

Setting Breeding Objectives and Priorities

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Setting Breeding Objectives and Priorities – Why ?

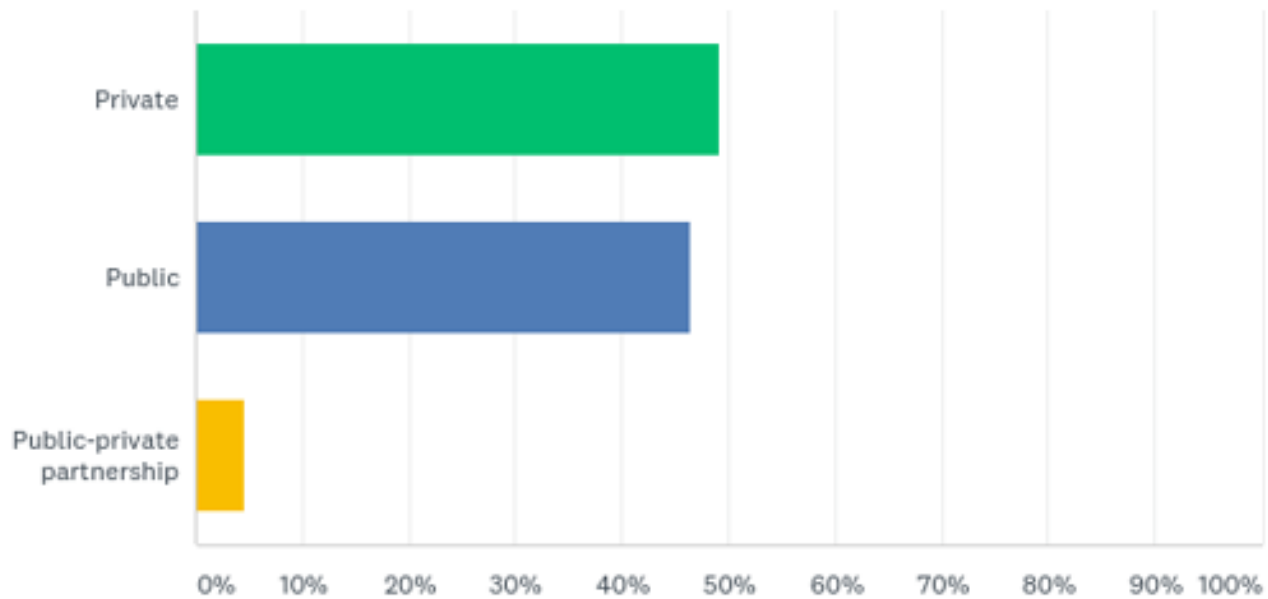
- The « ultimate » goal of breeding: value creation
- Breeding before breeders
- The rise of breeders and the call for objectives
- Modernity and the cry for priorities

Study Approach

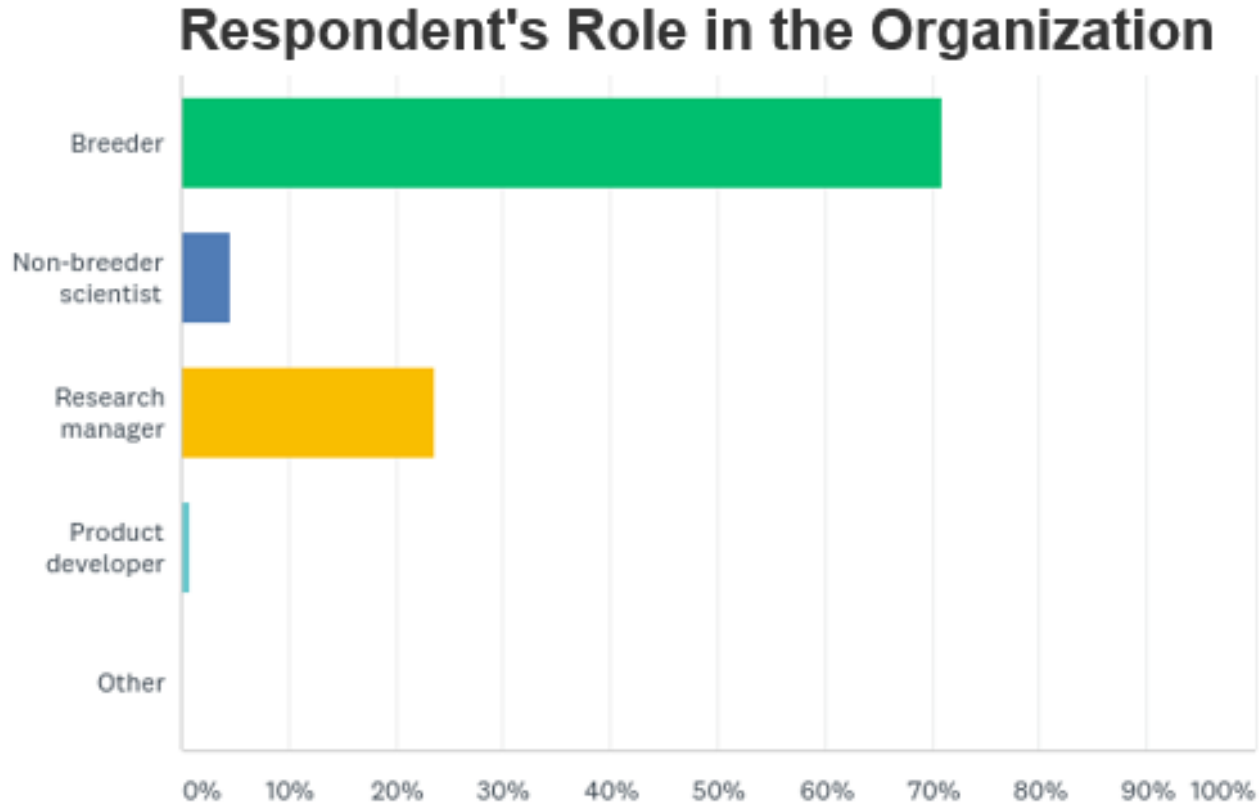
- General survey (Survey Monkey) – 110 responses
- Case studies – Few responses, moderate depth
- Other sources

General Survey Responses

Type of Breeding Organization

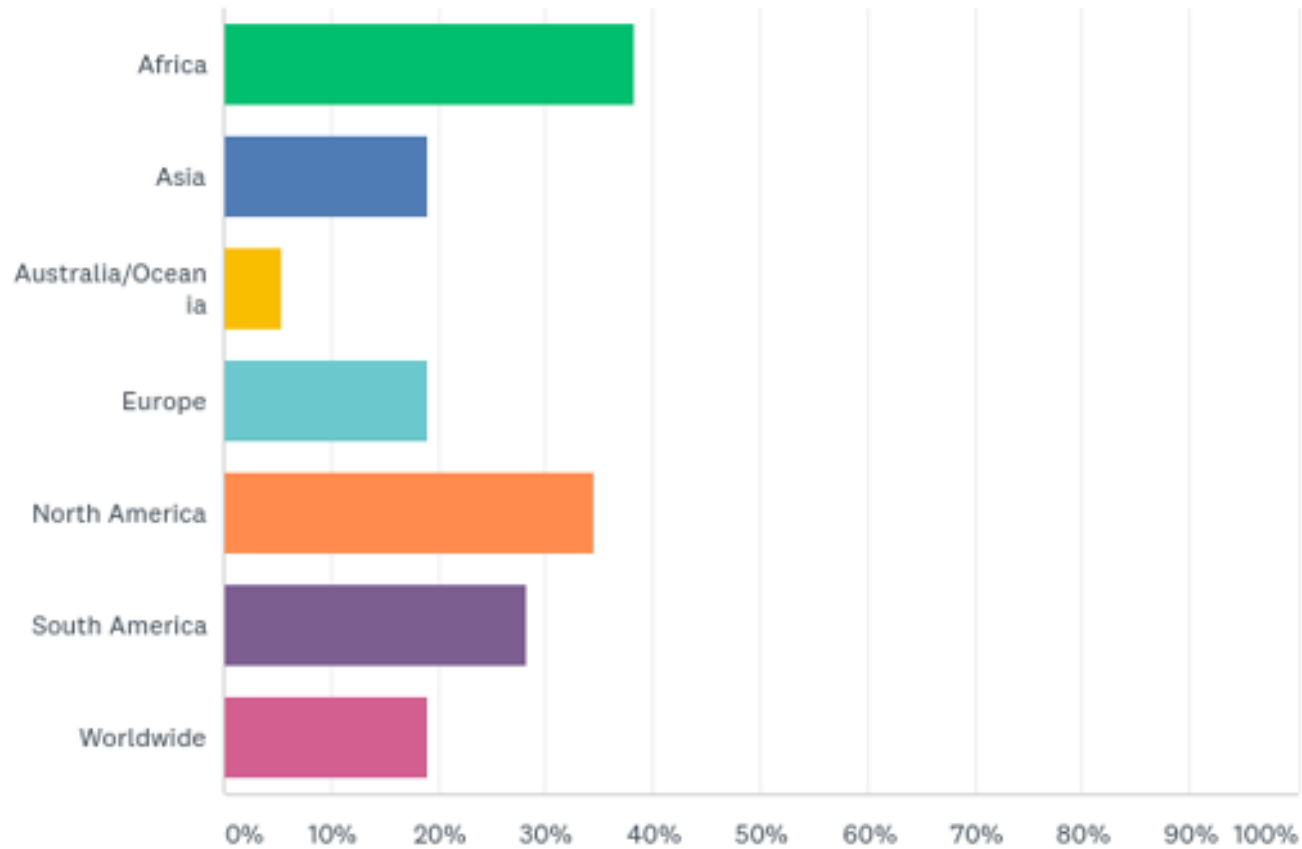


General Survey Responses

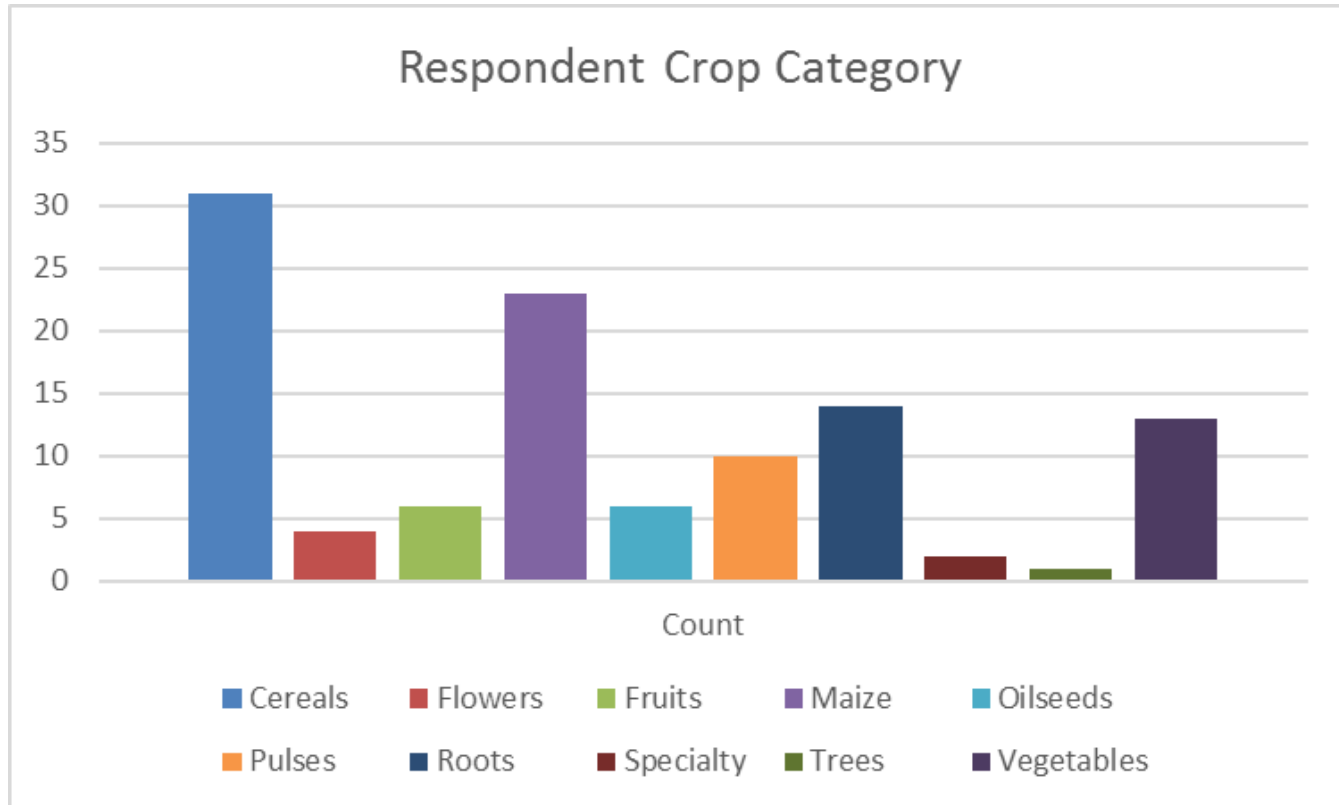


General Survey Responses

Target Geography



General Survey Responses



Survey Approach

- Agree/Disagree
- Testing of facts' intensity
- General bias towards agreement

Definitions – Breeding Customers

- Growers: individuals or organizations who grow plants or raise animals with the aim of harvesting or collecting one or more specific products (grain, whole plant, tubers, milk, meat, wool, etc.).
- Product chain: individuals or organizations who take products harvested or collected by growers, possibly transform them (although not necessarily), and provide them to end-use consumers. In some cases, growers can also be considered as product chain.
- End-use consumers: individuals or organizations who use products for food, feed, or energy. In some cases, growers can also be considered as end-use consumers.

Definitions – Markets

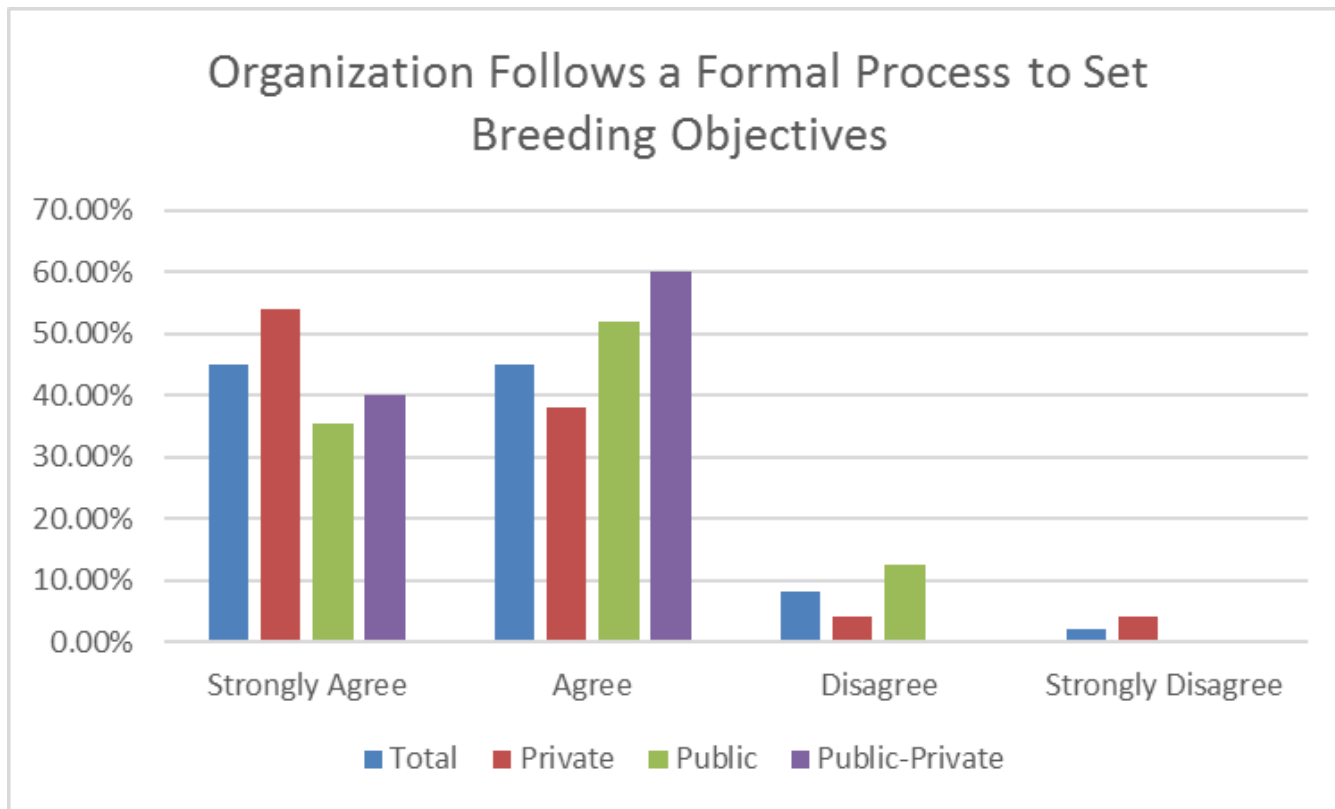
- Market segment: a geographic area or a group of people having a relatively homogeneous demand for a commodity (here crop varieties or animal breeds). The population of users who make up a market segment may all be located in a single agro-ecology or this population may be distributed across several different agro-ecologies. The extent to which an agro-ecology and a market segment coincide will depend on the extent to which user demand (preferences) for a breeding product are determined by climate, soils and land-use constraints.

Definitions – Products

- Product profile: set of targeted attributes which a new plant variety or animal breed is expected to meet to be released onto a market segment.

Attributes must be understood as traits with a specific value, this value being defined either in absolute or relative terms. For instance, a product profile may list grain yield (11 tons/hectare or more), or tolerance to downy mildew (same as or better than variety X), total oil content (no less than variety Y).

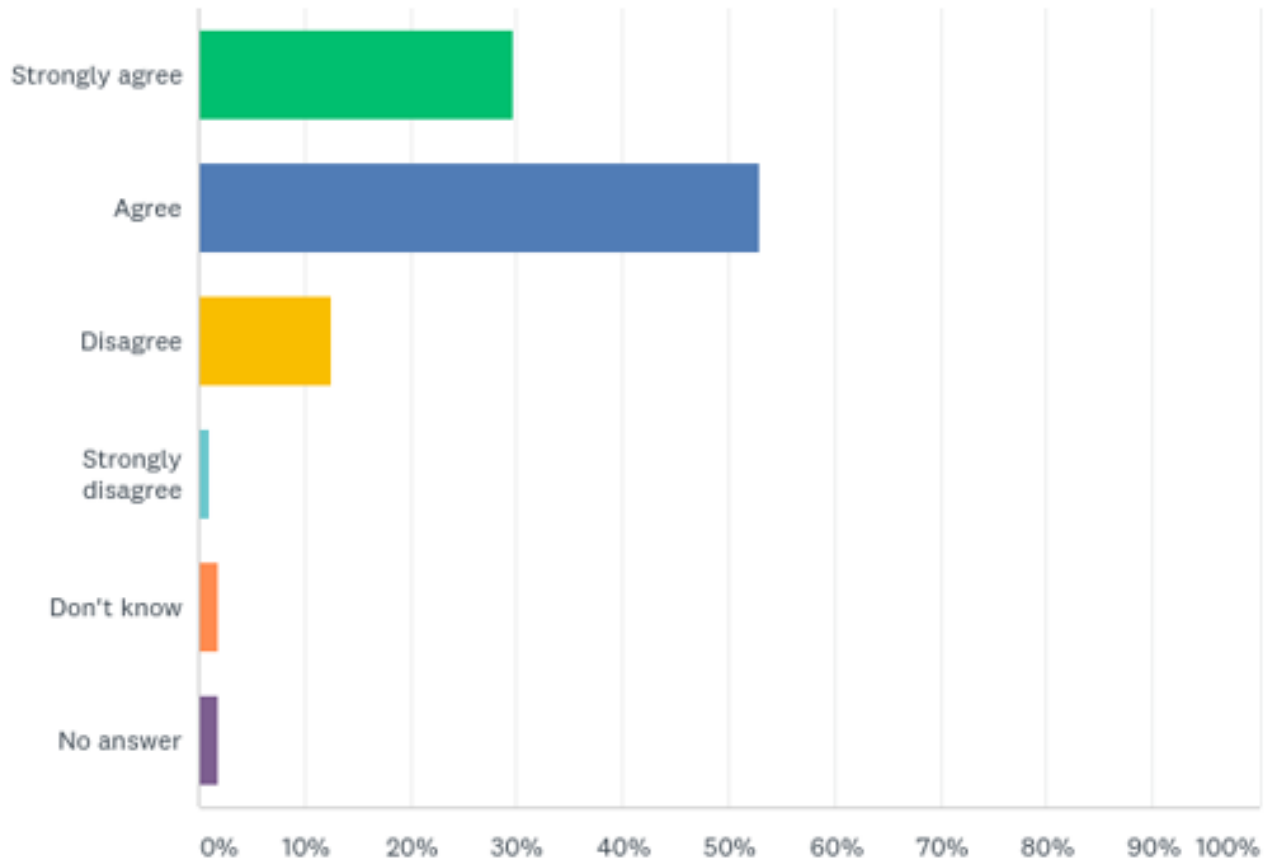
Connecting Needs and Actions



- Process perceived as being formal
- Absence of many and essential formal elements

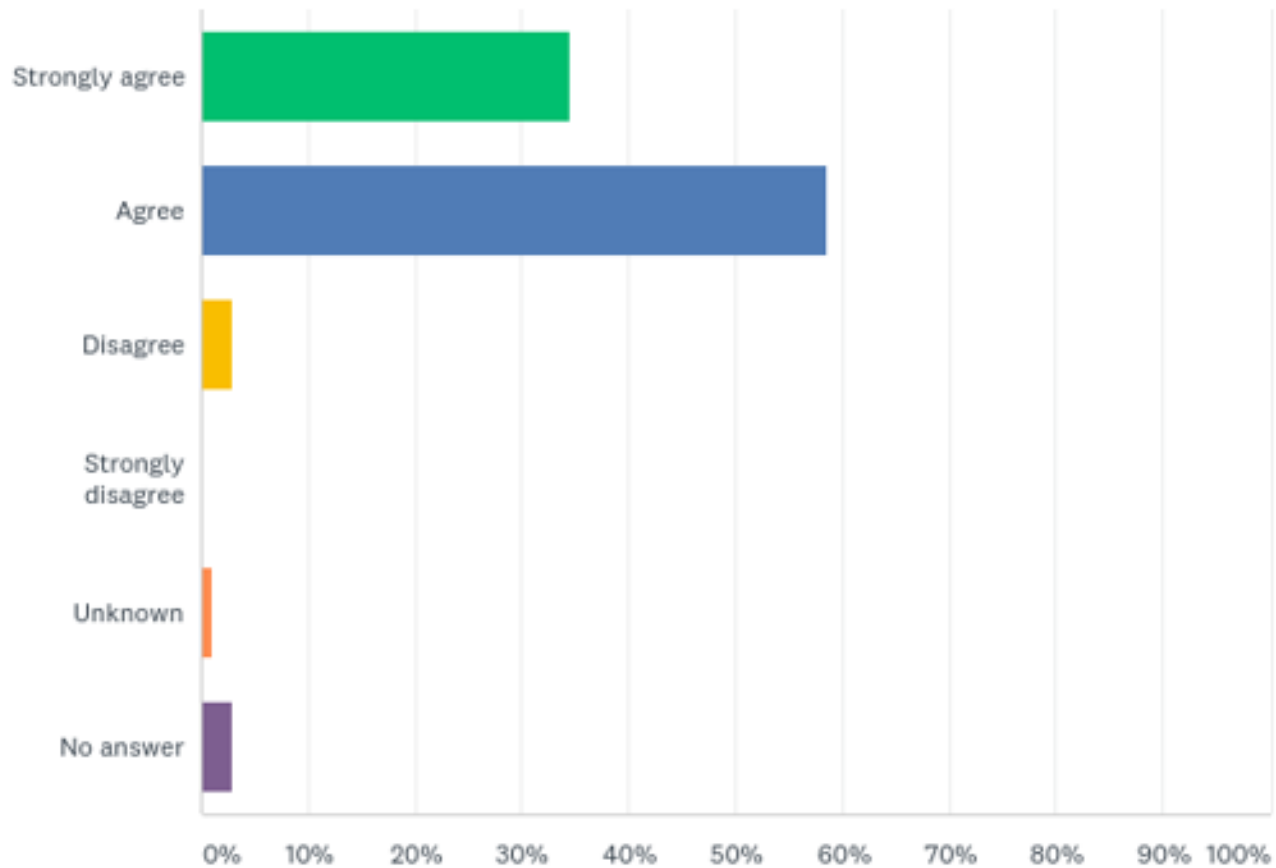
Defining Markets

Use of Quantitative Market Segment Data



Defining Markets

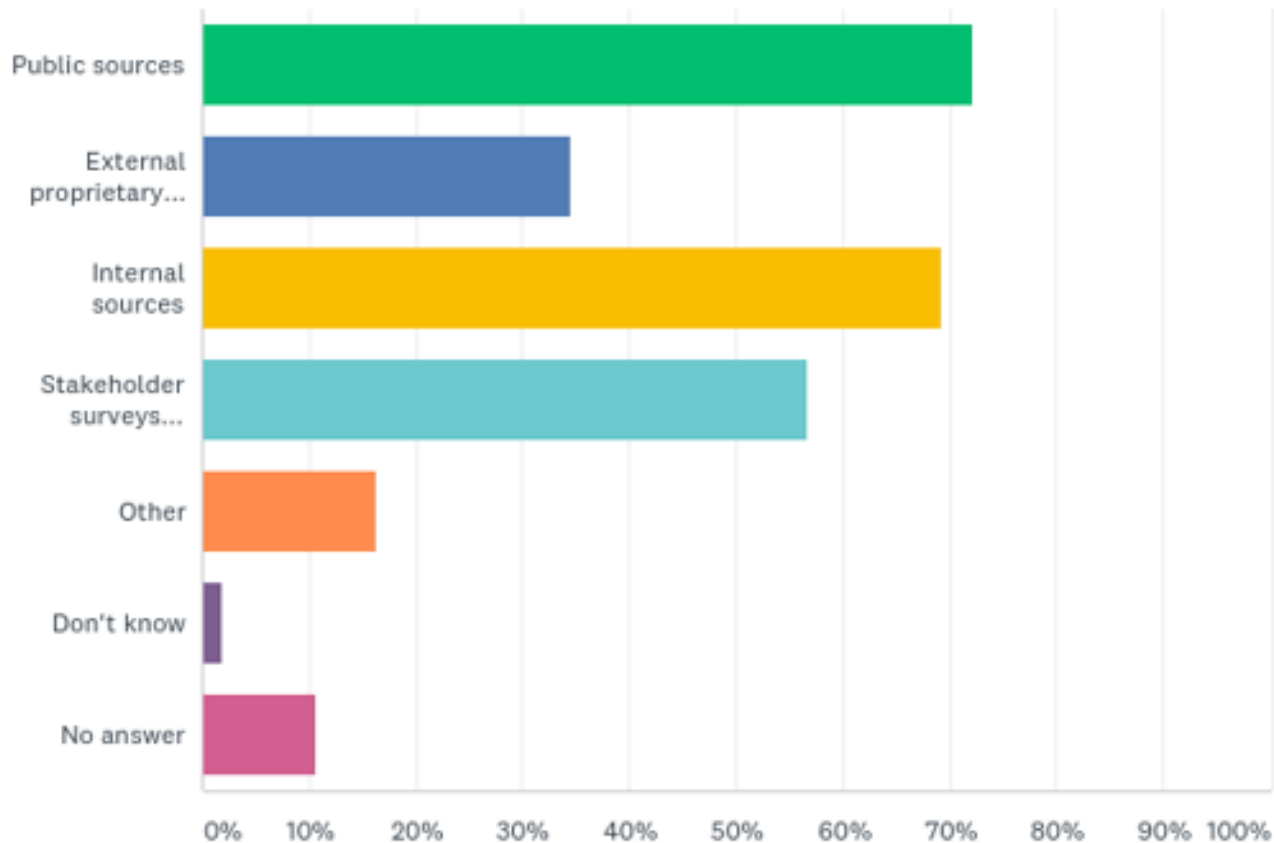
Use of Qualitative Market Segment Data



- Most data is qualitative

Defining Markets

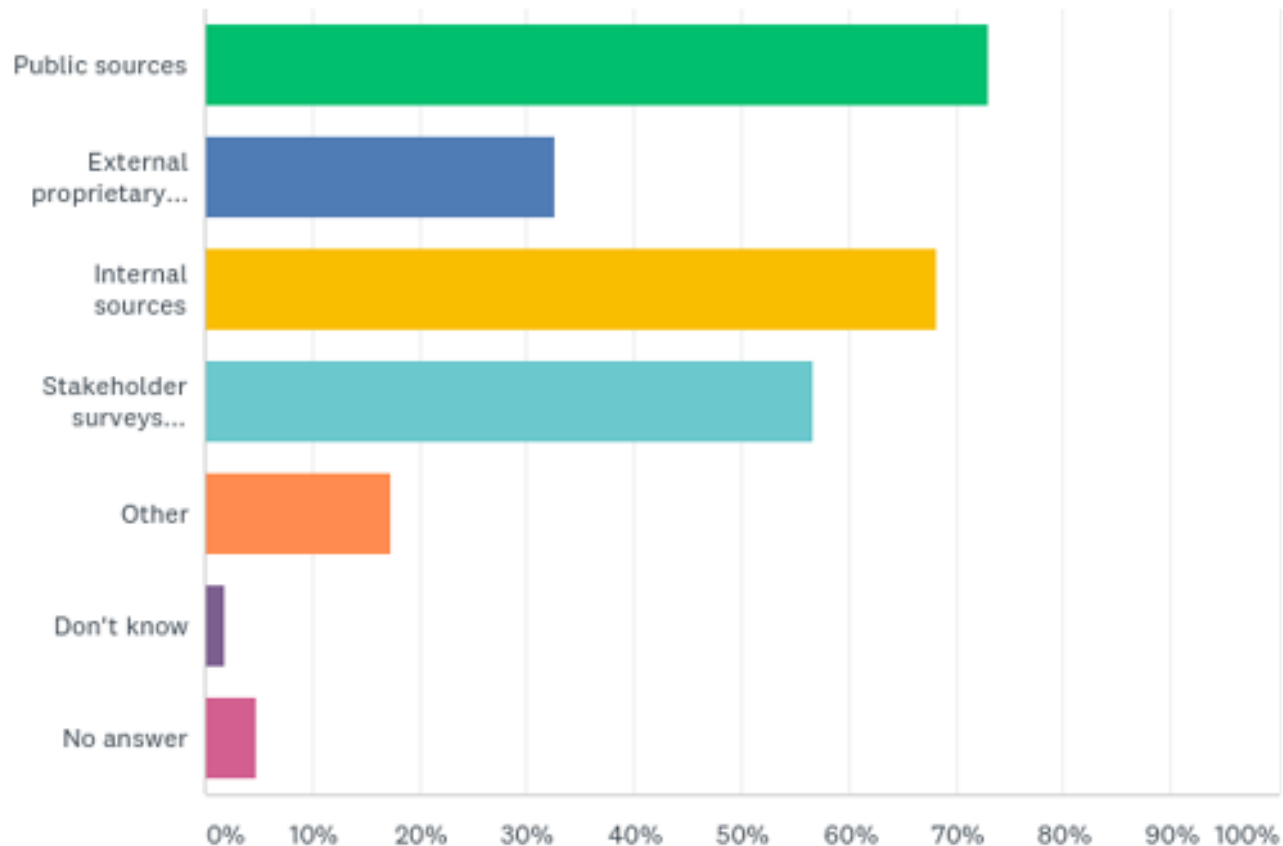
Sources of Quantitative Market Segment Data



- Heavy reliance on internal sources

Defining Markets

Sources of Qualitative Market Segment Data

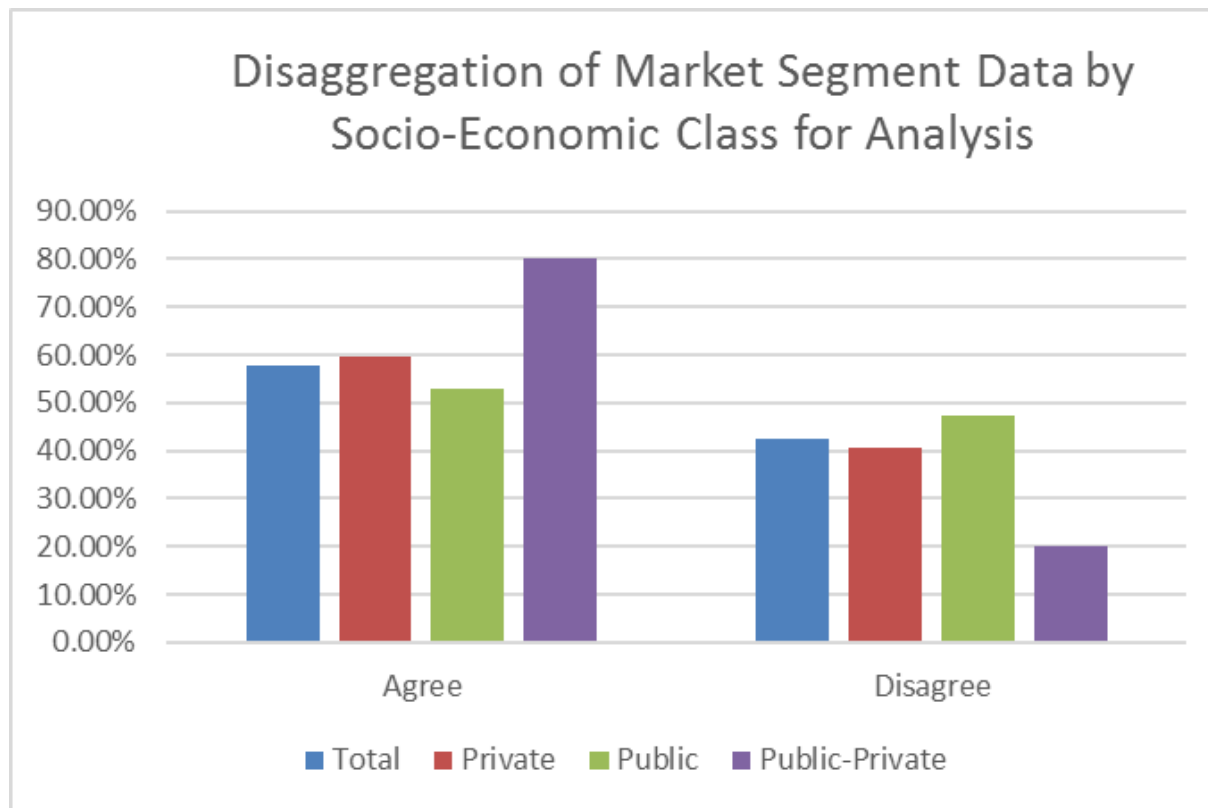


- Heavy reliance on internal sources

Defining Markets

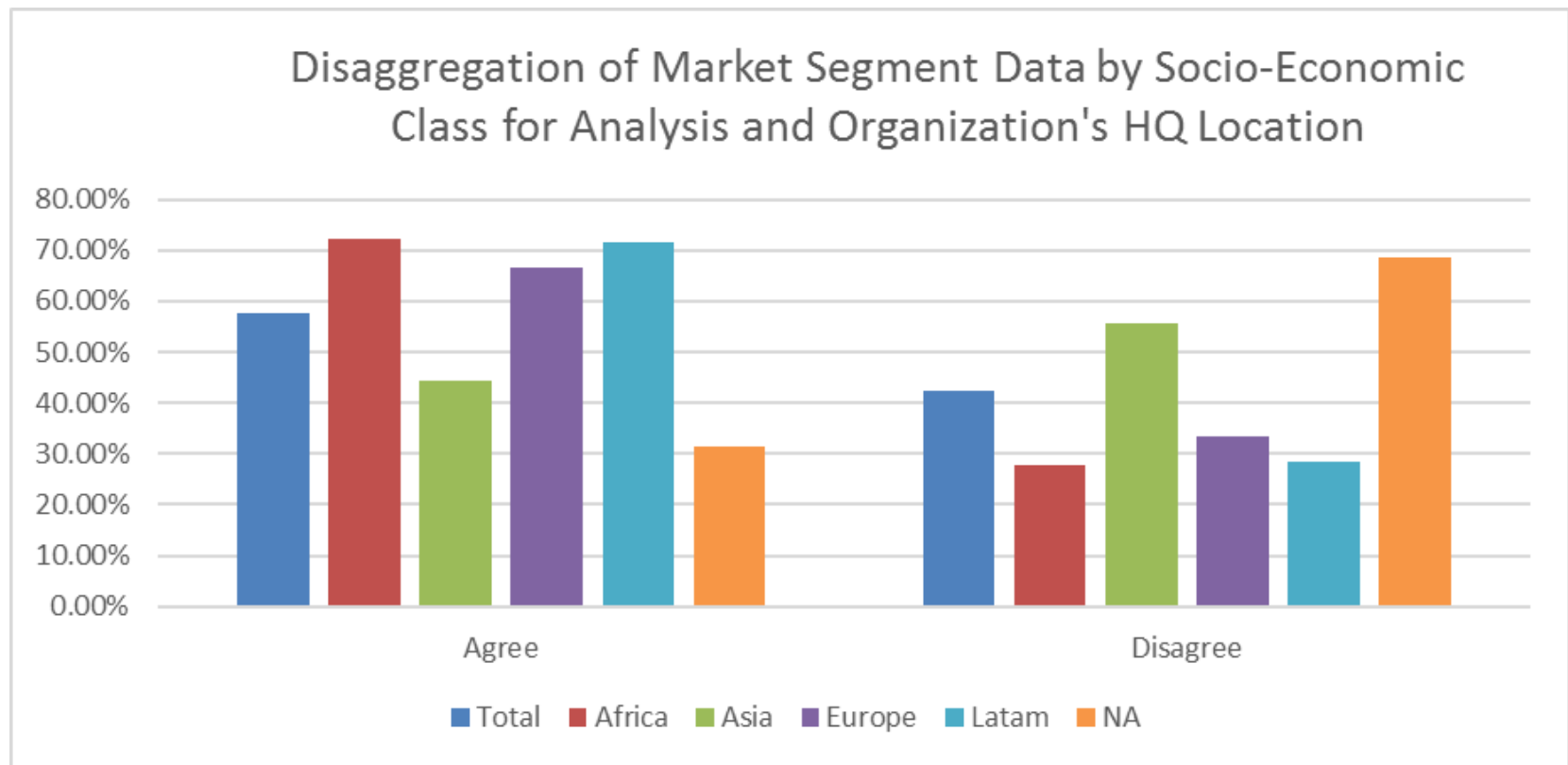
- Precise market analyses not generalized.
- No specific market data sources / examples have been provided.
- Market knowledge often “collected” directly by breeders through interactions with market actors (growers, chain, end-users), especially in smaller organizations.
- Market definition charged to marketing groups in larger organizations.

Market Segments and Socio-Economic Classes



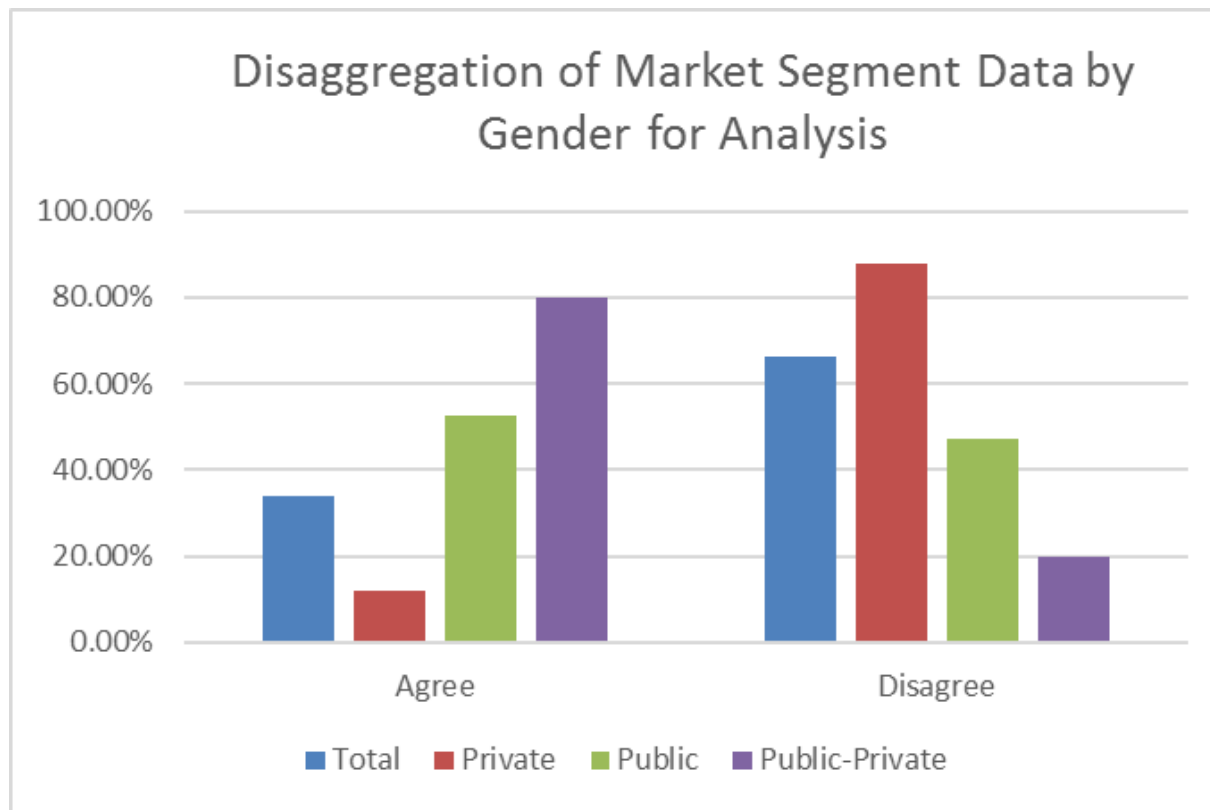
- Relatively homogeneous approach across organization types

Market Segments and Socio-Economic Classes



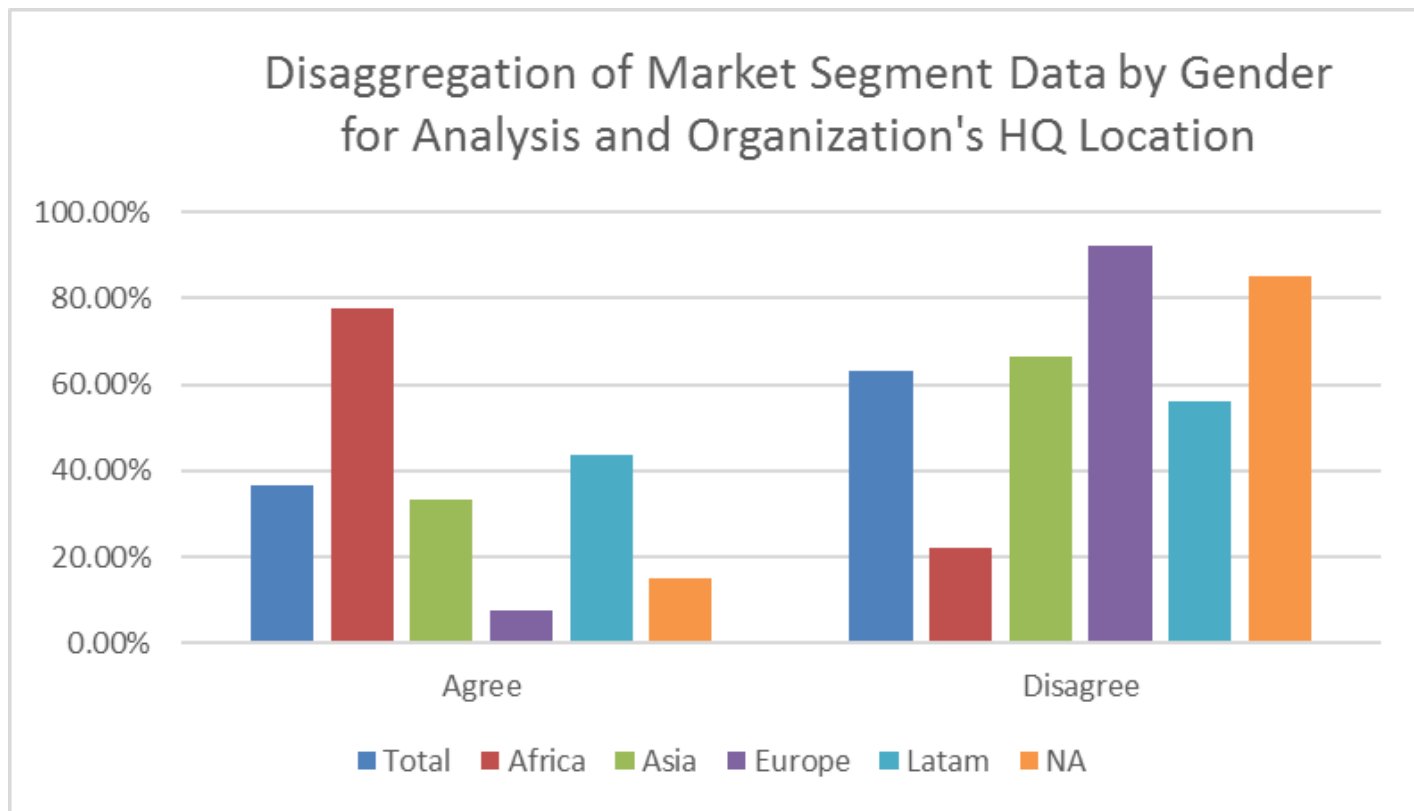
- North America, least concerned by socio-economic segmentation

Market Segments and Gender



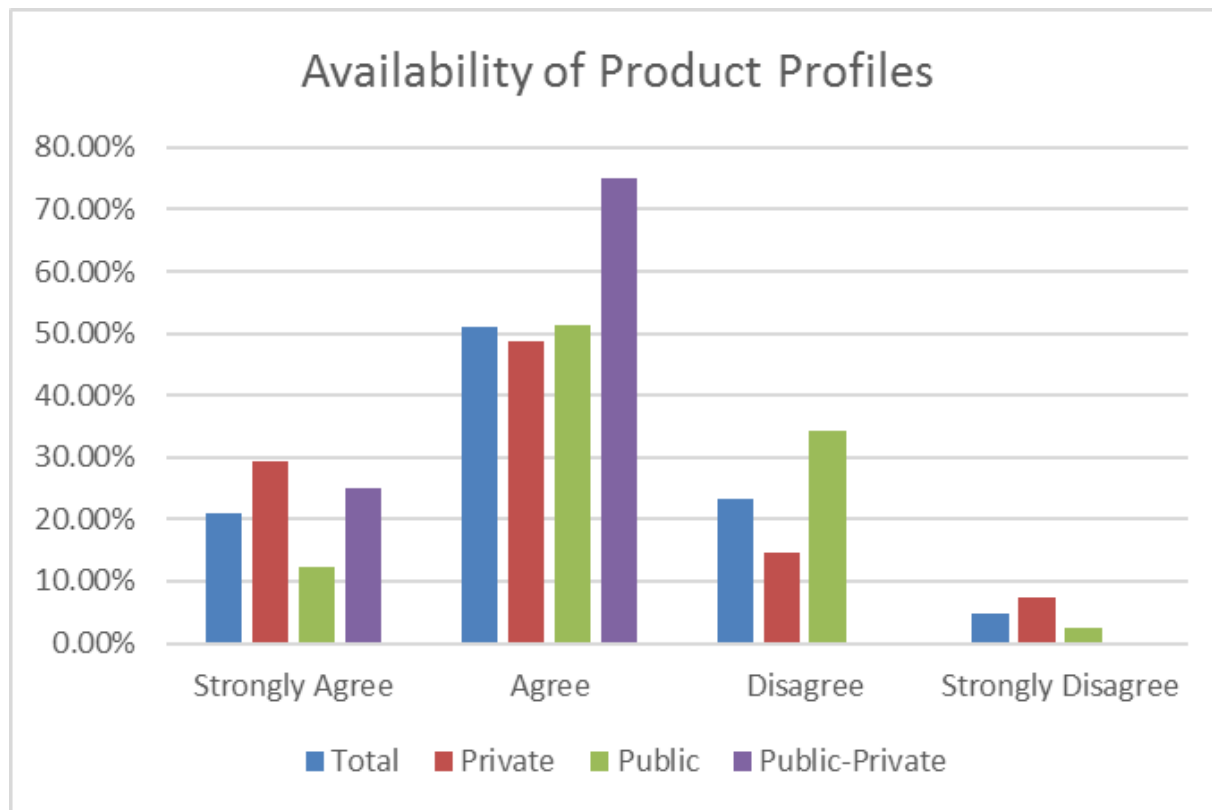
- Tremendous difference between public and private organizations
- Mostly a public “concern”

Market Segments and Gender



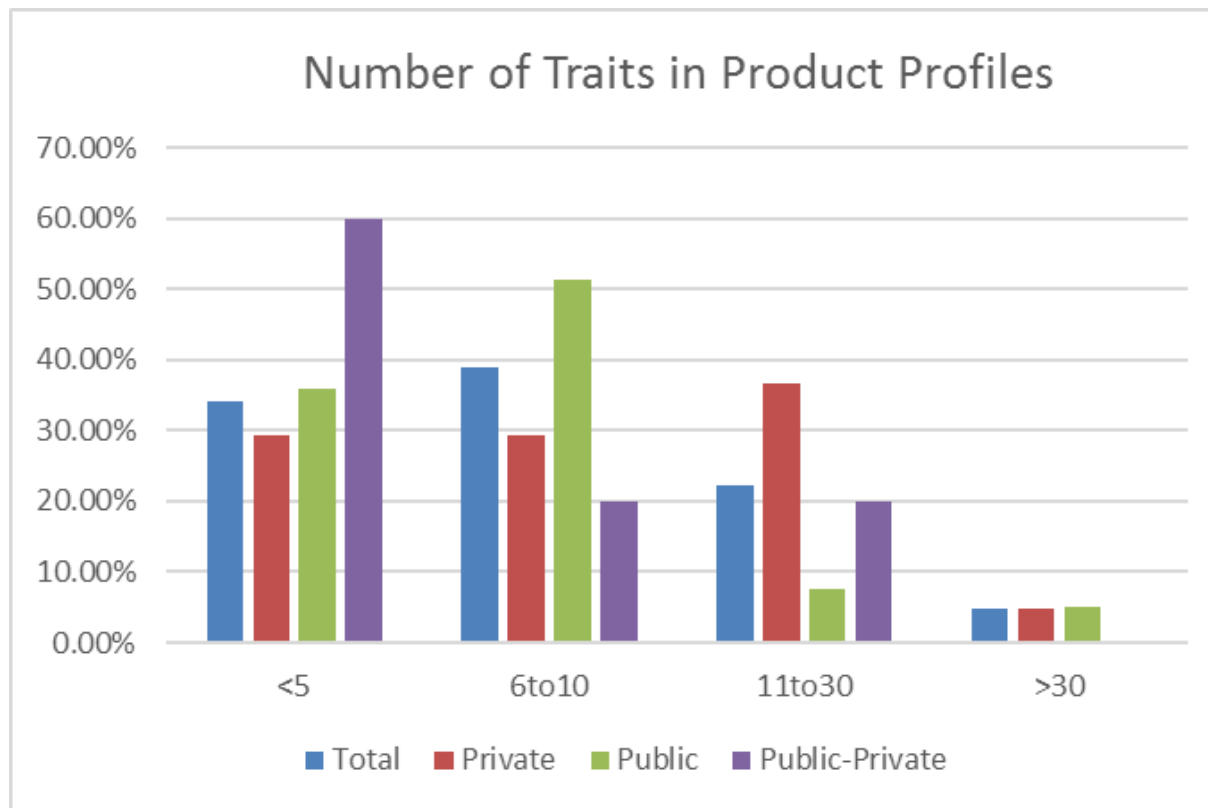
- Huge variation across regions (headquarters)
- Mostly an African “concern”
- Almost ignored in the developed world

From Market to Breeding – Product Profiles



- Slightly stronger in private than public organizations
- Perception most likely ahead of reality

From Market to Breeding – Product Profiles



- Slightly simpler objectives in public than in private organizations

From Market to Breeding – Product Profiles

Trait	Reference	Priority
Yield	Check1 +5%	1
Lodging resistance	<20%	2
Plant height	90-110	2
Maturity	Early	3
Protein content	>7.5%	1
Oil content	Check2	3
Fiber content	>=Check3	2
Mildew resistance	Resistant	2
Virus resistance	>Check4	1
Smut resistance	Intermediate	3
Drought tolerance	Check5	2
Al soil tolerance	Moderate	3

■ Market demands

1. Must-have; 2. Important; 3. Nice to have

From Market to Breeding – Product Profiles

Trait	Reference	Priority	Selection Objective
Yield	Check1 +5%	1	<i>Maximize</i>
Lodging resistance	<20%	2	<i>Reach threshold</i>
Plant height	90-110	2	<i>Reach threshold</i>
Maturity	Early	3	<i>Reach threshold</i>
Protein content	>7.5%	1	<i>Maximize</i>
Oil content	Check2	3	<i>Reach threshold</i>
Fiber content	>=Check3	2	<i>Reach threshold</i>
Mildew resistance	Resistant	2	<i>Maximize</i>
Virus resistance	>Check4	1	<i>Reach threshold</i>
Smut resistance	Intermediate	3	<i>Opportunistic</i>
Drought tolerance	Check5	2	<i>Opportunistic</i>
Al soil tolerance	Moderate	3	<i>Opportunistic</i>

1. Must-have; 2. Important; 3. Nice to have

- Breeding opportunities

Breeding and Traits

Many of the quantitative traits that constitute the primary focus of plant breeding are very complex in inheritance, with variation believed to be attributable to dozens if not hundreds of underlying genes. It is not unusual to identify 20 chromosome regions affecting yield or other key agronomic traits in a bi-parental, marker-based mapping project in maize. If only 20 key genes segregate independently in a breeding project, the favorable gene combination for all 20 loci occurs in an F2 at such a low frequency that growing the F2 population over the entire U.S. corn acreage would be insufficient to provide a 95% chance that the most favorable genotype would occur. Even if the F2 population were randomly inbred to fixation, several million inbred lines would be required to have reasonable chance of recovering the favorable genotype. Clearly, breeders rarely, if ever, recover the optimum genotype from their breeding crosses. With low heritabilities, small sample sizes, and breeding approaches involving rapid inbreeding, the simple goal of achieving a gene combination significantly better than the parental genotypes is an ambitious undertaking with relatively low odds of success. By employing genetic markers in a recurrent selection scheme as discussed above, our aim is to improve the fixation rate of favorable QTLs by using recurrent cycles of marker-based selection. In a practical sense, we would like to accomplish this within reasonable experiment sizes and within and among modestly sized populations and to use three or more generations per year in multiseason nurseries or greenhouses.

(1) Plant Breeding: Past, Present, and Future. TM Crosbie et al. (2006) Plant Breeding

(1)

From Market to Breeding – Product Profiles

Trait	Reference	Priority	Selection Objective	Desired Impact
Yield	Check1 +5%	1	<i>Maximize</i>	3
Lodging resistance	<20%	2	<i>Reach threshold</i>	2
Plant height	90-110	2	<i>Reach threshold</i>	7
Maturity	Early	3	<i>Reach threshold</i>	9
Protein content	>7.5%	1	<i>Maximize</i>	1
Oil content	Check2	3	<i>Reach threshold</i>	10
Fiber content	>=Check3	2	<i>Reach threshold</i>	5
Mildew resistance	Resistant	2	<i>Maximize</i>	8
Virus resistance	>Check4	1	<i>Reach threshold</i>	4
Smut resistance	Intermediate	3	<i>Opportunistic</i>	11
Drought tolerance	Check5	2	<i>Opportunistic</i>	6
Al soil tolerance	Moderate	3	<i>Opportunistic</i>	12

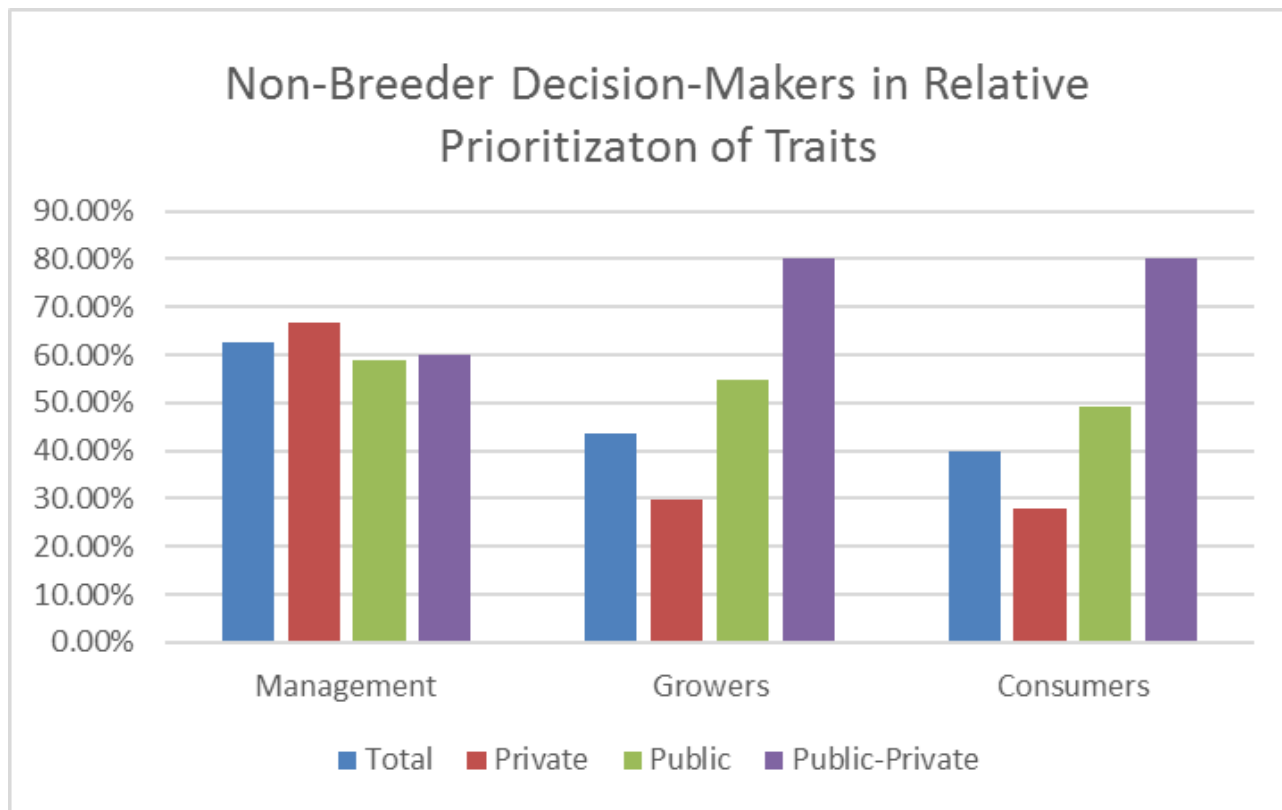
1. Must-have; 2. Important; 3. Nice to have

■ Strategy

From Market to Breeding – Product Profiles

- Huge diversity in what is understood by product profile (and resulting documents)
- Product profiles are not breeding strategies
 - Lack current performance context
 - Lack termed decisions
- Strategies often undetermined or determined by non value creation-driven elements
- Beware of changing market demands

Trait Prioritization

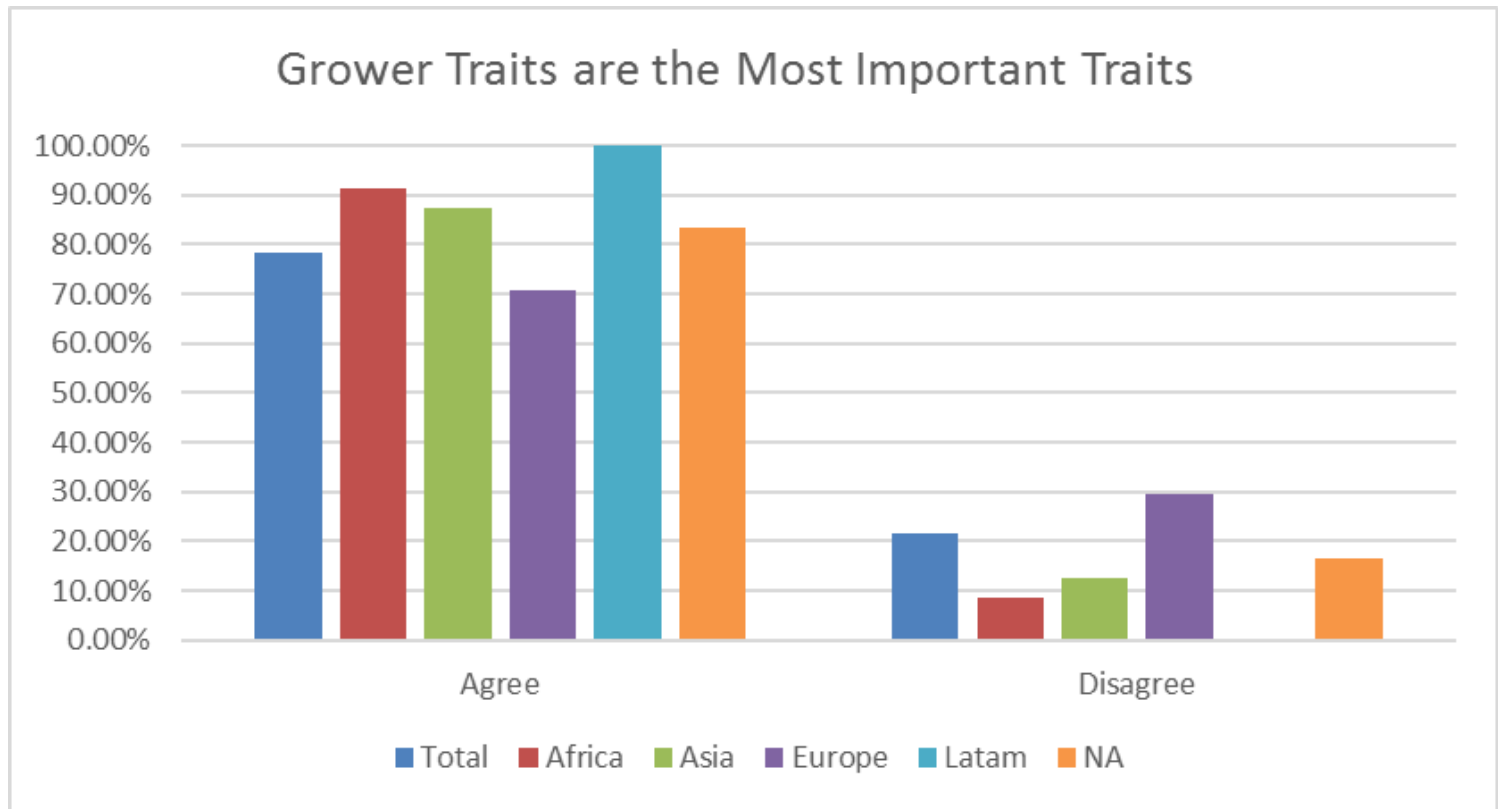


- More direct involvement of all stakeholders in public than in private breeding programs

Decision-Making

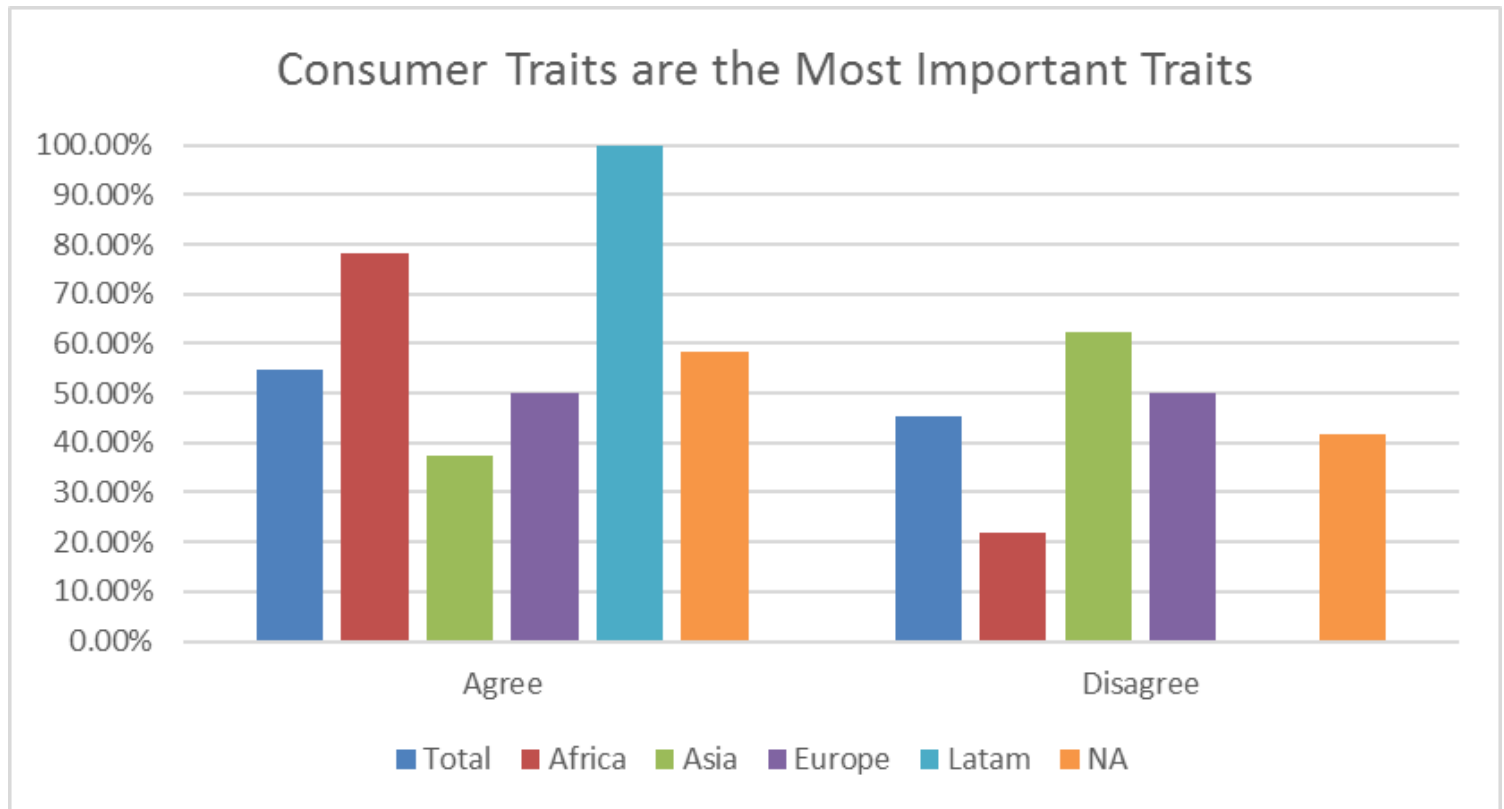
- Often breeder, alone
- Crop teams with representatives from marketing, development, breeding

Trait Prioritization



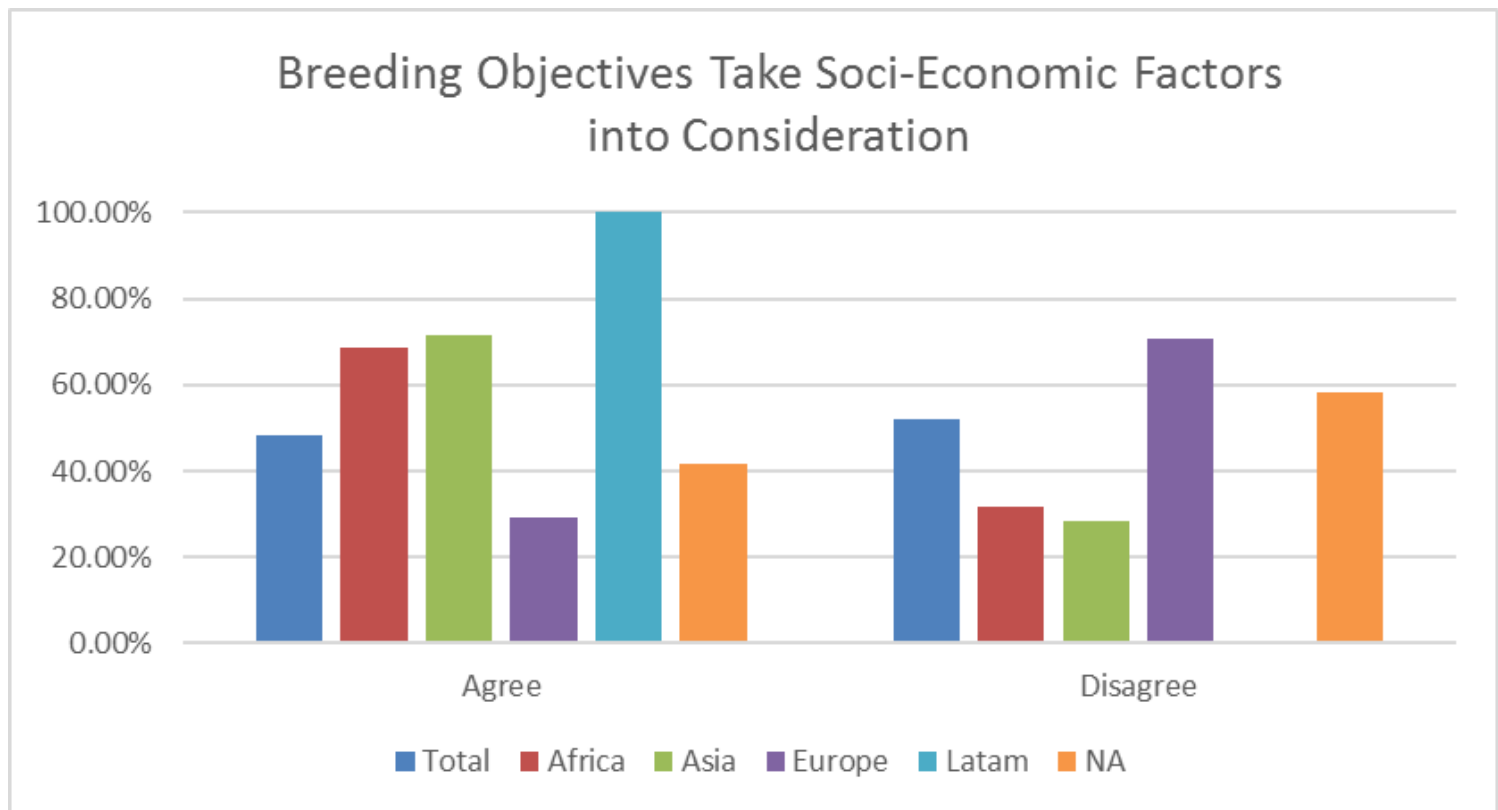
- Growers are a strong focus for all regions

Trait Prioritization



- End-consumers are most important for programs based in Africa and Latin America

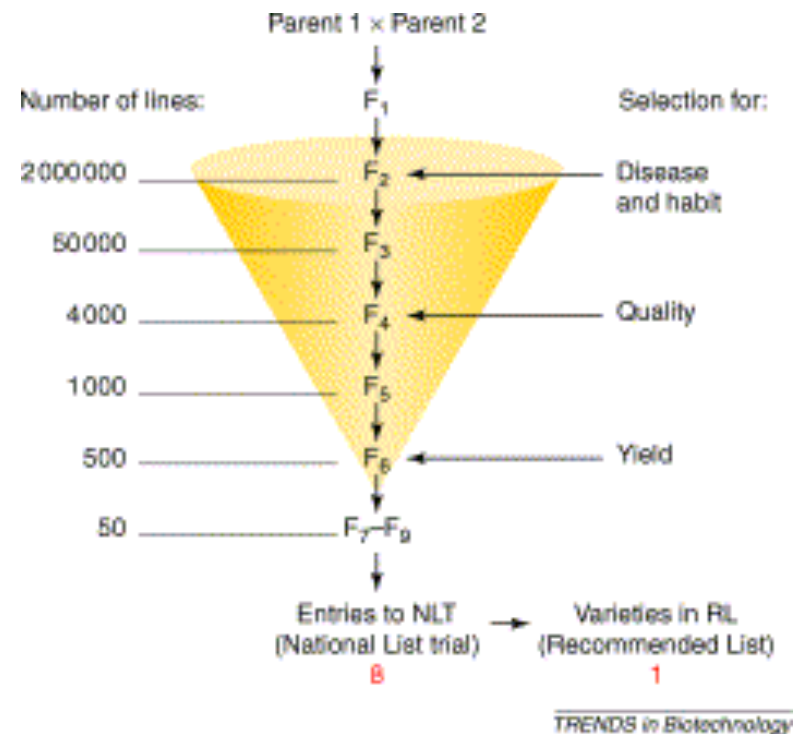
Trait Prioritization



- Socio-economic factors mostly taken into account in developing countries

Trait Prioritization

- Reality often quite different from intentions
- Tremendous impact of operational constraints
 - Early breeding stages
 - Late breeding stages



Trait Prioritization

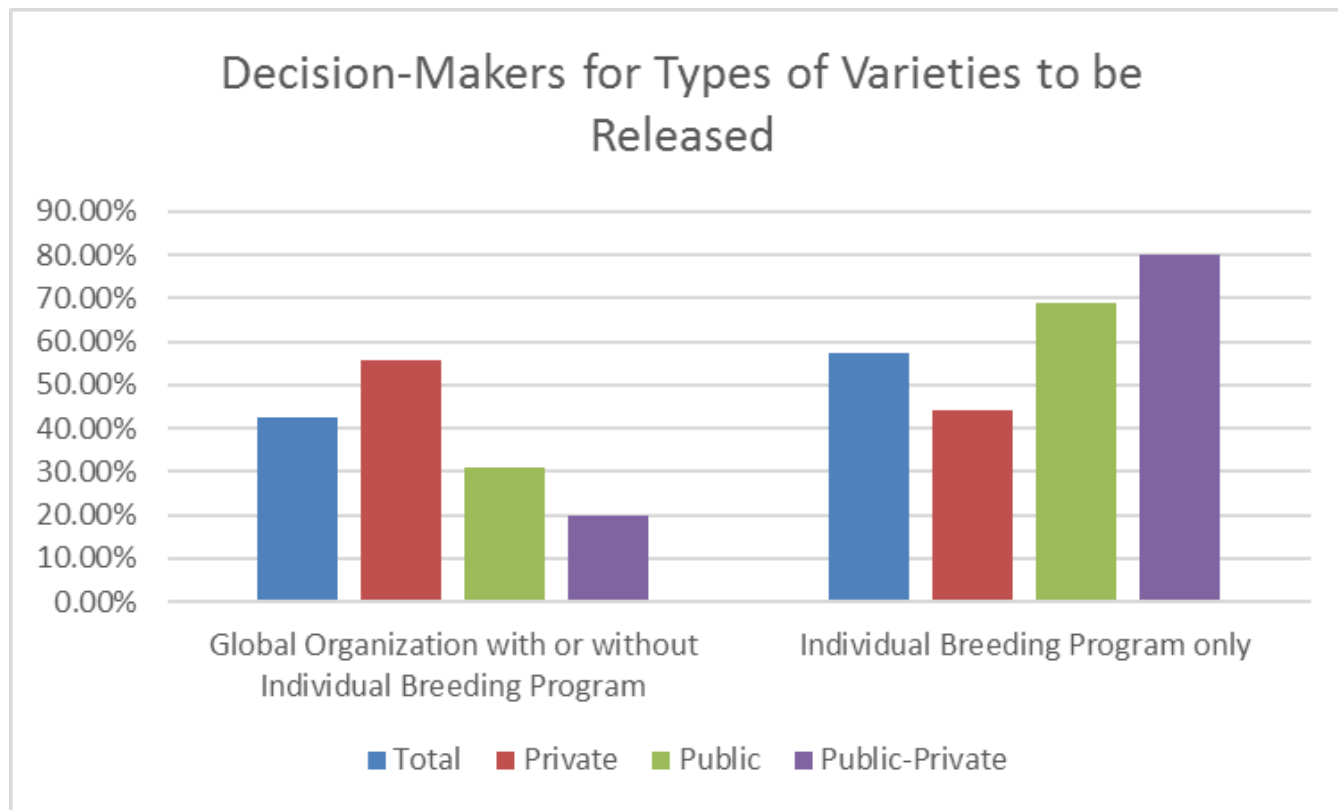
- Unresolved complexity often leads to lack of demonstrable gains
 - Selection indices

$$I = b_1X_1 + b_2X_2 + \dots + b_nX_n = \sum b_iX_i$$

b_i 's are the index weights and X_i 's are the phenotypic values for each trait

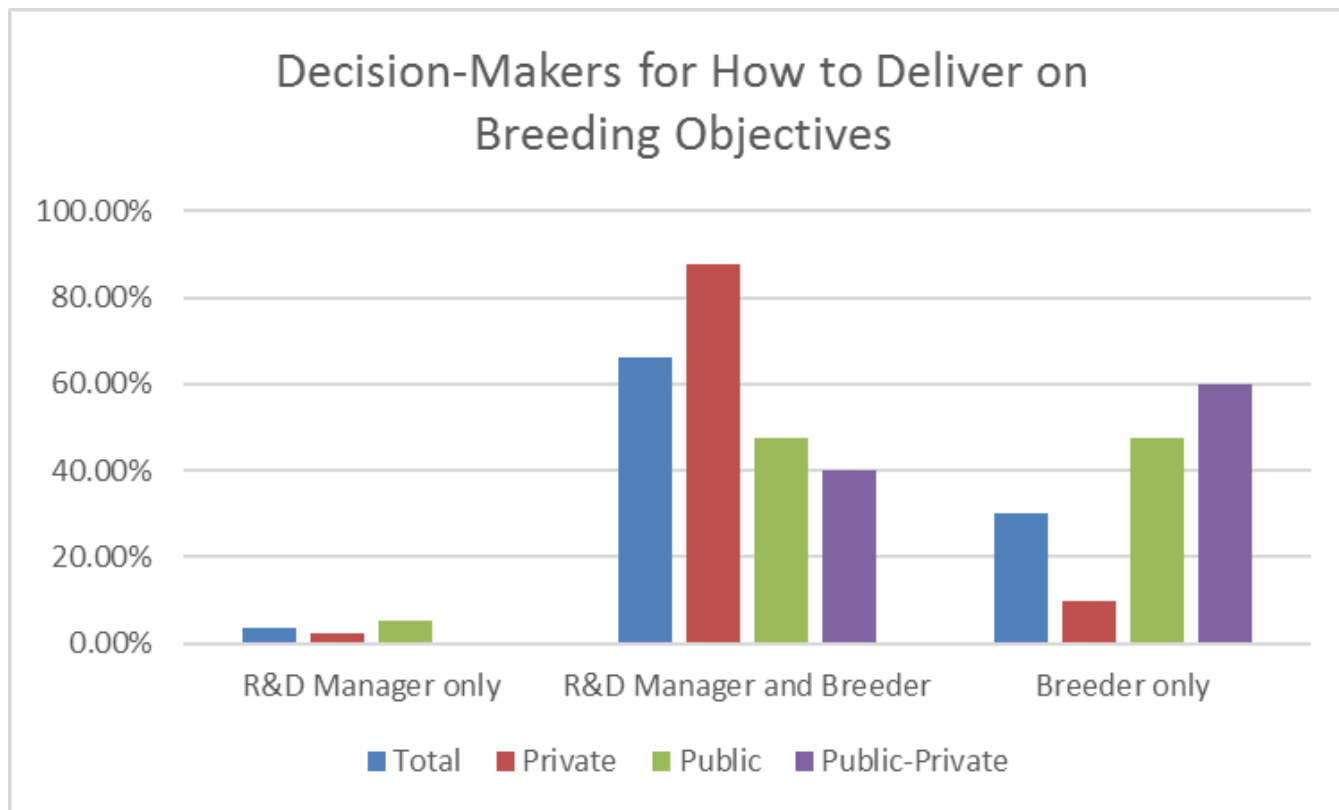
- Prioritization based on value creation
 - Increased growing area (“market share”)
 - Increased income

Markets and Types of Varieties



- Significant differences between public and private organizations

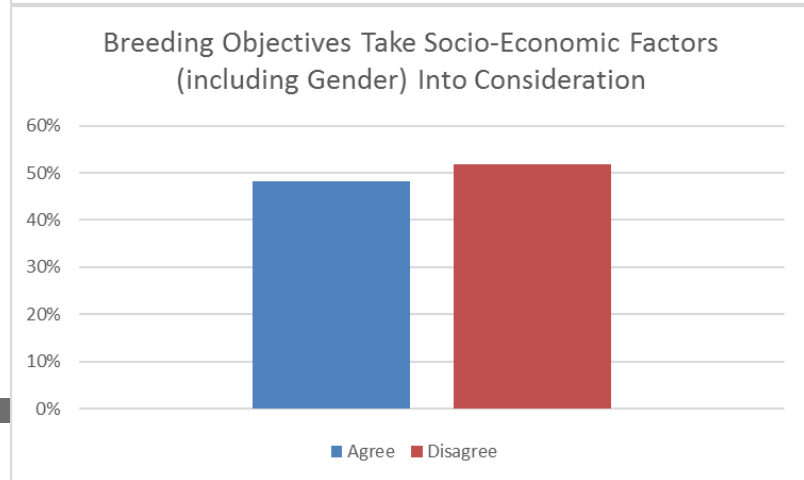
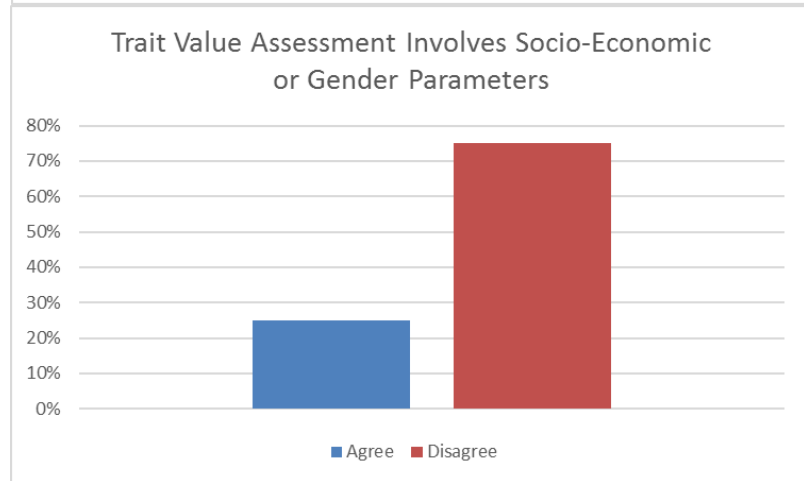
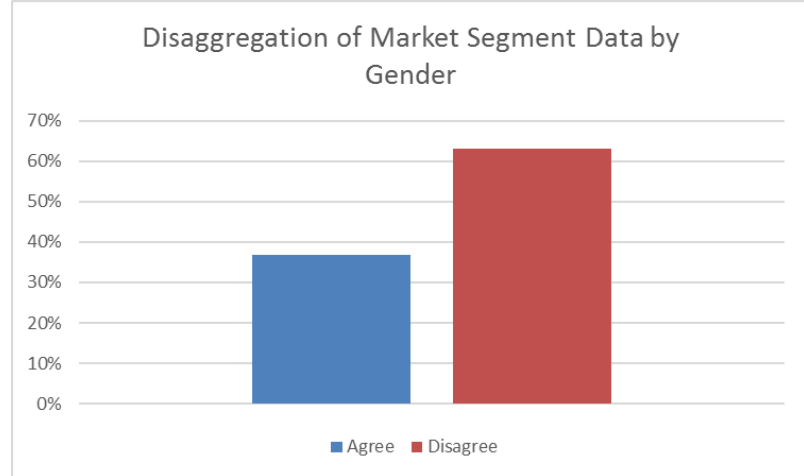
Breeding Technologies and Approaches



- Significant differences between public and private organizations

Consideration for Gender

- Of all the factors that were presented, gender is the least taken into consideration, overall



Conclusions & Learnings

- Setting breeding objectives and priorities almost unanimously recognized as desirable / good practice
- Facts often lagging behind intentions
- Numerous “parasitic” elements / constraints
 - Changing market “pull”
 - Operational constraints
- Most successful breeding programs generally had / have clear and persistent objectives and priorities

Conclusions & Learnings

- Not obvious / certain if there are best practices
- Market knowledge
- Realistic ambition
- Significant improvements / deliveries