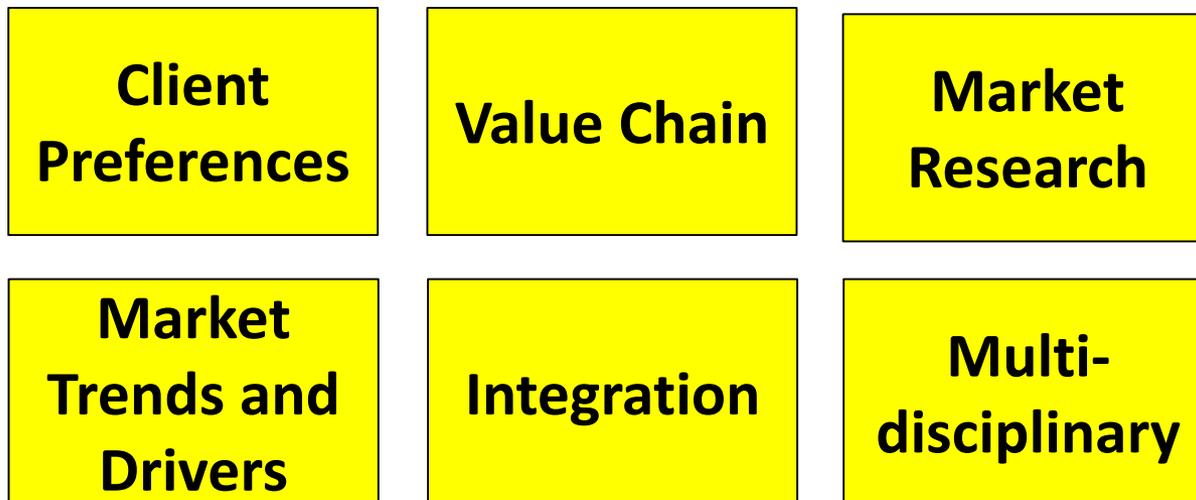
# Breeding Goals and Objectives

- Measuring progress towards goals over time
  - Setting smart targets and milestones for long term breeding programs
  - Performance indicators need to be
    - Valid
    - Reliable
    - Sensitive
    - Simple
    - Useful
    - Affordable

# 3. Principles of Demand-Led Breeding

## What is demand-led plant breeding?

- **Demand-led breeding** is an approach that enables plant breeders to develop higher performing varieties that meet customer requirements and market demand
- It is based on six core principles



# Definitions

- **Client Preferences:** Understanding the *needs and preferences* of smallholder farmers, processors, traders, retailers, consumers and other actors along a value chain
- **Value Chain:** A set of value adding activities performed by all actors in the production to consumption chain for a specified product.
  - Analysis of the *value chain* of the target crop species and the *agricultural innovation system* in which the value chain operates
- **Market research** is used to define the *performance standard and priority* of each varietal characteristic, to test and validate key assumptions throughout variety development process.

# Definitions

- **Market trends and drivers:** Demand-led breeding is based on a clear understanding of *market trends and drivers* and *development timescales*
- **Integration:** Demand-led breeding uses *public and private sector expertise* and *integrates* the best practices from both into the variety development process
- **Multidisciplinary teams:** Varietal design and solution development is conducted using a *multi-disciplinary* team approach

# Definitions

- **Product Innovation:** A good or service that is new or significantly improved. This includes significant improvements in technical specifications, components and materials, software in the product, user friendliness or other functional characteristics.
- **Process Innovation:** A new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software.
- **Marketing Innovation:** A marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.
- **Organizational Innovation:** A new organizational method in business practices, workplace organization or external relations.

# Demand-Led Breeding, Innovation System and Value Chains

- Demand-led breeding follows an innovation system and value chain approaches
- It requires a broader range of competencies and actors with different roles and responsibilities to develop a new variety

# Demand-Led breeding, Innovation System and Value Chains

The main elements within an **innovation system** are:

1. **Research domain**
2. A **business and enterprise** domain; and
3. Bridging institutions that **link** the two domains

# Role of the Breeder

The breeder is the main actor in demand-led breeding design

- The breeder:
  - Provides breeding expertise
  - Becomes the champion of demand led approach
  - Responsible for coordinating, facilitating and linking actors and audiences with diverse interests

# Role of the Breeder

- The breeder:
  - Needs to learn ***new skills*** especially in the business domain and work with a range of non-traditional allies for the success of his/her program
  - Also needs to ***train and mentor*** a new generation of young breeders in demand-led breeding approaches

# Similarities between Demand-Led Breeding and Farmer Participatory Breeding

- **Similarities:**
  - Setting goals
  - Objectives
  - Generating variability (crosses, landraces, gene bank accessions)
  - Selecting and testing experimental varieties
  - Variety release and promotion
  - Seed multiplication and distribution
- Both approaches aim at developing ***client specific products*** and ***increased adoption*** of end products

# Demand-led Breeding goes beyond Participatory Plant Breeding

## Participatory Plant Breeding

- Highly localised activity
- End products are designed to suit specific environments
- The key actors in PPB are the farmers and the breeders
- PPB focuses on local needs, largely in subsistence food systems
- PPB focuses on local practises and harnesses expertise of farmers and breeders
- Seed distribution in PPB is limited to the locality of its operations

## Demand led breeding

- Broader in scope and targets large areas or agro-ecological zones where the crop can be produced at national, regional and global levels
- Targets all actors in a value chain and innovation system
- Emphasizes markets, their demands, trends, and uses a broad range of tools such as market research, modern product promotion tools and value addition
- Seeks to combine the best practises from both public and private sectors
- Aims to disseminate seed of new varieties widely within national borders, regionally and globally.

# Benefits of Demand-Led Approaches

Demand-led breeding has multiple benefits including:

- Higher chance of adoption
- Tapping larger markets and hence uses economies of scale
- It can lead to better returns on investment
- Potentially attractive to private investment
- It is more sustainable in that private sector is likely to continue with production and marketing seed of new varieties in the long term

# Benefits of Demand-Led Approaches

Demand-led breeding has multiple benefits including:

- In the longer term, the public and private sector linkages will be strengthened based on mutual benefits
- Demand-led breeding is likely to make significant and sustainable contributions toward national goals of food and nutrition security

# Challenges of Demand-Led Approaches

- The main risks include:
  - Failure to meet the targets
  - Time involved in linking up with all the actors in the value chain
  - Unfavourable political and policy environments
  - Slow adoption of new varieties
  - Depends on continued willingness of actors in a value chain to collaborate with breeders

## 4. Summary

- Demand-led approaches aim to ***make the business of plant breeding in Africa more responsive to market demands***
- Demand-led approaches go beyond farmer participatory breeding approaches to inclusivity of all the key stakeholders in the value chain
- Demand-led breeding retains emphasis on the value of the breeders' eyes and experience

# Summary

- An appropriate balance is required between using demand-led approaches and technology/innovation push to maximise market creation for new varieties
- Role of plant breeders is much more than just leading crossing or selection programmes.
- The breeder must also be an integrator of inputs and be able to take on board information from a broad range of sources, including non-technical experts

# Summary

- Understanding that customers need to be central to new variety design
- Be very clear on who are the customers and what factors influence their buying decisions on purchasing seed and the products of new varieties.

# Demand-Led Plant Breeding

## Chapter 1

### *Principles of Demand-Led Plant Variety Design*

Paul M. Kimani

[pmkimani@uonbi.ac.ke](mailto:pmkimani@uonbi.ac.ke)

