SYSTEMATIC REVIEW OF BPAT AND CRP EVALUATIONS ON MARKET SEGMENTATION AND TARGET PRODUCT PROFILE DEVELOPMENT IN CGIAR BREEDING PROGRAMS

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Michael Friedmann[1], Valerien Pede[2], Vivian Polar[3], Brendan Rice[4] & Hope Webber[5]
[1]Independent Consultant, USA; [2] IRRI, Philippines; [3]CIP, Peru; [4]IFPRI, USA; [5]IITA, Nigeria.

CIP INTERNATIONAL POTATO CENTER
CGIAR

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International Potato Center
P.O. Box 1558, Lima 12, Peru
cip@cgiar.org • www.cipotato.org

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CONTENTS

Acronyms

BPAT	Breeding Program Assessment Tool
CIP	Centro Internacional de la Papa (International Potato Center)
CGIAR	Consultative Group on International Agricultural Research
CRP	CGIAR Research Programs
EiB	Excellence In Breeding
FP	Flagship Program
G+	Gender Plus
G+PP	Gender Plus product profile query tool
GBI	Gender Breeding Initiative
IITA	International Institute of Tropical Agriculture
ISDC	Independent Science for Development Council
MI	Market Intelligence
MIPPI	Market Intelligence and Product Profiling Initiative
NARES	National Agricultural Research and Extension Systems
TPP	Target Product Profile
RTB	CGIAR Research Program on Roots, Tubers and Bananas

INTRODUCTION

Plant breeding is a very effective way to increase agricultural production and lead to impacts on food and nutrition security as well as improving incomes and livelihoods. The impacts of plant breeding, however, are dependent on the adoption of improved varieties by the target farmers. There is a balance between push and pull approaches to plant breeding. The former deals with developing improved varieties that address major production constraints, and upon release, are promoted and provided to farmers for their approval and adoption. The premise is that higher yielding potential will attract the attention of farmers, and they will choose to adopt the new variety. The latter deals with finding what the market needs and demands, be it the producers, processors and/or consumers. Then varieties are developed to fit that market demand. This is also known as demand-led breeding (Persley & Anthony, 2017). Due to variety adoption levels that have been below expectations (Thiele et al., 2020), there has been a shift in CGIAR breeding programs towards more demand-led-breeding.

The CGIAR Initiative on Market Intelligence (MI Initiative)[1] is bringing together a disciplinary team of scientists including breeders, agronomists, pathologists, seed system experts, social and gender scientists, crop and climate modelers along with national agriculture research and extension systems (NARES) from target countries to design and implement a demand-led breeding approach of varietal improvement across CGIAR mandate crops. Although there is a large existing body of work on the traits and varieties farmers prefer, including the differences in trait preferences between men and women, this has not been compiled in a standardized form that can be used for comparative purposes to inform trait prioritization and breeding investments more systematically. Since demand-led breeding involves superimposing consumer and producer-centered thinking on the agroecology-driven breeding programs, this requires substantial efforts in collecting market intelligence data to understand the drivers of variety adoption. Therefore, the MI Initiative is defining strategies for generating and using market intelligence in order to guide decisions on breeding program design.

A central tenet of demand-led breeding programs is the identification of market segments and the definition of the ideal variety for meeting the requirements within each segment. A market segment is defined as a group of farmers with common variety requirements that include production (where and how the crop is grown) and end-user requirements (what the crop is used for)[2]. This segmentation takes into account the geographical region, agro-ecological zone(s), end use of the crop (fresh product, processed, as feed), color (of seed, grain, or skin and flesh of roots, tubers, vegetables and fruit), production environment, production system (rainfed/irrigated), and maturity. Once the market segments are defined, then varieties are designed to have a set of traits that respond to the needs and preferences of producers, processors and consumers in the specific market segment. The critical traits that must be found in the new product are documented and listed in a TPP (Target Product Profile), with defined levels and thresholds, usually compared to benchmark varieties that are popular in that market segment. The TPP presents also additional traits that are also desirable, and might lead to particular impacts, be it in nutrition, gender equity, adaptation to climate change, or resistance to emerging diseases. These are also part of the TPP and undergo a prioritization process as not all traits might reach the desired levels during the breeding cycle.

[1] https://www.cgiar.org/initiative/market-intelligence

[2] https://hdl.handle.net/10568/126019

OBJECTIVE OF STUDY & METHODOLOGY

This working paper looks at the development of market segmentation to guide the definition of TPPs across the CGIAR breeding programs. A framework was developed through a participatory process to extract and generate learnings, from Breeding Program Assessment Tool (BPAT)[3] evaluations of breeding programs and from CGIAR Research Programs (CRP)[4] evaluations, on the need to use market intelligence information to guide breeding decisions. This framework can be used to identify bottlenecks and opportunities in the breeding programs and formulate strategies for where the MI Initiative could contribute to respond to recommendations from the evaluations. Therefore, the framework (see Annex 1) was used to screen the set of crops-specific CRP Evaluations by the Independent Science for Development Council (ISDC), the CRP Annual 2021 final reports[5], and the BPAT evaluations of the center crop breeding programs. Some breeding programs underwent two cycles of BPAT evaluation. In some cases, CGIAR Center responses to the first BPAT evaluation were available and had been also screened. The matrix of BPAT program evaluations is shown in Annex 2, and the matrix of CRP evaluations and 2021 final reports is shown in Annex 3.

The study was limited by not having access to the full set of BPAT reports. In addition, since the CRP evaluations and the BPATs were carried at different times, it was difficult to make direct comparisons between programs, as some were evaluated before or after the processes of defining TPPs were being established. Nevertheless, an attempt was made to generalize across programs.

CRP Evaluations

The ISDC carried an extensive evaluation of the CRP programs during the years 2019-2020[6]. The purpose of the evaluations was to assess the CRP programs based on their work from 2017 through 2019 with respect to the extent to which they delivered quality of science, their effectiveness in achieving outputs and outcomes and the importance of those identified results, as well as the extent to which they were positioned to be effective in the future seen from the perspectives of scientists and of the end users of agricultural research. This was to both evaluate accountability and also to generate learning for going forward, while striving to standardize and harmonize the data collected across the programs.

The reviews were designed to deliver top-level findings to its primary audience, the CGIAR System Council, the CGIAR System Organization, the CRP management teams, and the Flagship Program (FP) co-leads of each CRP and the partner CGIAR centers.

[3] https://plantbreedingassessment.org/bpat-project/bpatmission/

[4] https://iaes.cgiar.org/evaluation/crp-2020-review

[5] https://hdl.handle.net/10947/2538

[6] https://iaes.cgiar.org/evaluation/news/evaluative-reviews-streamlined-approach-accountability-and-learning

CRP Annual Reports 2021

The CRP programs ended in December 2021, and each program submitted a final report, covering the achievements of the last year, in April 2022[7]. These reports were also used as a source of information to complement the CRP evaluations that were carried out at earlier dates. The CRP reports were centered mainly around achievements in the form of highlighted publications, outputs, lists of innovations, policy changes, and progress towards outcomes. Information regarding breeding program design and interaction of breeders with other disciplines including social scientists usually was found in highlights of individual FP within the CRP report.

BPATs

The BPAT is a structured evaluation process for breeding programs that assesses their management and organization using criteria commonly used to evaluate commercial plant breeding programs. It consists of a questionnaire and an evaluation visit by a team of cultivar development experts. A report is then generated describing the program strengths and recommendations for improvement. From this, the breeding programs then develop an improvement plan.

Many CGIAR breeding programs underwent the BPAT, which was used to guide the support provided by the CGIAR Excellence in Breeding Platform (EiB)[8]. The assessments strove to help the breeding programs better understand client needs, streamline their breeding processes and create more efficient operations, ultimately leading to increases in genetic gain due to the breeding program outputs.

The BPAT Assessment had 11 components. The first component dealt with Breeding Objectives and Product Profiles and was the main source of information for this work. Other relevant components were Breeding Organization, Product Development & Release, Program Impact, and Engagement with NARES. Each section had a set of recommendations that were also considered. In those cases that there was a second BPAT assessment, these recommendations were looked at for any progress, as well as new recommendations from the second round.

RESULTS

Information extracted from the three sources was compiled into the framework (see Annex 1). There were several points that showed commonalities across CRP programs or crop breeding programs. In a number of cases, there was no information provided to answer some of the points in the framework, or there was not enough detail to draft a coherent answer. The information was then summarized across CRP programs and BPAT assessments (of the individual crop breeding programs) to generate a simplified version that included overall conclusions and a set of probable indicators that can be used to evaluate the development and use of market research to inform market segmentation and refinement of TPPs (see Table 1).

The main indicators that cover the points raised in the framework are described in the sections below:

[7] https://hdl.handle.net/10947/2538

[8] https://excellenceinbreeding.org/content/about-eib

1. Product Concepts Defined

This came across as a mixed result. The CRP evaluations showed that some CRPs had breeding targets defined for agroecological zones (so not mentioning product concepts *per se*) and the annual reports highlighted foresight work for future preferences and several *ex-ante* studies. It was the first round of BPATs that brought up the product concepts but found variation between the programs. Some did not have product concepts, whereas for those that did, the list of product concepts was found to be too long and requiring a prioritization process.

2. Market Segments Developed

Although the early BPATs did not find market segments developed in the breeding programs, both the CRP Evaluations and Annual Reports as well as the second round of BPATs reported on the development of market segments, with 320 market segments mentioned in the CRP Evaluations.

3. Information sources for Market Segments/ TPPs

CRP Evaluations and Reports detailed various socio-economic studies, but it is not clear how these informed the development of TPPs. The BPATs provided only a few examples of specific studies, but they also did not have clarity if this kind of information was used to inform the development of the market segments or the TPPs.

4. Multidisciplinary Teams Established

This followed two types of multidisciplinary teams, either complementary biophysical disciplines for plant breeding (such as plant pathology, plant physiology, nutrition) or those having social scientists to evaluate market segments, social inclusion, etc. Overall, multiple disciplines providing information to the breeders were identified, including social scientists in some cases. However, the evaluations did not find established and institutionalized multidisciplinary teams, rather the consultations were found to be informal, provided in an *ad-hoc* basis. It was mainly a consultative process with various experts from different disciplines within the organization. For example, plant pathologists highlighted emerging diseases, and value chain experts provided feedback to breeders on post-harvest trait needs.

5. TPPs Defined & Developed

These were mentioned in all the reports and evaluations. The CRP evaluations reported on 372 product profiles. However, both the CRP evaluations and the BPATs found these product profiles needed to undergo a more rigorous trait prioritization process and to be refined using market research, which was found to be lacking.

6. Formal Process for TPP Development

Only the second round of BPATs considered this issue. Although some breeding programs showed progress in this direction, with dedicated teams for carrying out surveys to inform prioritization of market segments, it still was not clear if this was institutionalized. This was also related to the involvement of multidisciplinary teams and their contribution to TPP development.

7. Governance structure for trait decisions

The reports and evaluations did not deal with the topic of governance structure for trait decisions, rather with the governance structure of the CRP program, or of the breeding team composition. Indirect

observations were made related to the lack of involvement of NARES partners in the development of market segments and TPPs, which relates in some way to the governance question.

8. Trait prioritization implemented thru formal process

Since the BPATs mostly recommended that trait prioritization processes should be put in place, especially using multidisciplinary teams and being informed by market research, overall, this would not seem to be the case. The CRP reports mention the involvement of gender specialists using the Gender Plus product profile query tools (G+PP) to refine the traits in the product profiles. Again, although various disciplines are mentioned in the BPAT evaluations, there is no clarity on their involvement in the definition and prioritization of traits in the TPPs.

9. Market Intelligence info used for breeding decisions

From the evaluations and reports, there is not enough information provided to get a proper sense on how much market information was used for breeding decisions. Most reports do not mention anything about use of market information. Where mentioned, breeders either did not have any market intelligence information, or they had it in a non-structured form, which may or may not have been used to inform the product profiles. Breeding programs had information on production constraints, major agroecology regions as targets, some producer/consumer preferences, but market sizes and potential impacts were not mentioned. Since the BPATs recommend carrying out market research to refine the TPPs, this suggests as well that market information was not used for breeding decisions.

In the period following the BPAT reports, CRP evaluations and reports used in this study, surveys are being carried out by economists in South Asia and East Africa to better define market sizes, as this kind of information was lacking. The most recent estimation of market segment size was conducted through an expert elicitation e-survey. This approach will allow the programs to reassess the set of market segments and undergo a prioritization process to inform investment decisions.

CONCLUSIONS

In conclusion, the development of market segments and associated product profiles has revealed several gaps in the process, particularly in terms of governance, multidisciplinary collaboration, and the integration of market intelligence. The following key findings summarize these areas for improvement:

- **Lack of clarity in market segmentation**: While market segments and product profiles were described and submitted to EiB, the process by which these segments were defined, and the roles involved, remain unclear. There was minimal or no evidence of market research guiding this development.
- **Limited use of market intelligence**: Breeders were central to the development of the initial product profiles, with a strong understanding of production constraints. However, many lacked structured market intelligence, which may or may not have been used to inform trait selection and profile development.
- **Absence of multidisciplinary teams**: Despite the presence of scientists from various disciplines supporting breeding efforts, multidisciplinary teams were not consistently established or utilized in the definition of market segments and product profiles.
- **Unclear governance in decision-making**: Governance structures around trait prioritization and product profile development were poorly defined. Evaluations focused on describing the capabilities of breeding teams, rather than their involvement in the product profile development process and decision-making power.

- **Initial focus on product concepts**: Early BPAT evaluations centered on the lack of clear product concepts rather than addressing market segmentation or product profiles, which limited their alignment with the intended framework questions.

These findings highlight the need for a more structured, transparent, and interdisciplinary approach to market segmentation and product profile development going forward.

RECOMMENDATIONS

This section presents a set of recommendations to address a structured approach to developing market segments and TPPs in breeding programs. By integrating multidisciplinary teams, aligning with key impact areas, and incorporating market research, the process ensures both current and future market needs are addressed effectively.

Establishing a Formalized Process for Defining Market Segments and Developing Target Product Profiles (TPPs): Ensure a step-by-step process is clearly outlined describing structure, roles and responsibilities of the different stakeholders, as well as expected outputs and outcomes. To achieve this, the following specific suggestions should be considered.

a) **Institutionalize Multidisciplinary Teams:** Ensure the inclusion of social scientists as part of a multidisciplinary team, with dedicated funding, and clearly defined roles and responsibilities for all team members.

b) **Develop a Market Research Plan:** Formulate and implement a structured plan for market research to identify and inform gaps in the market segments supported by appropriate funding and clearly defined objectives and timelines.

c) **Reassess and Prioritize:** Based on market research, the multidisciplinary team should conduct a formal reassessment of market segments and TPPs in alignment with investment priorities and organizational guidelines.

d) **Align with CGIAR Impact Areas:** Ensure that the prioritization process incorporates the five CGIAR impact areas—nutrition, poverty, climate, gender, and environmental health.

e) **Plan for Future Markets:** Given that the breeding cycle can span over a decade, TPPs must consider long-term market demands. Predictive market research should be used to develop future-focused segments and profiles.

f) **Prioritize Traits Thoughtfully:** For each TPP, conduct a trait prioritization exercise considering potential impacts, genetic feasibility, phenotyping, budgetary constraints and ensuring that traits are in demand, Gender-responsive, impactful and feasible.

g) **Iterative Refinement:** This process must adapt to evolving market conditions while considering the long breeding cycle. Multidisciplinary teams should actively engage in advancement meetings to help navigate changing priorities without derailing the breeding program's objectives.

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ANNEX I

Framework to extract and generate learnings from BPAT and crop reviews on the need to use market intelligence information to guide breeding decisions

1. Breeding-related issues – particularly related to market intelligence

1.1. Market Segmentation and target product profiling

Overview: we are interested in information on market segmentation and the process of developing target product profiles from the BPAT study and CRP evaluations. Please provide information on the following aspects of market segmentation.

1.1.1. Market segmentation

- How clear based on the evaluations are the markets/market segments the country program/breeding program targeted? (e.g., very clear, somewhat clear, not clear, other specify). Please expand.
- In absence of market segmentation, what was the basis for defining main breeding targets (Agroecological regions; Donor-based; TPEs, other?)
- Do the evaluations provide information on how frequently market segmentation occurs (i.e., the process of, and tools used to, identify and aggregate growers into groups with common varietal needs)? (E.g., every year, every other year, less frequently than every other year, never, there is no mention of frequency). If not mentioned, then refer to advancement meetings or priority setting meetings.
- Is there any information in either of the evaluations on the information used to characterize market segments? If so, please indicate what characteristics are used (things like area, gender differentiated preferences, producer characteristics, consumer characteristics, etc.)?
- Are market segments defined by the program or external to the program?
- Is there any other information on how development and/or use of market segments is done that you can share from the evaluations? e.g. market research studies used to inform breeding program design (objectives, market segments and/or TPPs)
- Is there mention of who is involved in market segment development, particularly in relation to involving several disciplines? If possible, based on the information available, who is involved? (E.g., breeders, seed certification agencies, processors, economists, gender specialists, farmers). Any mention of multidisciplinary team establishment and/or involvement?

1.1.2. Target product profiling

- Based on the evaluations, does the program develop target product profiles (i.e., a set of traits that will meet the needs of a target group)? (yes, no, not mentioned, other). Or product concepts (if product profiles are not mentioned).

- To what extent are trait decisions made in response to a given target group? (trait decisions in the program are specifically made in response to a well-defined target group (i.e., a market segment), trait decisions are loosely geared towards a market segment, trait decisions are not made in response to a market segment(s).
- Is there information on the process of developing target product profiles/trait selection related to how developed the process is? Which of the following best covers the situation described in the evaluations?
    - There is a group and a formal process within the breeding team dedicated to developing and updating TPPs.
    - TPPs are developed within the breeding program but not through a formal process.
    - TPP development is done by an entity outside of the breeding program (e.g., CGIAR TPPs being used by NARES or vice versa).
    - Other, please share.
- Is there any other information available on governance aspects of trait/TPP decisions?
- Is there mention of who is involved in trait selection/target product profile development, particularly in relation to involving several disciplines? If possible, based on the information available, who is involved? (E.g., breeders, seed certification agencies, processors, economists, gender specialists, farmers).
- Is there any other information on how product profiles are implemented and decided upon (trait decisions made) that you can share from the evaluations?

1.2. Market intelligence / research and linking to the market/go-to-market strategy.

Overview: we are interested in getting a sense of what the evaluations have to say about how market intelligence and market research was used in the breeding program.

- What do the evaluations indicate in terms of how market information is used in breeding decisions – particularly the target product profile development? For example, is there mention of a systematic process by which market research is collected and shared to inform all decisionmakers in the TPP development process; is market information collected and used ad hoc in breeding decisions; there isn't much use of any of market information in breeding decisions/TPP development; other (please expand).
- Were there any bottlenecks or challenges mentioned in the evaluations regarding use of market intelligence in breeding decisions (e.g., lack of funding to finance systematic information gathering from end-users, lack of expertise, lack of availability or timeliness of the market information, lack of detail in market information, etc.)
- Were there any proposed solutions, recommendations, or successes related to market intelligence/understanding the market(s) highlighted in the evaluations? Please summarize.
- Were there any challenges or successes associated with bringing together several disciplines in breeding decisions? Please summarize.
- What is your sense based on the evaluations of how market intelligence was used in breeding decisions (e.g., defining market segments, deciding on traits, at breeding product advancement meetings, etc.).

- Is there any other information from the evaluations on market intelligence and how it is used that you can share from the evaluations?

2. Attitudes, incentives, structures, and decision making in the research programs/breeding programs.

Overview: we are interested in getting a sense of what the evaluations have to say about how decisions were made, the structure of the program, how coordination across disciplines took place, etc.

- Please provide information (if any) from the evaluation on the decision-making structure of the research program/breeding program (e.g., decision-making done by teams of individuals with diverse backgrounds/transdisciplinary teams, decisions are mainly taken by breeders, etc.)?
- Does the evaluation identify the management and governance of the research program/breeding program? Is its effectiveness discussed? If so, summarize the main findings. Describe where transdisciplinary teams might come in. If no mention, are there any references made for a need for transdisciplinary teams?
- Does the evaluation describe the partnerships involved in the research program and their effectiveness? Summarize. Also indicate what types of partners there are, and what disciplines those partners are coming from (e.g., distinguish within NARES between breeders, plant physiologists, gender experts versus economists)
    - How is the quality of the breeding program measured?
    - Tangible outputs (e.g., germplasm) – describe.
- Measures of innovations and adoption of outputs coming out of the program (e.g., varietal release, sales volume, varietal turnover, etc.). Describe.
- Is there attention paid to impacts in the five CGIAR impact areas in measuring performance, and if so, which of the five impact areas are included? If no mention, then perhaps number of varietal releases, % adoption?
- Does the evaluation provide information on the disciplines involved in the research program, their respective contributions, and challenges or successes in involving actors from multiple disciplines?

ANNEX II

Matrix of BPAT evaluations

Center	Breeding Program	1st BPAT (date done)	2nd BPAT (date done)
Africa-Rice	Rice[1]	n/a[2]	n/a
CIAT	Cassava & Rice	Nov 2018	n/a
CIAT	Beans & Forages	Nov 2018	n/a
CIMMYT	Maize & Wheat	n/a	n/a
CIP-HQ	Potato & Sweetpotato	May 2018	n/a
CIP-Hubs[3]/NARO-Ug	Sweetpotato	Nov 2021	n/a
CIP-Hub-Kenya	Potato	Nov 2021	n/a
ICARDA	Barley, Bread Wheat, Durum Wheat, Lentil, Chickpea	n/a	Dec 2023
ICRISAT	Chickpea, Groundnut, Pigeon Pea, Sorghum, Pearl Millet, Finger Millet	n/a	June 2020[4]
IITA	Cassava	Feb 2018	June 2021[5]
IITA	Yam	Dec 2017	July 2021
IITA	Banana, Plantain	May & Nov 2017	Dec 2020
IITA	Cowpea, Maize, Soybean	Dec 2017	July 2021
IRRI	Rice	April 2018	Aug 2023

*** Dates denote the period during which the BPAT was carried out. The reports were published a bit later.**

[1] Only a table with BPAT recommendations and Center response was screened

[2] n/a -Either the report was not available, or the center did not undergo a BPAT evaluation

[3] Hubs in Mozambique and Uganda (Ug)

[4] Only an extract of the report was screened

[5] Done together with NARO and NRCRI partners

ANNEX III

MATRIX OF CRP EVALUATIONS AND 2021 FINAL REPORTS

CRP or Platform	CRP Evaluation* (date done)	CRP Final Report 2021 (submitted April 2022)[1]
EiB (Excellence in Breeding Platform)	May 2022	YES
GLDC (Grains, Legumes & Dryland Cereals)	July 2020	YES
MAIZE	November 2020	YES
RICE	December 2020	YES
RTB (Roots, Tubers & Bananas)	November 2020	YES
WHEAT	July 2020	YES

* Includes evaluation and annexes.

[1] YES- Denotes report was available and reviewed

TABLE 1: Summary of Indicators for Market Segmentation and Development of TPPs Across CRP and BPAT Evaluations and Reports

Table 1A.

Criteria/Sources	Product Concepts Defined
1st BPAT	Some programs were found to not have Product Concepts. Others had product concepts, but the list was found to be too long, and a prioritization process recommended.
2nd BPAT	
CRP Evaluations	Breeding targets defined for agroecological zones, some are donor-based, and attempts to link to Target Population of Environments (TPEs).
CRP Final reports	Some foresight work for future preferences, adaptation to climate change. Also reported ex-ante work for Gender-Sensitive targeting.
Overall Conclusions	**PARTLY. Some programs had product concepts, but they were too many and not prioritized**

Table 1B (continued).

Criteria/Sources	Market Segments Developed
1st BPAT	Mostly not found in early first BPATs. Recommendations included calls to develop market segments based on market research.
2nd BPAT	Most programs with help of EiB developed market segments. However, it still was not clear how much market research was utilized to develop the market segments, nor details of who was involved besides the breeders.
CRP Evaluations	320 market segments developed, but no further descriptions.
CRP Final reports	Reports show identification of market segments and together with breeding pipelines and target product profiles. Some details were provided on particular trait categories that were included.
Overall Conclusions	**YES. Market segments and associated product profiles were described (and submitted to EiB). However, there is a lack of clarity in how the market segments were defined and by whom (and presumably developed without or with little market research).**

Table 1C (continued).

Criteria/Sources	Multidisciplinary Teams Established
1st BPAT	Found most programs to interact with various disciplines in a consultative, ad-hoc basis. Recommendations to establish formal multidisciplinary teams.
2nd BPAT	Multiple disciplines mentioned, but still not clear if they contribute to development of market segments and TPPs in a formalized process. In some reports, it is not clear if the teams are yet in place, in spite of earlier recommendations. Some programs have dedicated social scientists for market research.
CRP Evaluations	Apparently mainly breeding leads. Not NARES nor local seed companies. No multidisciplinary team yet.
CRP Final reports	No information given.
Overall Conclusions	**NO. Although there are scientists in various disciplines in the centers, and they support the breeding teams, multidisciplinary teams in most cases were not established nor used to define market segments and develop product profiles. Interactions were on an ad-hoc consultative basis. Some programs have dedicated social scientists for market research. No information on budget allocations to support these teams although BPATs called for the establishment and institutionalization of multidisciplinary teams also including social scientists.**

Table 1D (continued).

Criteria/Sources	Information sources for Market Segments/ TPPs
1st BPAT	Example given of CIP Sweetpotato Uganda on a 1000 minds survey that ranked 13 traits. But it is unclear how this information is used in the breeding program to make advancement decisions.
2nd BPAT	Geography information (acreage) used for breeding objectives or general pipelines, not explicitly mentioned for market segments. Other breeding programs do not show detailed information.
CRP Evaluations	Under the sections describing the Flagships (FPs), in some CRPs, there were FPs specifically involving social scientists generating information on consumer demand and value chains (e.g. GLDC FP1; RTB FP4). For GLDC, these studies were based on ex-ante analysis covering economic, poverty and nutritional attributes, but did not include wider consumer/market acceptance issues which could affect variety adoption. There were some connections with the breeding FPs, but there is not much detail on how this translated to the development of the product profiles.
CRP Final reports	EiB mentions breaking down some market segments by gender and age.
Overall Conclusions	**PARTLY. Most reports did not address this point of where information was taken from to develop market segments and TPPs. Breeders accessed information from different disciplines to determine major production constraints and farmer trait preferences. CRP Evaluations and Reports detailed various socio-economic studies, but it is not clear how these informed TPPs.**

Table 1E (continued).

Criteria/Sources	TPPs Defined & Developed
1st BPAT	Most programs have product concepts or product profiles defined, but they mostly need to be refined and require market research for adjustment.
2nd BPAT	Although significant progress was made on development of product profiles, there were still large gaps in their description of how to internalize them within the breeding teams. Market research, product replacement strategy, and clear definition of benchmark varieties were lacking. There was no obvious trait prioritization process apparent in any program. Current draft product profiles still need further refining and need to use market research.
CRP Evaluations	372 product profiles developed. Each of the 372 product profiles was characterized by a maximum of 25 elements, including agro-ecology, up to six basic traits and three added-value traits. To better meet contemporary standards, profiles required further trait-level objectives (these were minimal) and relative trait priorities (these appeared to be absent). As a result, the product profiles in terms of informativeness and quality fell short of contemporary standards. The lack of relative trait priorities inhibited their use to set breeding objectives and making breeding decisions.
CRP Final reports	Programs have developed product profiles linked to market segments.
Overall Conclusions	**YES. Most programs have product concepts or product profiles defined, but they mostly need to be refined and require market research for adjustment and for trait prioritization to be better implemented.**

Table 1F (continued).

Criteria/Sources	Formal Process for TPP Development
1st BPAT	
2nd BPAT	IRRI has implemented the development of product profiles by applying a comprehensive global market segmentation analysis, including market research to identify priority segments. Consequently, it appears that trait decisions in the program are specifically made in response to a well-defined target group (i.e., a market segment). This is not stated directly, but the TPPs are linked to breeding pipelines that are linked to market segments. IITA Cassava- trait prioritization process in place and categorized but process of integration into all stages of breeding programs is incomplete. Traits are listed but not clearly prioritised and there appears continuing internal debate on how to prioritize for different targets: direct consumer and commercial- Industry processing markets.
CRP Evaluations	Not enough information to provide a rating. Trait decisions are loosely geared towards a market segment.
CRP Final reports	Not enough information to provide a rating. Stakeholder engagements of the crops to provide feedback to the breeding program to refine the target product profiles. (GLDC).
Overall Conclusions	**PARTLY. Breeders were mainly involved in the development of the first set of product profiles, having a good understanding of production constraints to inform trait selection. However, either they did not have any market intelligence information, or they had it in a non-structured form, which may or may not have been used to inform the product profiles.** **Some processes are described for using information from different stakeholders to inform trait prioritization, yet overall appears to still not be a formalized process.**

Table 1G (continued).

Criteria/Sources	Governance structure for trait decisions
1st BPAT	A number of projects related to breeding, bio-fortification, phenotyping and seed system are underway- could lead to a fragmented approach rather than a strongly coordinated program focused on defined product concepts. The supplementary funding provided by projects has meant that project goals often don't align with key product profiles as defined for each breeding program.
2nd BPAT	Most programs do not provide any information on governance aspects. Most evaluations do not mention governance of the breeding program yet commend the capabilities of the breeding teams. Mention is made of scientists in other disciplines such as plant pathology providing good support for breeding operations, yet no mention of product profile development The NextGen cassava project has a dedicated team called the Survey Division which is tasked to support Breeding in decision-making and trait prioritization, by generating information on consumer priorities and needs, to enhance adoption and impact. IITA COWPEA- A formal product design process has been initiated and product profiles aligned with NARES partners using EiB tools. IITA MAIZE- investing effort into formalizing and documenting the product advancement and release process. IRRI- On farm data collected by seed systems experts and various demographic and socio-economic factors are considered while identifying the preference.
CRP Evaluations	Besides RICE CRP, not enough involvement of NARES partners in development of market segments/TPPs. Donor funded projects on biofortification, gender, climate change resilience. Most or all of the 372 product profiles were developed directly from data collected with the Product Replacement Strategy Tool without evidence of multiple stakeholder input for each product profile, possibly through consultation with a single individual.
CRP Final reports	RICE-Expansion of the national agriculture research and extension systems (NARES) breeding network in line with the market segmentation.
Overall Conclusions	**NOT CLEAR. Governance around decision making on trait prioritization, product profile development and definition of market segments was not clear- evaluations dealt with describing the breeding teams and their capabilities, but not in relation to product profile (concept) development. Some programs have initiated formal product design processes and carried out surveys to support breeding program decision-making.** **Some donor-led projects may have different goals that do not align with key product profiles of the breeding program.**

Table 1H (continued).

Criteria/Sources	Trait prioritization implemented through formal process
1st BPAT	
2nd BPAT	Most reports describe the breeding teams, but do not provide details of who is involved in the trait selection/TPP development process. IRRI- Seed systems team collect data used to realign TPPs- but no mention if they were involved in the development of the TPPs from the start. Product advancement is currently informal and decided by breeder. AFRICA RICE has three teams led by a chief breeder and experts in various disciplines. However, there is no information on the level of involvement of these additional expert scientists. CIP Sweetpotato Uganda team - mention is made of three product profiles developed in conjunction with a cross-functional team of stakeholders. But no further details of team composition. CIP Potato Kenya team mentions inclusion of a social economist and farmers, but no further detail. IITA Cassava- cross functional teams e.g., agronomy, crop protection, quality etc. the collaboration is on a good-will basis only. IITA Banana- response to BPAT states that breeders, post-harvest experts and socio-economists are involved. ICARDA-The ICARDA breeding teams have a good mix of experienced and early career talented scientists across a range of disciplines (Plant Breeding, Biometrics, Pre-Breeding (connected to Genebank), Plant Pathology, Quality, Physiology). No mention in regard to who is involved in trait selection/TPP development. ICARDA all programs-Breeders have defined 'must-have' traits, but a fully integrated formal process or prioritization of traits has not been optimized.
CRP Evaluations	Apparently mainly breeding leads. Not NARES nor local seed companies. No multidisciplinary team yet.
CRP Final reports	Mention mainly gender specialists in implementation of use of G+ tools.
Overall Conclusions	**NOT CLEAR. Trait prioritization seemed to be lacking, so no description of a process for trait priority decisions. Market segments and associated product profiles were described (and submitted to EiB). However, there is a lack of clarity in how the market segments were defined and by whom (and presumably developed without or with little market research).**

Table 1l (continued).

Criteria/Sources	Market info used for breeding decisions
1st BPAT	Most reports do not mention anything about use of market information.
2nd BPAT	Most reports do not mention anything about use of market information. IRRI-The market data was collected, but no mention is made of the process on how it is used to define the TPPs.
CRP Evaluations	Overall, evaluations and reports do not provide sufficient information to get a sense on the use of market information to inform breeding decisions.
CRP Final reports	Overall, evaluations and reports do not provide sufficient information to get a sense on the use of market information to inform breeding decisions.
Overall Conclusions	**NOT CLEAR, PROBABLY NOT.** **Most reports do not mention anything about use of market information. Breeders either did not have any market intelligence information, or they had it in a non-structured form, which may or may not have been used to inform the product profiles.** **Breeding programs had information on production constraints, major agroecology regions as targets, some producer/consumer preferences, but market sizes and potential impacts not mentioned**.

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For more information, please contact CIP Headquarter. Av. La Molina 1895, La Molina. Apartado 1558, Lima 12, Peru.

5-11-3496017 *cip-cpad@cgiar.org* *www.cipotato.org* | *@cipotato* *@Cipotato* *@cip_potato*

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