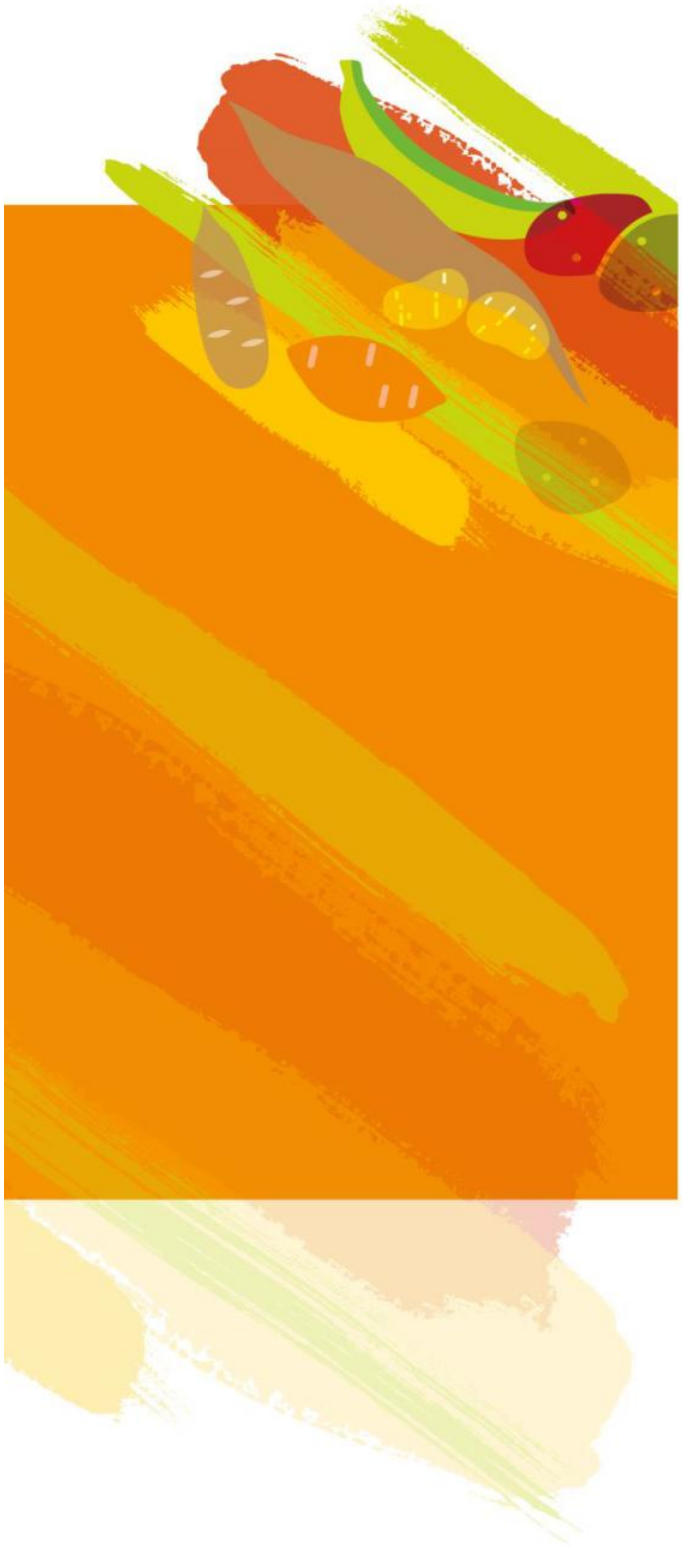

RTB Workshop Report

Hackathon to develop market segments and product profiles for breeding programs

Michael Friedmann, Samuel Storr and Graham Thiele

N O V E M B E R 2 0 2 0

RESEARCH PROGRAM ON Roots, Tubers and Bananas

CGIAR Excellence in Breeding Platform

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RTB Workshop Report

Hackathon to develop market segments and product profiles for breeding programs

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www.rtb.cgiar.org/

Contact:
RTB Program Management Unit
International Potato Center (CIP)
Apartado 1558, Lima 12, Peru
rtb@cgiar.org • www.rtb.cgiar.org

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Hackathon to develop market segments and product profiles for breeding programs

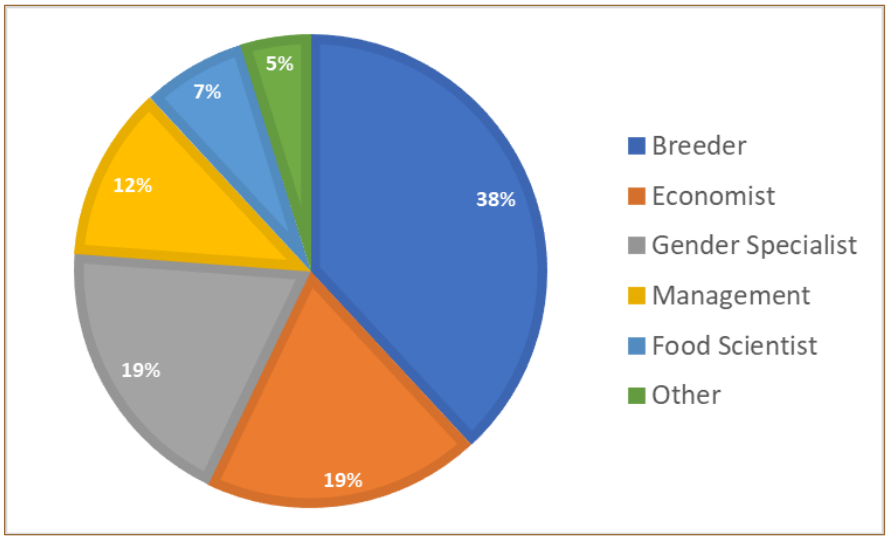
1 Introduction and objectives

On 18-19 November 2020, an online hackathon was held for members of the RTB Breeding Community of Practice (RTB-BCoP) with the following objectives in mind:

1. To provide recommendations to breeding teams for improving market segment definitions and product profiles and to serve as a model for others including:
    - How to identify market segments for clonal crops-possible sources of information, what assumptions might work, etc.
    - How to improve product profiles: what is the prioritized trait set that best fits the associated market segment.
2. To share knowledge of processes and concepts on development of the above.

There were 42 participants in total comprised of a mix of breeders, economists, gender specialists and food technologists from 10 organizations and programs (Figure 1; Annex 1).

Figure 1. Distribution of participants by discipline



On the two-day agenda, participants first heard from Peter Coaldrake (CGIAR Excellence in Breeding Platform – EiB) on the practical application of market segments and product profiles in breeding programs, followed by Vivian Polar (RTB / Gender in Breeding Initiative) on the Gender Plus (G+) tools for incorporating gender in breeding program targets.

Four case studies were then presented representing cassava in Nigeria and Southeast Asia, sweetpotato in Uganda and yam in West Africa, according to a standard template designed to demonstrate the process by which market segments were identified and product profiles were derived.

On the second day, participants broke out into groups by case study, with groups being pre-selected to provide multi-disciplinary input to each case study. A predefined checklist was provided to collect feedback for each case presented (Figures 4 & 5). This checklist was designed to assess the process, coverage, clarity and relevance of the market segment and linked product profile presented, in order to generate knowledge to improve these two processes within the RTB-BCoP and beyond.

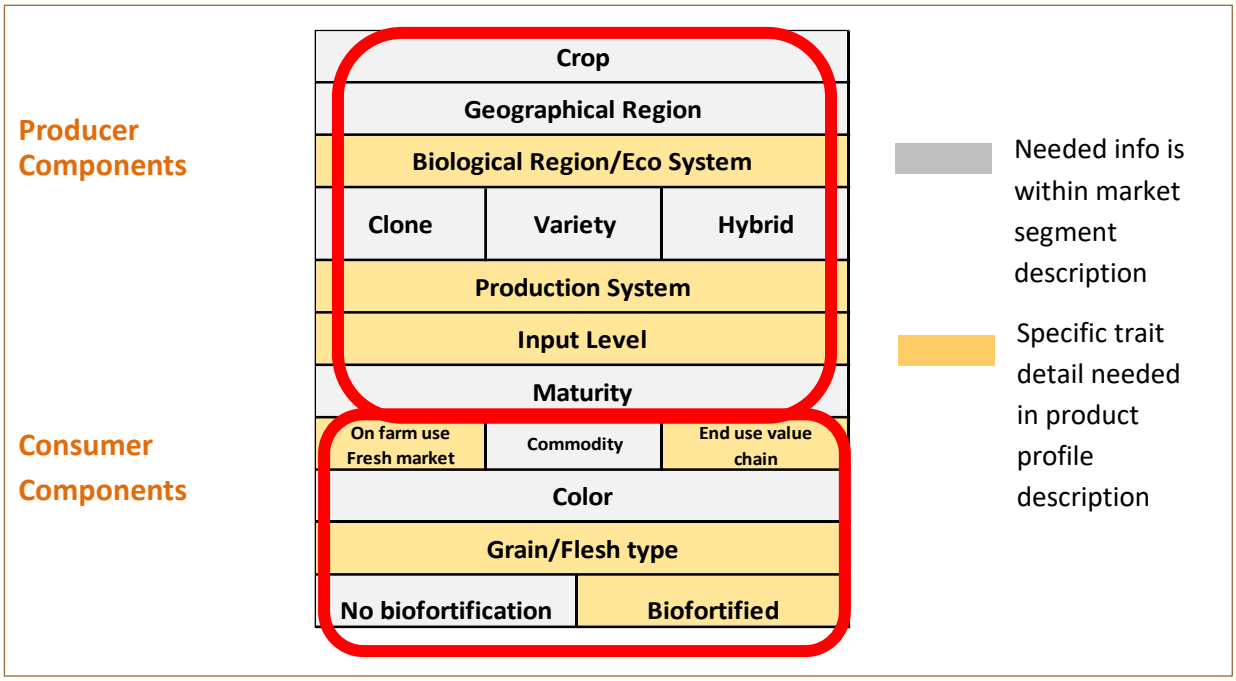
This workshop report briefly outlines the concepts presented, general findings, an overview of feedback to each case study, and finally the main recommendations and next steps identified by the organizers.

2 Key concepts

2.1 Market segments and product profiles

In order to define the market segments that a breeding program is targeting, the basic agronomic, demographic and economic characteristics of the geographic region are first identified. Next, producer components related to the production of the crop and consumer components related to quality traits are identified to form the basis for describing market segmentation (Figure 2). Upon defining the traits and their desired levels to address the components in the market segment, a corresponding product profile is developed following a standard template (Figure 3A & 3B).

Figure 2. Producer and consumer components of the market segment.



Source: Peter Coaldrake / EiB

Figure 3. A) Quantity and B) quality traits within the product profile that correspond to producer-consumer components of the market segment

A) Quantity traits

				Product Profile Market Segment 1		
Crop						
Geographical Region						
Biological Region/Eco System						
				Trait	**Scale**	**Min Score**
			Key trait 1			
			Key trait 2			
			Key trait 3			
			Key trait 4			
			Key trait 5			
Clone	**Variety**	**Hybrid**				
Production System						
				Trait	**Scale**	**Min Score**
			Key trait 1			
			Key trait 2			
			Key trait 3			
Input Level						
				Trait	**Scale**	**Min Score**
			Key trait 1			
			Key trait 2			
Maturity						

B) Quality traits

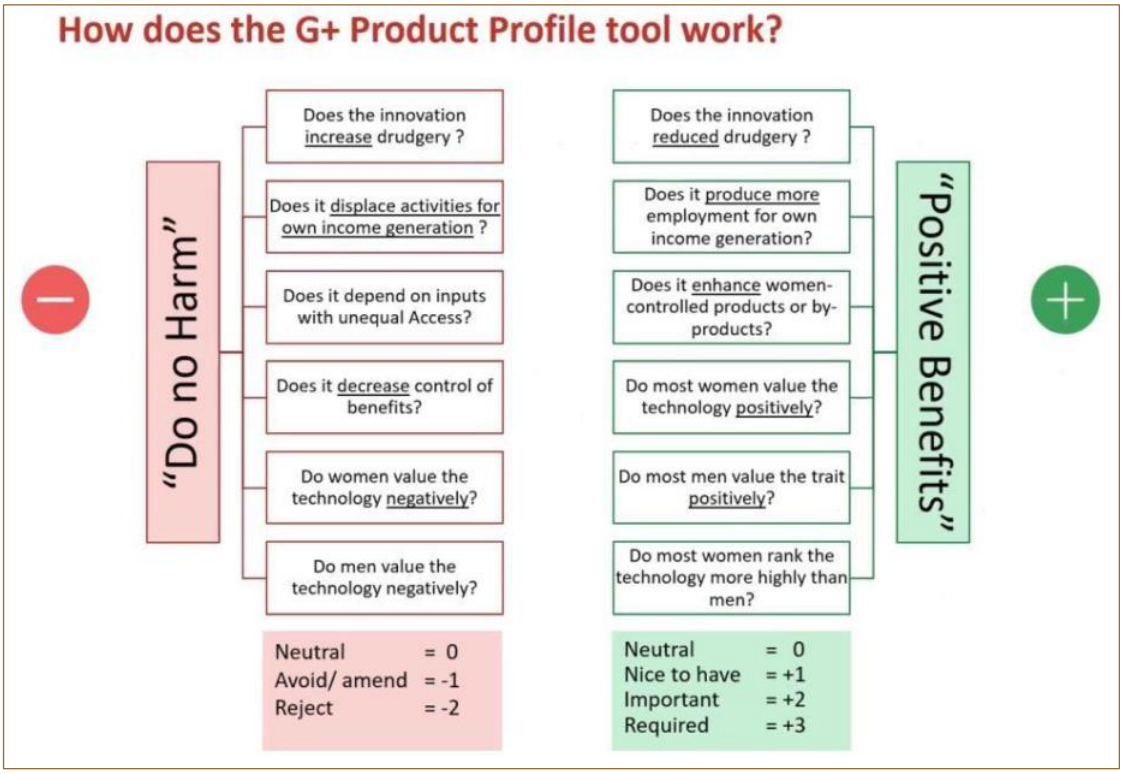
On farm use Fresh market	**Commodity**	**End use value chain**		**Commodity**		
Color						
Grain/Flesh type						
				Trait	**Scale**	**Min Score**
			Key trait 1			
			Key trait 2			
			Key trait 3			
No biofortification		**Biofortified**		No		

Source: Peter Coaldrake / EiB

2.2 The G+ Product Profile Query Tool

The G+ Product profile query tool (Figure 4) is used to evaluate the characteristics of varieties proposed in the product profile with respect to acceptability and benefits to gender-differentiated end-users.

Figure 4. How does the G+ Product Profile tool work?



Source: Vivian Polar / RTB

Using the G+ Product Profile query tool, each trait can be assessed and scored according to potential negative ("do no harm") and positive benefits according to a consistent set of categories: drudgery, income, inputs, control over benefits, value to each gender. In addition to this G+ scoring incorporated in the product profile, gender-specific traits can also be incorporated in the product profile.

3 Hackathon structure and dynamics

To structure the groupwork and feedback generated, a set of six questions was used as a checklist to evaluate the process to develop and describe the market segment presented in the case studies (Figure 5).

Figure 5. Checklist to evaluate market segments in working groups

1. **Is there a well described and standardized process to gather and use information to define the production component of the market segment?** Yes/No/Partly
2. **Do the production components adequately define the TPEs to be targeted and their associated production systems?** Yes/No/Partly
3. **Is there a well described and standardized process to gather and use information to define the consumer component of the market segment?** Yes/No/Partly
4. **Do the consumer components describe the main areas related to the use and marketing of the crop?** Yes/No/Partly
5. **Does the market segment description capture the size and relevance of the market including impacts on poverty, food security and/or social inclusion?** Yes/No/Partly
6. **Have gender implications of the market segment been adequately considered?** Yes/No/Partly

Likewise, a set of four questions was used as a checklist to evaluate the associated product profile presented in the case studies (Figure 6).

Figure 6. Checklist to evaluate product profiles in working groups

1. **Do the quantity traits in the product profile correspond to the production component in the market segment?** Yes/No/Partly
2. **Do the quality traits in the product profile correspond to the consumer component in the market segment?** Yes/No/Partly
3. **Are the traits in the product profile clearly defined in a measurable way (scale)? Is the scale clear and easily understood?** Yes/No/Partly
4. **Have gender implications of traits been adequately considered?** Yes/No/Partly

In addition, the groups also discussed what worked and what could be improved in the process to define market segments and associated product profiles.

4 Findings

4.1 General findings - more data required!

The four presenters provided varying strategies to collect data that informed the development of the market segments. For defining the producer components, the geographic areas selected for each crop encompassed particular agroecological zones that spanned a number of countries or different regions of the same country. However, gaps were identified in the available data, such that more agroecological and climatic data was needed to properly segment the markets in the selected geographies, as the proposed market segments were found to be too broad. Moreover, the proposed market segments encompassed different production schemes for the crop, that would necessitate a further segmentation, as the requirements for a variety would probably differ.

For the consumer components, the breeding programs used a variety of data sources to identify processor and consumer requirements, however gaps remained to characterize clear market segments. As the crops presented are usually consumed in quite different forms, this would necessitate a further segmenting of the proposed market segments by adding a usage component to the process of their definition. In addition, more data is required to capture the size of such market segments and their economic and livelihoods importance.

Gender disaggregated surveys were frequently used to determine if the market segments and associated product profiles could be affected by gender considerations. However, gender differences did not greatly affect trait preference rankings. Nevertheless, the differentiated involvement of men and women in production, processing and consumption in different regions provided valuable insights. Better and more explicit integration of the G+ tools, particularly the element of “do no harm” (such as when assessing drudgery concerns in production and processing), could help to better segment markets in the future. Input from food scientists was also needed to help define the traits to address the various uses of the crops for different food products.

While dominant market varieties may currently be adopted across broad agroecological regions, from the discussions it became apparent that defining more segmented markets would result in more focused breeding products better attuned to particular production schemes and consumption behaviors.

Overall, there was a lack of available demographic and economic information, disaggregated by gender, to identify the size, importance and potential impact of market segments. There was a general agreement that breeders need assistance from economists and other social scientists to generate such information in order to develop and define relevant and effective market segments. Consequently, this negatively impacted the ability of breeding programs to identify well-defined market segments, even when there was a clear process to do so. Across all case studies this highlighted the challenges of striking a balance between developing smaller and more focused market segments, and the total number of market segments that a breeding program can tackle while still creating significant impact. Again, inputs from economists and other social scientists would be essential to help find such a balance.

The wealth of information to identify customer and producer segments, from the vast trait ontologies available to each breeding program, supports breeders to refine and prioritize the number of traits being targeted in each product profile. To a large extent, trait definitions, scales and measurement protocols were judged to be strong aspects of the breeding programs presented.

In the breeding process, early engagement with end users, the formation of strong multidisciplinary teams, and the ability to include customer preference survey data and some participatory selection methods from an early

point in the stage-gate process were considered strong practices. Early engagement with NARS was also considered a best practice, both as a source of market intelligence but also due to their role in shaping demand. Moreover, with increasing roles envisioned for NARS partners in final variety development as well as variety testing and dissemination, it becomes critical for the product profiles to be designed jointly between the NARS and CGIAR breeding programs.

Overall, there is a clear need to use a consistent approach to define and describe market segments and to create a unique product profile for each market segment. Likewise, there needs to be a robust process to identify the market segments that offer the greatest potential for impact.

4.2 Case study 1: Yam in West Africa

Targeting a contiguous region of five countries from Cote d'Ivoire to Nigeria, seven mega-environments were identified and prioritized by two market segments: white yam for fresh consumption (both domestic and for export), and water yam for processed products.

On this basis, using available studies, a regional consultant and a study survey of trait priorities conducted with 153 farmers in Nigeria, three product profiles were derived to serve the market segments:

- An early maturity white yam, adapted to southern Guinea Savannah, less likely to depend on staking, and suitable for fresh and processed markets.
- An intermediate to late maturity white yam adapted to humid forest and derived Guinea Savannah, also suitable for fresh and processed markets.
- A greater water yam with anthracnose adopted to humid forest and derived savannah for the processed markets.

FAOSTAT data was also used to assess the market segment value and poverty impact potential.

The challenges faced by the team included the following:

- A lack of information on regionally diverse consumer trait preferences.
- The volume and boundaries of the markets were not well-characterized.
- Tools are needed to incorporate feedback on market requirements.
- A need for tools to translate qualitative market preference into quantitative screening targets.

Due to circumstances arising from the Covid-19 pandemic, a planned social science survey was not carried out; in the future, engagement with social scientists would be sought to better understand trait preference variability at the consumer, market and farmer level. As the program works from an ontology of around 180 traits, new information is helpful to better refine the number of traits assessed, which is compared against available genetic variability. The information requirements to identify market segments and derive product profiles placed too great a burden on breeders; more specialization and participation of a broader multidisciplinary team is required in the future.

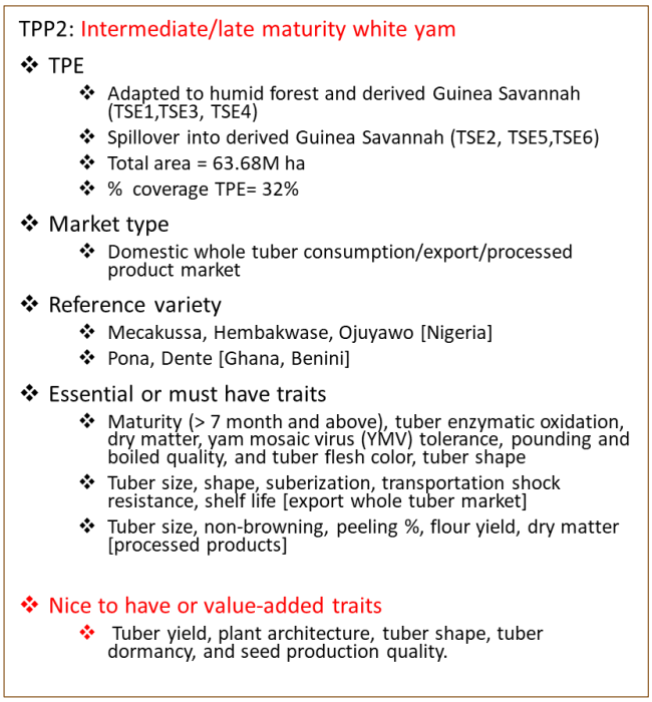
The market segment (1) selected for review by the working group is shown in Figure 7

Figure 7. Market segment for yam

Fresh whole tuber consumption market in West Africa			
Market Segment Desciption:	These are domestic open or premium export fresh whole tuber markets to consume yam in the boiled, roasted, fried form and as porridge/pounded as well as ojojo (cookies made from water yam).		
Agro-Ecological Zone(s) in the market segment:	Humid forest and derived Savannah	Southern Guinea Savannah	
Countries in the Market Segment	1) Nigeria	2) Ghana	3) Côte d'Ivoire
	4) Benin Republic	5) Togo	
Market Segment Data	Total Hectares of Crop grown in the market segment:		6,736,890 Ha
	Average Yield/Hectare of Crop across market segment:		5.5-17.5 t/ha
	Current Average Selling price of Crop (Local Currency/Kg):		Average tuber size whole sale price (Naira/60 tubers): 1) White yam 6,000-10,000 in Dec/Jan and 15,000-20,000 in March/May, 2) water yam 2,500-4,000 in Dec/Jan and 7000-8000 in March/May
	Estimate of the % of crop sold versus consumed on farm/in household		60% sold
	Total population of the market segment		180 million
	Number of male farmers growing the crop in the market segment		14,767,110
	Number of female farmers growing the crop in the market segment		13,042,890
	Estimate of the % of total population living in poverty in the market segment		68%
	Estimate of the % of farmers living in poverty in the market segment		34%

The associated product profile is shown in Figure 8.

Figure 8. Product profile yam



The key points of group feedback are summarized in Tables 1 & 2. Overall, the following lessons emerged from the discussions:

- A multi-disciplinary team needed for process

- Agroecological zones should be more specific
- Need to collect data on poverty impacts
- A Usage Component should be added to the market segment template
- The market should be further segmented into different consumer preference categories
- Available gender data should be incorporated and used to evaluate trait rankings

Table 1. Summary of checklist feedback for the yam market segment

Market Segment					
1	2	3	4	5	6
Process for Producer Component	Producer Components Define TPEs	Process for Consumer Component	Consumer Components Describe Use	Market Segments Captures Size	Gender Implications in Market Segment
YES	PARTLY	PARTLY	PARTLY	NO	NO
Agroecol zones well described, but process robust?	Highlight complexity of market- requires more focus	Surveys on use of crop for products useful	Need to add category of Use of Crop to market segment Components	Very difficult to satisfy this parameter- too many issues and missing data	Gender data on number of women farmers only
Market Segment too broad, need to make more specific	Need to find balance between breaking down & keeping broad	All uses bundled together into one market segment-too complex	Many other issues need to be considered (regional, gender preferences, maturity)	How many resources is it worthwhile to invest to first get all this data	Breeder needs assistance from social scientists

Table 2. Summary of checklist feedback for the yam product profile and general comments

Product Profile				General Comments	
1	2	3	4	1	2
Quantity Traits Correspond to Producer Component	Quality Traits Correspond to Consumer Component	Traits Clearly Defined and Measurable	Gender Implications of Traits Adequately Considered	What Worked About the Process	What Could be Improved About the Process
PARTLY	YES	YES	NO		
Traits stretched over too wide a geography	Market segment too broad, so traits may not correspond to consumer component	Scales not presented but are available and used	Data exists on gender preferences, but not yet used to inform product profile	Agroecol zones well described	process to segment the market needs more focus
If list of traits too narrow, then how to breed for the market segment?	Strong focus on consumer and processor preferences	Use index and also proxy traits		Emphasis more on quality traits	How to bring a diverse team together-too many factors. Data needed not easy to get

4.3 Case study 2: Cassava in Southeast Asia

Targeting southeast Asia (SEA), four ecological regions were identified across six countries, with a single market segment of industrial cassava production targeted across all regions, due to the high value of industrial cassava to farmers, high rate of adoption of improved varieties and potential to add value through disease resistance. The product profile introduced is for a cassava variety that meets needs for industrial uses while offering resistance to Cassava Mosaic Disease, to which the three dominant varieties in the region are vulnerable.

The market segment and product profile definition were developed using input from team members and a large-scale survey of cassava-growing households in Vietnam and Cambodia, along with surveys and reports.

The market segment selected for review is shown in Figure 9.

Figure 9. Market segment Cassava SEA

Market Segment Definition			
Market Segment Desciption:	**Cassava varieties for industrial use** with high yield and dry matter, good germination, and high disease and insect resistance (e.g., CBB, CMD, CBSD, thrips and whitefly). Provide NARS with improved breeding populations.		
Agro-Ecological Zone(s):	Tropic worm, wet, moist and montane		
Countries in the Market Segment	South East Asia including Laos, Cambodia, Vietnam, Thailand, India and Myanmar	Information source?	
Breeding Zone Estimates	Total Hectares of Crop grown in the market segment:	FAOSTAT, 2018, region sum	3.7 million
	Average Yield/Hectare of Crop across market segment:	FAOSTAT, 2018 (average)	20.1 ton
	Average Income/Hectare (USD)		
	Number of Farmers Growing This Crop		5 million
	Average Income of Farmers (USD) Growing This Crop		
Current Market Description:	-- Produce **~30%** of the global cassava production. -- In 2019, cassava supply contracted as a result of **drought and CMD**. This resulted in high fresh root prices for farmers, and affected the competitiveness of the industry against substitutes. -- Matured commercial model in Thailand and Vietnam lead to the rapid increase the cassava production in Laos, Cambodia and Myanmar.		
Explain the value of applying breeding resources to breed for this market segment	-- There is an extremely **high rate of adoption** of improved cassava varieties in this region (e.g., Vietnam, 85%). -- The significant difference between susceptible and resistant varieties will faclitate the adoption of new varieties. -- Strong breeding programs in Thailand and Vietnam, but need **modernization** for increasing genetic gains.		

The product profile used to target this market segment (see Figure 10) would meet the key producer traits identified by the survey, which include factors such as germination, vigor, plant type, lodging, root rot resistance and yield, but also with a preference for earliness to improve the price of the crop or avoid losses. Producers were known to prioritize high starch content and starch stability to enable the year-round operation of factories; starch quality is ensured during processing. It was anticipated that CMD resistance, alongside other forms of resistance, would offer immediate value to farmers, while the survey conducted did not identify gender differences in the uptake of new varieties.

Figure 10. Product profile Cassava SEA

Crop				**Cassava**
Geographical Region				**South East Asia**
Biological Region/Eco System				
		Trait	Scale	Min Score
	key trait 1	CMD	MAS, yes or no; 1 to 5; 1, good	yes; <=2
	key trait 2	CBB	1 to 3; 1, good	<=2
	key trait 3	thrips	1 to 3; 1, good	<=2
	key trait 4	mite	1 to 3; 1, good	<=2
	key trait 5	CBSD	MAS, yes or no	future
	key trait 6	whitefly		future
	key trait 7	CWBD		future
Clone	**Variety**	**Hybrid**		**Clone**
On farm use Fresh market	**Commodity value chain**	**End use value chain**		**end use value chain**
Production System				**industrial use**
		Trait	Scale	Min Score
	key trait 1	fresh color	1 to 3; 1, white	1
	key trait 2	root type	1 to 5; 1, good	<=2
	key trait 3	starch content	10-40%	>25%
Imput level				**medium and high**
Maturity				**NA**
Skin Color (brown, white)				**white /brown**
Grain/Flesh type				**white**
Biofortification				**no**
Production/Multiplication Traits				
		Trait	Scale	Min Score
	key trait 1	germination	0-100	>85%
	key trait 2	vigor	1 to 5; 5, good	>=4
	key trait 3	plant type	1 to 5; 1, good	<=2
	key trait 4	lodging	1 to 5; 1, good	<=2
	key trait 5	root rot	0-100%	<=10%
	key trait 6	yield	ton/ha; % checks	>=25; >105% of checks

The challenges faced by the team included:

- A lack of available and disaggregated data on household poverty values to determine the impact of the market segment.
- A lack of data on production trait needs across the different environments.
- A need for better information from climate scientists.
- A need for better understanding of how producer preferences are differentiated between regions. How to strike the right balance between level of granularity in the environment targeted and breeding program resources.

The key points of group feedback for the cassava SEA case study are summarized in Table 3 and Table 4. Overall, the following learnings emerged from the discussions:

- Include climate experts to better segment market agroecological zones.
- It may be necessary to consider differences in agricultural practices between regions.
- Evaluate needs of household consumption as separate market segment.

- Gender preferences might be apparent for household consumption and related to farm size.
- Processing traits were well defined in the product profile.
- Access to a multidisciplinary team was a key strength.

Table 3. Summary of checklist feedback for the cassava SEA market segment

Market Segment					
1	2	3	4	5	6
Process for Producer Component	Producer Components Define TPEs	Process for Consumer Component	Consumer Components Describe Use	Market Segments Captures Size	Gender Implications in Market Segment
YES/PARTLY	PARTLY	YES/PARTLY	YES	PARTLY	PARTLY
Data from FAOstat and collected by the team	Not enough data to support the definition of TPEs-work with climate experts	Surveys on consumer preference, considering on-farm consumption	96% go to processing	Value of the product and its export value are known	Considered, but no sign of adoption differentiation noted between men and women
Survey to capture information on costumer preference	There is more diversity of preferences for on-farm use of cassava	Inclusion of national programs can be of great value for more reach	small scale vs large scale farmer differences need to be considered	Need to disaggregate because data are very general for the region; need info on poverty levels	Family farming: No intrahousehold data available to capture preference differences (lack of resources)

Table 4. Summary of checklist feedback for the cassava SEA product profile and general comments

Product Profile				General Comments	
1	2	3	4	1	2
Quantity Traits Correspond to Producer Component	Quality Traits Correspond to Consumer Component	Traits Clearly Defined and Measurable	Gender Implications of Traits Adequately Considered	What Worked About the Process	What Could be Improved About the Process
YES	YES	YES	PARTLY		
For processing; Quantity traits included: e.g. yield, DM content, plant height; also germination and stem thickness	White color, starch component and size	Traits to measure are clear for breeders	Market component in SEA different from that in other regions, no big difference regarding gender differences	Multidisciplinary team; importance of inclusion of social scientists. Meetings held several times throughout the year	Better coordination of meetings (due to Covid-19)
Separate breeding pipelines for separate regions are needed	There is a high rate of adoption of new varieties	Trait ontology available; same understanding of traits for different partners	Need to document the 'lack' of gender differences; some gender differences during harvesting process at small scale level	Surveys provide systematic data	Need to include environmental information (input level, soil type…) for a better characterization of TPEs

4.4 Case study 3: Sweetpotato in Uganda

Focusing on Uganda, an orange-fleshed sweet potato (OFSP) product profile was presented for a market segment spanning three major ecologies with varying challenges in terms of disease and pest pressures, along with drought. The OFSP market in this region is 95% focused on boiled consumption and 5% processing use, and the breeding program is focused on varieties that meet these constraints, particularly the need for vine vigor and resistance to sweet potato virus disease (SPVD), while adding value to replace the NASPOT 8 orange-fleshed variety (Figure 11).

Figure 11. Market segment sweetpotato East Africa

Section #3: Analysis of current market associated with Product Profile			
Agro-Ecological Zone:	East Africa		
Market Segment Description:	Orange-fleshed sweetpotato for food use (95%) and processing use (5%)		
Geographic (Country) - Ranked by Country Surface Area	1) Tanzania (766k)	2) Uganda (363k)	3) Ethiopia (216k)
	4) Rwanda (181k)	5) Kenya (64k)	6) Burundi (62k)
Breeding Zone Estimates:	Surface Area (Ha):		120k
	Yield/Hectare		10 t/ha
	Average Income/Hectare (USD)		
	Number of Farmers Growing This Crop		
	Average Income of Farmers (USD) Growing		

Much of the development of the product profile was led by a NARS partner, the National Crops Resources Research Institute (NaCRRI). Due to a lack of data, the types of market segment segregation were not outlined, instead combining production and value-chain components.

Three studies were available to assess consumer and producer preferences from different perspectives: an economic trait preference study conducted through EiB by AbacusBio that identified trait preferences by customer segment (producers, vine multipliers and consumers) and calculated an economic trait value, an RTBFoods study that ranked traits according to dry, boiled and processing needs, along with a Tricot sensory study pilot into customer preferences.

The available studies provided a good framework to assess the consumer component. These studies provided gender-disaggregated data, however differences in gender preferences did not necessarily affect overall trait rankings. Gaps to cover are seed-related traits as a priority, along with more data on multi-purpose varieties.

The combination of information from different approaches helped to better define the priority traits of interest from the large selection available to the breeding program, which were then incorporated into screening at the elite clone stage. In the product profile, these were well classified between basic (must have) traits and value-added, and the scales by which they could be assessed were clear (Figure 12).

Figure 11. Product profile sweetpotato East Africa

Product profile	Basic Traits	Value Added Traits	Benchmark variety
Orange fleshed sweetpotato	High dry matter content 32% Moderate resistance to Sweetpotato virus disease (SPVD) Moderate resistance to Alternaria blight disease (ALT)	Tolerance to sweetpotato weevil (SPW) Increase beta carotene (200 microgram per gram on dry weight basis) Improved shape and smoothness, storability	New Kawogo (SPW) Ejumula (B carotene) Beauregard (Root shape)

Challenges met by the program included:

- A lack of basic data on the market segment that prevented full characterization of the target area, particularly in terms of gender disaggregation.
- The information available for adoption of different varieties is not generic nor easily comparable.
- Although gender disaggregated data is available, the G+ tools are not yet integrated.

The key points of group feedback for the sweetpotato East Africa case study are summarized in Table 5 and Table 6. Overall, the following learnings emerged from the discussions:

- The breeding program could benefit from greater involvement of social scientists and food scientists.
- More data on agroecological zones is needed to properly segment markets.
- Various consumer studies with different approaches provide valuable information on consumer component and traits.
- The market segment template needs to be expanded to better capture consumer components
- The full value chain should be better evaluated to adequately characterize the market segment and associated traits.

Table 5. Summary of checklist feedback for the sweetpotato East Africa market segment

Market Segment					
1	2	3	4	5	6
Process for Producer Component	Producer Components Define TPEs	Process for Consumer Component	Consumer Components Describe Use	Market Segments Captures Size	Gender Implications in Market Segment
PARTLY	PARTLY	PARTLY	PARTLY	NO	PARTLY
Not all data for breeding zone estimates available	No data available of performance of variety by TPE regions	RTBFOODS (sensory and field based) / Abacus bio study (field based)/TRICOT (field based) provide a framework to access the consumer component and the market	There is a process but the template does not capture consumer components; suggest modification of templates	Need a clear definition of expected impact of the breeding program on the target population-welfare or income impacts	Need to link G+ tools to EiB templates
Data generic, data should be more disaggregated; Quality of available secondary data questionable	Production components for SP in general should apply for OFSP	EiB templates do not capture information on consumer component; market segment disaggregated level needs to be defined		Types of market segment (demographic, physiographic, behavioral and geographic segmentation) not defined; size not determined	Data available from Abacus bio and RTBFoods project but not included in template

Table 6. Summary of checklist feedback for the sweetpotato East Africa product profile and general comments

Product Profile				General Comments	
1	2	3	4	1	2
Quantity Traits Correspond to Producer Component	Quality Traits Correspond to Consumer Component	Traits Clearly Defined and Measurable	Gender Implications of Traits Adequately Considered	What Worked About the Process	What Could be Improved About the Process
PARTLY	YES	YES	PARTLY		
Production component is represented more in macro level based on a combination of several varieties	Market segment defined as fresh root market – need to review existing studies to establish connections of quality traits with consumer composition	Minimum threshold of trait scale? Are there trait weights and how are priority traits defined?	Considerations exist that address gender but were not explicit	Classification of must-have and value-added traits were done well	Understanding of the full value chain with different needs for various actors
Data on multi-purpose varieties not reflected; Need for inclusion of important seed-related traits				Opening up to social scientists/ economists with better understanding of markets as well as food scientists to contribute to PP	

4.5 Case study 4: Cassava in west and central Africa

In West and Central Africa, a market segment was presented spanning three humid agro-ecological zones that cut across five countries, with a focus on Nigeria (Figure 13). The product profile introduced was for an industrial use cassava variety, one of four categories of cassava products in the region, with a focus on providing high yield, dry matter content and favorable plant type, but with a particular focus on processed product quality (Figure 14).

Although the compiled data provided a good starting point to define the market segment, more was needed to include basic factors such as number of farmers living in poverty, at a broader level to understand what insight this market information can provide on potential demand for new varieties.

Whereas previous work had focused on geographic segmentation, in this year there was a much greater focus on identifying cassava quality requirements. Resources available to the breeding team included a multi-disciplinary team, spanning areas such as gender science, seed systems, food science, pathology, entomology and agronomy, along with close involvement from the National Root Crops Research Institute (NCRCI) of Nigeria. Social sciences expertise was consulted but this was considered to be the greatest area for expansion.

Figure 13. Market segment for cassava West Africa

Section #4: Market Segment Definition			
Market Segment Description:	Market Segment 1: Cassava for granulated and paste products (garri, attieke, fufu). This is the main market segment for West Africa and Central Africa that accounts for > 70 % of the region's production. Cassava roots are processed into garri, attieke, fufu, among others. Processing involves some degree of fermentation to remove cyanides and produce sour products that are either dry roasted or steamed.		
Agro-Ecological Zone(s) in the market segment:	Humid Forest	Derived Savanna	Northern and Southern Guinea Savanna
Countries in the Market Segment	1) Nigeria	2) Ghana	3) Sierra Leone
	4) Benin	5) Cote d'ivoire	6) other West and Central Africa regions without current CBSD pressure

Market Segment Data	Total Hectares of Crop grown in the market segment:	7885805.7
	Average Yield/Hectare of Crop across market segment:	6.8
	Current Average Selling price of Crop (USD/ton):	104.5
	Estimate of the % of crop sold versus consumed on farm/in household	NA
	Total population of the market segment	225781085
	Number of male farmers growing the crop in the market segment	34873960
	Number of female farmers growing the crop in the market segment	36726944
	Estimate of the % of total population living in poverty in the market segment	34
	Estimate of the % of farmers living in poverty in the market segment	NA

The process presented focused on listening to users throughout the breeding process, with information from several different sources was considered by the team: an IITA cassava monitoring survey, the RTB Foods project which provides trait preferences per group (producer, processor and consumer by gender), surveys supported by NextGen cassava such as a gender-responsive trials and the AbacusBio- 1000minds survey of economic trait rankings. TRICOT trials were also used along with demand creation trials supported by BASICS (Building an Economically Sustainable, Integrated Cassava System). An effort was made to integrate the different sources of information, but this was highlighted as a challenge.

Through this combined knowledge it was possible, for example, to assess gender balance throughout the entire cassava value chain from production to consumption. Trait preference rankings were identified by different ethnic groups and in different agroecological zones, among which there is a wide diversity of processing methods and preferred food characteristics. Multiple use traits were also identified as a selection criterion, and novel consumer traits such as appearance being identified (Figure 13).

While multiple-use cassava products have a utility in reducing the number of product profiles required, trade-offs can be identified such as between high dry matter and food quality. While most cassava farmers produce the crop for both food and income, in the future it may be possible to explore use-specific varieties.

Figure 14. Product profile for cassava West Africa

Trait Category	Trait Name	Gender Relevant Trait	Enhanced Nutrition	Trait Measurement Units	Minimum trait requirement or threshold	Benchmark product to meet/or exceed
Yield	Fresh root yield (t/ha)	Yes	No	Fresh root yield (t/ha)	10 better than key checks	TMEB419, TMSI30572, TME1, TME2
Biotic Resistances	Cassava mosaic disease	No	Yes	1 - 5 scale; 1 = best	≤ 2	TMEB419
Consumer Traits	Dry matter content	Yes	Yes	Percentage dry matter after oven drying	> 30%	TMEB419
Value Chain Traits	Processed product quantity (garri, fufu)	Yes	Yes	Percentage product per unit of fresh roots	≥20%	TMSI30572
Consumer Traits	Processed product quality	Yes	Yes	Color, texture, taste	Bright colored product, non-sticky	TMSI30572
Agronomic Traits	Plant type	Yes	No	Levels of branching and height at first branching level (cm)	≤ 2 branching levels; ≥ 1m first branching height	

Challenges met by the program included:

- Limited data available to define the market segment, determine economic value and potential impacts of the breeding program on a gender-disaggregated basis.
- A need for greater involvement of social scientists.
- The difficulty of integrating the different sources of information from various approaches.
- A lack of clarity on how to further segment markets, while considering the number of product profiles that could be managed by the breeding program and providing high return on investment.

The key points of group feedback are summarized in Table 7 and Table 8. Overall, the following learnings emerged from the discussions:

- Although a wealth of data was generated by collaborations with social scientists, this was difficult to translate to concrete parameters in some cases.
- More economist engagement is needed to define market segment size and potential impact.

- Consumer components should be further segmented according to products produced. A more systematic integration of the G+ tools will likely identify areas for improvement of the processor segmentation.
- Gender considerations did not greatly affect trait preference rankings, yet women play important roles in production and processing, and therefore gender considerations provide valuable insights, for example in improving segmentation.
- The quantity traits presented could have been expanded to include traits such as disease resistance, in-ground storability and early maturity.
- The quality traits can be disaggregated further through engagement with food scientists to better define consumer traits, including for multi-purpose varieties.

Table 7. Summary of checklist feedback for the cassava West Africa market segment

Market Segment					
1	2	3	4	5	6
Process for Producer Component	Producer Components Define TPEs	Process for Consumer Component	Consumer Components Describe Use	Market Segments Captures Size	Gender Implications in Market Segment
PARTLY	YES	YES	YES	PARTLY	YES
Broad geography; Not entirely clear that there was a clear process to define the geographies for the production component; don't really know how to segment the markets yet	Variety release committees are concerned withTPEs, some varieties are more broadly while others more specifically adapted	Lots of efforts working with processors, consumers, etc	Need a better understanding of the size of these market segments in order to make decisions about breeding invesments (need more engagement of economists)	need for more clear information on these market sizes and how they translate to poverty, food security, etc. Impact is not really well-captured	Women are primary processors and this has been considered quite adequately by working with processors
Production component has been well dealt with in the past; emphasis on quality component.	Key AEZs are well covered by the breeding programs	the market segment is so broad since there are so many different processed products; need more efforts/resources to study the diversity of products in the region	But there's need for more clarity/structure	Breeding programs don't really address these broad goals. This market segment is the most important for food security, as there is a lot of home consumption	Along the value chain, still have a lot to do across countries in terms of being clear about gender considerations

Table 8. Summary of checklist feedback for the cassava West Africa product profile and general comments

Product Profile				General Comments	
1	2	3	4	1	2
Quantity Traits Correspond to Producer Component	Quality Traits Correspond to Consumer Component	Traits Clearly Defined and Measurable	Gender Implications of Traits Adequately Considered	What Worked About the Process	What Could be Improved About the Process
PARTLY	PARTLY	YES	YES		
Maybe the list of traits is a bit restrictive	Consumer traits may not be well enough unpacked with respect to the quality traits. Traits are quite aggregated. The traits are still being defined with food scientists	In general, very good job on scales; working on scales for quality traits	Gender relevance has been considered, but the best format to do this still unclear.	talking about this in new ways that we've not previously considered, so seems to be quite useful, as it provides structure to breeding efforts.	need to be a bit clearer with respect to methodology; how you move from market segment to product profile could be improved. Number of traits in the profiles may be too restrictive
Traits other than CMD, like mites and CBB are considered but not part of the selection index; CBSD for long term (pre-breeding)	Multipurpose varieties-Farmers already separate these. Dry matter stability is important as well as in-ground storability	People want to make gari and fufu from the same varieities. They may eventually choose different varieties if differences exist	G+ tool has been applied, but has not really led to modifications in the product profile. The chart may need to be updated based on findings from G+ exercise	Promotes interdisciplinary discussion; brings a balance between production and quality components; standardized format enables comparability between programs	There is a need to bring in socioeconomists to help clarify market segments (market sizes)

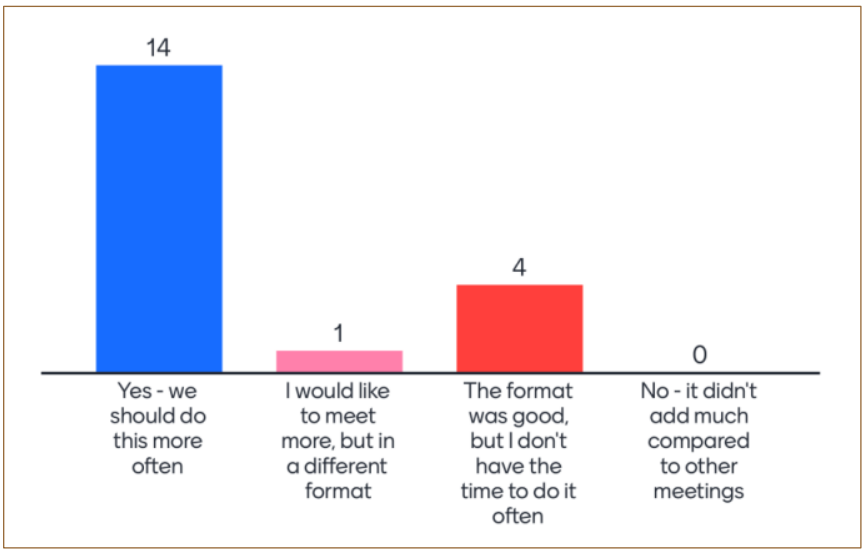
5 Recommendations and next steps

A number of common recommendations arose across the group work:

- Enhance interactions with economists and social scientists to define market segments in terms of size, value and impact.
- The agroecological zones used to define market segments are too broad and require more data to effectively sub-divide them according to differences in agricultural practices and climatic conditions.
- A crop usage component needs to be added to the market segment template.
- Greater clarity and guidance is needed to derive product profiles from defined market segments.
- Greater clarity and guidance is needed on how to translate different sources of data to trait rankings.
- The G+ tools show potential and should be integrated into the product profiles to enhance their relevance and effectiveness.

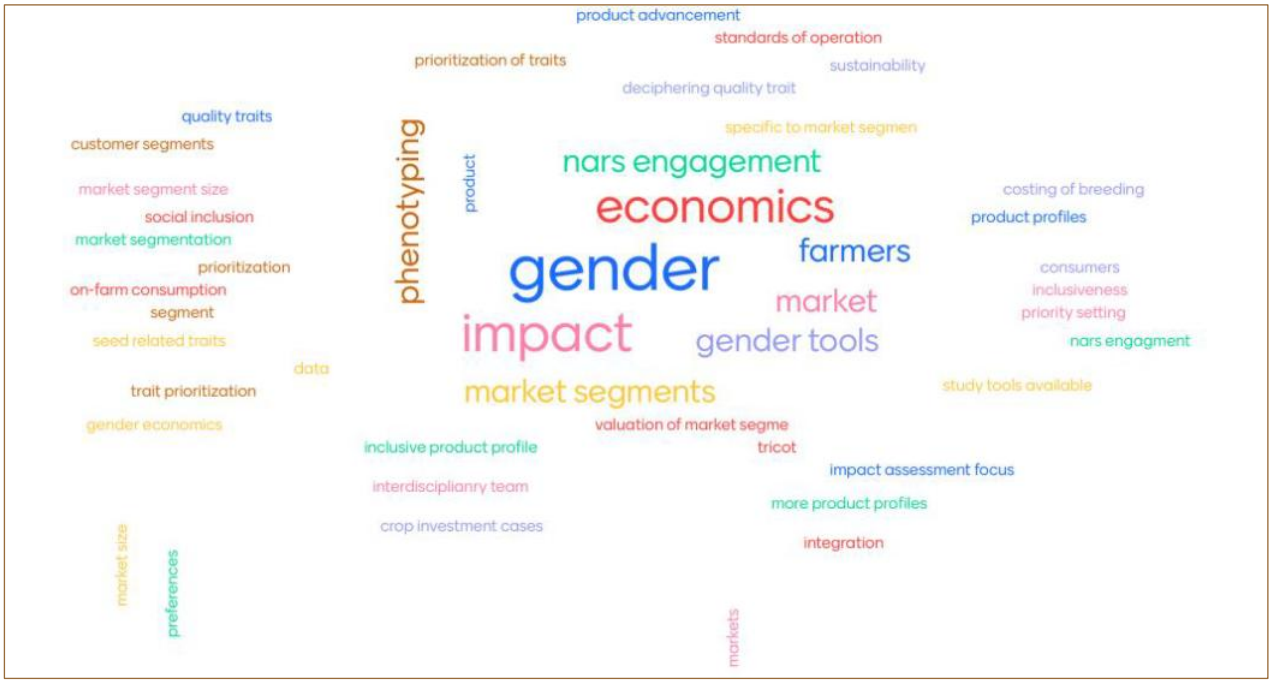
A live survey (Figure 15) conducted at the end of the workshop (with 21 participating) showed support for the hackathon format and an inclination to organize future meetings in this way, although time constraints are an issue for some.

Figure 15. Was this hackathon a good initiative by the RTB-BCoP?



Ideas for future hackathons, captured in a word cloud, showed a consensus around gender and economics/impact as important topics for future hackathons, along with specific hackathons focused on individual components such as market segmentation, customer segments, trait prioritization, etc., in addition to phenotyping, NARS engagement and the development of cross-functional teams. See Figure 16.

Figure 16. What topics should be discussed in the future?



6 Annexes

6.1 List of participants

Name	Institute	Position	Day 1	Day 2
Arega, Alene	IITA	Economist	Yes	Yam
Amah, Delphine	IITA	Lead breeder, plantain	Yes	Sweetpotato UG
Amele, Asrat	IITA	Lead breeder, yam	Yes	Yam
Andrade, Maria	CIP	RTB Flagship 2 leader, breeder, sweetpotato, Southern Africa	Yes	Sweetpotato UG
Ashby, Jacqui	Consultant	Consultant, gender specialist	No	Cassava SEA
Becerra, Augusto	Alliance of Bioversity & CIAT	RTB Flagship 1 leader, lead cassava program	Yes	Cassava SEA
Brown, Allan	IITA	Lead breeder, Mchare banana	No	Cassava SEA
Campos, Hugo	CIP	Director of Research	Yes	Sweetpotato UG
Carey, Ted	CIP-retired	Breeder, sweetpotato	Yes	Cassava Africa
Coaldrake, Peter	EiB	Consultant	Yes	Yam
Cole, Steve	IITA	Gender specialist	Yes	Yam
Dufour, Dominique	CIRAD	Senior food technologist	Yes	Cassava Africa
Egesi, Chiedozie	NRCRI, Nigeria	Director of the Nextgen Cassava Project	No	Yam
Forsythe, Lora	NRI	Associate Professor in Gender, Inequalities and Food Systems	Yes	Yam
Friedmann, Michael	RTB	Science Officer	Yes	Yam
Hareau, Guy	CIP	Social sciences lead	Yes	
Kanju, Edward	IITA	breeder, cassava, Eastern Africa	Yes	Cassava SEA
Kante, Moctar	CIP	post-doc	Yes	Cassava SEA
Kawuki, Robert	NARO, Uganda	Lead breeder, cassava	Yes	Cassava Africa
Kulakow, Peter	IITA	Lead breeder, cassava	Yes	Cassava Africa
Lindqvist-Kreuze, Hannele	CIP	Breeding Lead, DI1.1 cluster leader	Yes	Cassava SEA
Marimo, Pricilla	Alliance of Bioversity & CIAT	Gender specialist	Yes	Cassava Africa
Mayanja, Sarah	CIP	Gender specialist	Yes	Sweetpotato UG
Mendes, Thiago	CIP	Lead breeder, potato	Yes	Yam
Mignouna, Djana	IITA	Economist	Yes	Cassava Africa
Moyo, Mukani	CIP	FANEL lab	Yes	Sweetpotato UG
Newby, Jonathan	Alliance of Bioversity & CIAT	Rural and Resource Economist	Yes	Cassava SEA
Ntawuruhunga, Pheneas	IITA	breeder, cassava, Southern Africa	Yes	Cassava Africa
Okello, Julius	CIP	economist	Yes	
Otieno, Susan	Kalro, Kenya	Breeder, potato	No	Sweetpotato UG
Polar, Vivian	RTB	Gender specialist	Yes	Sweetpotato UG
Pradel, Willy	CIP	Economist	Yes	Yam

Name	Institute	Position	Day 1	Day 2
Rajendran, Srinivasulu	CIP	Economist	Yes	Sweetpotato UG
Slavchevska, Vanya	Alliance of Bioversity & CIAT	Gender specialist	Yes	Cassava SEA
Storr, Sam	EiB	Facilitator	Yes	Facilitator
Swanckaert, Jolien	CIP	Sweetpotato Breeder East Africa	Yes	Sweetpotato UG
Swennen, Rony	IITA	Lead breeder, banana	Yes	
Teeken, Bela	IITA	Gender specialist	Yes	Cassava Africa
Thiele, Graham	RTB	RTB Director	Yes	Cassava Africa
Tran, Thierry	Alliance of Bioversity & CIAT	Postharvest specialist	Yes	Cassava SEA
Wossen, Tesfamicheal	IITA	Economist	Yes	Cassava Africa
Zhang, Xiaofei	Alliance of Bioversity & CIAT	Lead breeder, cassava	Yes	Cassava SEA

RESEARCH PROGRAM ON Roots, Tubers and Bananas

CGIAR

The CGIAR Research Program on Roots, Tubers and Bananas (RTB) is a partnership collaboration led by the International Potato Center implemented jointly with the Alliance of Bioversity International and the International Center for Tropical Agriculture (CIAT), the International Institute of Tropical Agriculture (IITA), and the Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), that includes a growing number of research and development partners. RTB brings together research on its mandate crops: bananas and plantains, cassava, potato, sweetpotato, yams, and minor roots and tubers, to improve nutrition and food security and foster greater gender equity especially among some of the world's poorest and most vulnerable populations.

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