

# **TRACKING VARIETAL CHANGE AND ASSESSING THE IMPACT OF CROP GENETIC IMPROVEMENT RESEARCH IN SUB-SAHARAN AFRICA**

## **BIOVERSITY INTERNATIONAL**

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### **OVERVIEW**

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Support for crop genetic improvement research and the delivery of new varieties to African farmers has been one of the foundation's largest areas of investment through grants to CGIAR centers and to the Program for Africa's Seed System (PASS). Yet, none of these grant-receiving institutions is able to provide convincing evidence on the total area currently being planted with their varieties or whether this area has been increasing over time. In past years tracking variety diffusion, studying the impact of the uptake of improved varieties, and using this information to improve research strategies was a major focus of social science research within the CGIAR system – but it is an area of research that has received little attention during the past decade. Just eleven percent of African staple crop area was sown to improved CGIAR varieties at the time of the last comprehensive review of the impact of crop improvement in developing countries in 1998. We have little evidence of what the recent impact of CGIAR crop improvement research in Africa has been. This is because comprehensive varietal diffusion information has not been collected since 1998 and because centers have drastically reduced their efforts to monitor impact. The immediate objective of this project is to collect baseline information on the diffusion of improved varieties for all staple crops in Africa and to initiate new work to analyze the impact of African based crop genetic improvement research on hunger, poverty and nutrition.

The project is organized around three main activities 1) Collection of baseline diffusion information for 14 crops in 25 Sub-Saharan Africa (SSA) countries, 2) Surveys will be used to verify diffusion information and to develop a feasible system for regularly monitoring diffusion and impact, 3) Studies will be funded to assess the effects of new varieties on poverty, nutrition, and food security. Because the bulk of these project activities will be carried out by CGIAR social scientists, the work will be closely linked with monitoring and evaluation (M&E) activities that are already occurring in crop improvement research projects that the foundation is funding. Because this project focuses on impacts, it will complement M&E efforts that monitor outputs and outcomes.

### **PROPOSAL SUMMARY**

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#### **I. Background and Context (“Why”, “Who Benefits” and “Where”)**

The crop improvement research effort of the Consultative Group on International Agricultural Research (CGIAR) centers and their national agricultural research systems (NARS) partners has had a large impact on world food production. Although this impact has been documented in a number of past studies, the last comprehensive study of the international crop improvement effort, organized by the Standing Panel for Impact Assessment (SPIA, formerly the Impact Assessment and Evaluation Group), was based on data collected a decade ago (Evenson and Gollin, 2003 based on 1997-98 data). Important changes have occurred in the funding and conduct of the international crop improvement effort and in the general climate for agriculture in the developing world since the completion of the Evenson and Gollin study (Beintema and Stads). The level and focus of funding for research in the NARS and in the CGIAR centers have fluctuated greatly, and the role of the private sector has evolved. Yet, the importance of the CGIAR/NARS crop improvement effort in feeding the world is arguably as important today as it has been at any time in history.

The steady uptake and turnover of crop varieties is fundamental to realizing a Green Revolution in Africa, and it is still important for helping achieve income growth for numerous poor rural households in South Asia. But our present understanding of improved variety adoption—by crop, by location, by adopter and by source—is limited, particularly in Africa. For which crops and in which geographies are improved varieties being adopted on a regular basis? Should donors and policy makers re-focus their efforts on research and plant breeding, seed delivery systems, and extension to increase the turnover of modern varieties, or can they now focus on other issues such as input supply, marketing, credit, etc.?

The most recent summary of the evidence of the impact of CGIAR-NARSs research in SSA notes the following differences between SSA and other regions (Maredia and Raitzer):

- The overall impact and rate of return to crop improvement research is much lower in SSA compared to other regions (Byerlee and Traxler).
- CGIAR contribution to crop genetic gains of 0.11–0.13% per year in SSA are less than one-third those of other regions.
- Aggregate adoption of modern crop varieties in SSA is much lower than in other world regions. Just 11% of SSA total area is sown to CGIAR varieties. This compares to 55% in Asia, 30% in Latin America, and 48% in the Middle East–North Africa.
- Just 10-15% of documented total CGIAR-NARSs research benefits in SSA are derived from crop improvement. Close to 85% of total CGIAR benefits stem from the biological control research, primarily from biological control of cassava mealybug. Nearly 75% of CGIAR research benefits in other regions of the world derive from crop improvement.

Despite the vital importance of a healthy crop improvement effort, current knowledge of diffusion of improved crop varieties is spotty. Data are more recent for some crops, particularly maize, but no CGIAR center or NARS has a system in place to regularly monitor the diffusion of the cultivars that they develop. Relatively little is being invested in identifying areas where improved varieties are moving either quickly, sporadically, or not at all, or in understanding the uptake pathways. Nor have the impacts of CGIAR research – even in proven areas of success such as varietal improvement – been adequately documented in terms of system objectives of reducing poverty and hunger.

## **II. Goal(s) and Objectives (“What”)**

The proposed work seeks to improve understanding of the impact of food-crop genetics research on the poor and food insecure in Sub-Saharan Africa. The analytical basis for what we believe to be true about crop improvement research in these areas is not very deep, particularly with respect to recent crop improvement investments, or of investments in Africa. The work will focus first on measuring the intermediate outcomes of varietal adoption and diffusion. After data are collected to measure diffusion, research will estimate the final impacts of crop improvement research on poverty and food security. The project is not only targeted at producing knowledge of these outcomes and impacts but also seeks to pilot methods to improve their measurement. In particular, the project seeks to devise practical means for the regular monitoring of variety diffusion and for the generation of widely accessible databases of crop varietal improvement on food crops in Sub-Saharan Africa. It also aims to pilot improved methods for analyzing the impact of varietal diffusion.

The *vision of success* is that this project will lead to a) an improved understanding of the impact of crop improvement research on poverty, nutrition and food security, b) that a cost-effective system is established for tracking the adoption of new varieties from investments in food crop genetic improvement in Sub-Saharan Africa and c) that this information will lead to improved research priority setting and ex-ante analysis of research investments. The project will make two types of contributions. First, by documenting the impact of crop improvement research, the project helps maintain support from donors and governments for investments in crop improvement systems. Without the evidence of the continuing impact of crop breeding in the post-Green Revolution era generated by the Evenson and Gollin study in 2003, it is likely that some donors such as the World Bank would have reduced their contribution to the CGIAR. The second contribution of this project is that detailed information on cultivar use can be used in deciding on relative resource allocation for commodities and specific lines of research. For instance,

variety-specific adoption research contributed to the reduction in emphasis and eventual closing of true potato seed (TPS) investments at the International Potato Center (CIP) (Chilver et al. 1996). Funds that were previously devoted to TPS research that started in the late 1970s were then redeployed to more important problems such as late blight resistance. The foundation has made large investments in both the CGIAR and African NARSs (through PASS). The data and analysis conducted in this project will provide information on the effectiveness of each of these systems in delivering modern varieties to farmers, and should provide insight into means to improve the way that these institutions can work together more effectively.

Three main objectives support the project's vision:

Objective 1: Construct a comprehensive evidence-based overview of the performance of food-crop genetic improvement in Sub-Saharan Africa. Data will be collected on varietal release, the scientific strength of NARS and International Agricultural Research Centers (IARCs) in crop improvement, the level of adoption in important countries by food crop, and the distribution of Center material that is transferred to NARS. This objective one will rely on CGIAR and NARSs records to collect release information. Diffusion information on individual varieties will be collected by asking knowledgeable experts to estimate the area under individual varieties. This was the sole source of diffusion information used in the Evenson and Gollin study, and we believe that this is the only financially feasible means to accomplish the objective of creating a comprehensive estimate of the use of improved crop varieties in Africa.

Objective 2: Improved methods for monitoring diffusion. This objective focuses on finding methods to improve the accuracy, cost-effectiveness and sustainability of collecting diffusion information to monitor the uptake of improved varieties. The project's sustainable vision for generating reliable information on varietal adoption is based on both nationally representative adoption surveys and low-cost methods to periodically estimate variety-specific levels of adoption. The project aims to generate complete and accurate adoption and impact related information that can be regularly updated.

The conduct of nationally representative adoption surveys will be a main component of this objective. Because varietal performance is heavily conditioned by genotype by environment interactions, these surveys will be characterized by substantially greater spatial coverage than past diffusion studies. Both village- and household-level information will be elicited.

Results from the national-level surveys will be compared to subjective estimates collected under Objective 1 to better understand systematic biases in 'quick-and-clean' estimates. Validating expert-opinion methods with nationally representative surveys in a few large countries for several staple food crops should lead to more rigorous estimation methods in the next update on the road to a routine monitoring system of varietal adoption and impact assessment. Experiments with the use of DNA fingerprinting analysis and remote sensing to collect additional data and to verify current methods will also be conducted.

Objective 3: A more comprehensive understanding of the impact of crop improvement on poverty, nutrition, and food security. This objective responds to the need to fill the profile of impact-related information nearer to the Millennium Development Goals of alleviating poverty and increasing food security via interventions featuring varietal change. Selected studies will be funded to assess the effects of new varieties in several areas especially those, such as gender-oriented consequences, that are characterized by a sparse literature. Several types of studies will support this objective that is partially based on the quantification of adoption outcomes in Objectives 1 and 2. These include modeling exercises at the country- or sub-regional level that feature geo-referenced detail, and special inquiries that focus on one or two priority impacts in a rigorous setting where earlier preliminary evidence points to the potential for documentation of important and relevant effect. This objective contributes toward reestablishing deep impact work as a core focus of CGIAR social science research. If this research shows promise, it will set the stage for additional foundation grants in specific impact studies in the future.

### **III. Approach (“How”)**

The scientific work will be carried out by social scientists located at eight CGIAR centers (Africa Rice, CIAT, CIMMYT, CIP, ICARDA, ICRISAT, IFPRI, IITA) and their national agricultural research system (NARSs) collaborators through sub-grant contracts. The work of the individual centers will be coordinated by consultant Tom Walker, an agricultural economist with more than 20 years’ experience working in CGIAR centers, with guidance from a steering committee comprised of members from the Standing Panel Impact Assessment (SPIA) of the CGIAR Science Council (SC) and Bioversity. Intellectual leadership will be provided by Derek Byerlee, Mywish Maredia and Tim Kelley of SPIA/SC. Additional leadership and project management will be provided by Gerard O'Donoghue, Director Corporate Services and Elisabetta Gotor, agricultural economist, at Bioversity.

Project objectives will be achieved through nine principle activities.

**Objective 1:** Designing, testing, and standardization of protocols for data assembly and collection on key aspects of crop improvement program performance

**Activity 1.1.** Document modern varietal output. Data on varietal release should be sufficiently detailed so that IARC content and the dynamics of new cultivar production can be measured. Key descriptors include the following: i) Official name of the release, ii) Year of the release, iii) Institutional source of the material, iv) Genetic background (parentage, genetic ancestry, pedigree) and v) Release classification (type of material, NARS input, and institutional source).

**Activity 1.2.** Document the scientific strength of crop improvement by commodity program. Another priority data set pertains to the dynamics of scientific strength of crop improvement programs in SSA—public, private, and the CGIAR itself. This will include assembly of information on expenditure and scientific human capital on the IARC, university, private sector and NARSs crop improvement programs from 1998-2009.

**Activity 1.3.** Document the adoption of new varieties in 2009. Update the 1998 diffusion estimates for either 2008 or 2009 for countries and crops covered in the 1998 initiative. This will involve the design, testing, and standardization of protocols for data assembly and collection on key aspects of crop improvement program performance, followed by data assembly, analysis and reporting.

**Objective 2:** The project’s sustainable vision for generating reliable information on varietal adoption is based on both nationally representative adoption surveys and low-cost methods to periodically estimate variety-specific levels of adoption. This objective focuses on finding methods to improve the accuracy, cost-effectiveness and sustainability of collecting diffusion information to monitor the uptake of improved varieties.

**Activity 2.1.** Planning the execution country-level adoption surveys.

**Activity 2.2** Pilot community and household information collection using innovative techniques for reliable variety identification.

**Activity 2.2.** Assessment of pilot studies for accuracy, cost-effectiveness and sustainability for use in regular monitoring of variety diffusion.

**Objective 3:** While objectives one and two are focused on data collection, this objective supports the analytical work by funding selected studies to assess the effects of crop improvement on poverty, nutrition and food security. These important topics are characterized by a surprisingly sparse literature.

**Activity 3.1.** Planning the selection of studies for comprehensive impact assessment. The research studies to be conducted will be identified by issuing a competitive request for proposals. To improve the prospects for informative comprehensive assessment, research in this objective is not restricted to the participating commodity Centers. A peer review panel will make recommendations for resource allocation in this area, which will be administered as a competitive grants program. Criteria for proposal selection would include:

1. Likely scale of impacts to be estimated.
2. Ability to assess impacts on food security, gender, poverty and the environment.
3. Innovativeness of methods that could substantially enhance the ability to carry out future impact assessment.
4. Capacity and reputation of the proposed grantee.

**Activity 3.2.** Conference on the effects of crop improvement on poverty, nutrition and food security  
Aimed to presentation of results and recommend a course of action for Phase 2 work in pursuit of the vision of a sustainable system of cultivar-specific adoption monitoring and impact assessment.

#### IV. Project Timeline and Milestones (“When”)

The Project has an expected duration of 2.5 years (30 months). The Tables below presents the time table for the 12 planned activities and for a set of 50 proposed milestones.

#### Objective 1: Design, testing, and standardization of protocols for data assembly and collection on key aspects of crop improvement program performance

Activities	Milestones	Target date (Month/Year)
1) Basic Data: Design, testing, and standardization of protocols for data assembly and collection on key aspects of crop improvement program performance	1. Prioritized country by commodity combinations finalized in the project initiation workshop	1/1
	2. Design and standardization complete for protocols for assembling and eliciting information on varietal release and strength of crop improvement programs	1/1
	3. Planned developed for testing practical methods to elicit cost-effective information on cultivar-specific varietal adoption	1/1
	4. Methods piloted for ‘quick-and-clean’ data collection on cultivar-specific adoption in one country by commodity	3/1
	5. Methods standardized for cultivar-specific adoption data collection across all IARCS for all priority combinations	3/1
2) Data assembly, documentation, processing, and editing	6. Data assembled on varietal release in priority country by commodity combinations	10/1
	7. Data collected on strength of NARS and IARC crop improvement programs	10/1
	8. Cultivar-specific adoption data collected for all priority combinations	10/1
	9. Processing and editing complete for assembled and collected data	11/1
3) Basic data: Analysis and reporting	10. Analysis done for data which captures the testing of hypotheses in Annex 7 and the disposition of IARC-distributed germplasm	6/2
	11. Commodity-specific IARC reports drafted	12/2
	12. Synthesis Report across all commodities drafted	
	13. Peer Review Reports completed	2/3
	14. Reports revised	3/3
	15. Presentation given on commodity-specific and synthesis report in Ending Phase I workshop	4/3
	16. Recommendations drafted for Phase II for data monitoring on varietal release, strength of crop improvement programs, estimates of cultivar-specific adoption, and use of distributed	5/3

Activities	Milestones	Target date (Month/Year)
IARC germplasm	IARC germplasm	
	17. Finalized publication plans for the reports in addition to the Green Cover Document	5/3
	18. Published a synthetic Green Cover Document that summarizes the results for the IARC and synthetic reports	6/3
	19. Eight revised reports made available online and Green Cover Document published	6/3
4) Survey Data: analysis and reporting	20. Data documentation manual drafted	12/1
	21. Data sets submitted for storage and for dissemination on the Internet	4/3

**Objective 2 To gain a deeper understanding about the adoption and diffusion of new varieties in selected priority countries and food crops in Sub-Saharan Africa**

Activities	Milestones	Target date (Month/Year)
5) Planning the country-level adoption survey	22. Country selection by commodity finalized in the project initiation workshop	1/1
	23. Standardized national-level adoption questionnaire finalized in the project initiation workshop	1/1
	24. Submission of two-page IARC-specific proposal for the national-level adoption survey with an emphasis on sample design for discussion at the project initiation workshop	1/1
6) Carrying out community and household surveys using innovative techniques for reliable variety identification	25. Piloting completed for questionnaire and the sample design for the approved proposal	11/1
	26. Village- and household-specific data collected on varietal adoption by cultivar	6/2
7) Processing and editing the adoption data	27. Data processed and edited on adoption	7/2
8) Analyzing the data, writing a country-specific report on the adoption of varieties by major food crops in the geographic population of interest, and drafting recommendations for Phase II	28. Data analyzed and country-specific IARC Reports drafted	12/2
	29. Synthesis Report across the selected countries drafted	1/3
	30. Peer Review Reports completed	2/3
	31. Reports revised	3/3
	32. Presentation given on revised country-specific and synthesis report in Ending Phase I workshop	4/3
	33. Publication plans finalized for the reports in addition to the Green Cover Document	4/3
	34. Recommendations drafted for Phase II for national-level adoption surveys	4/3
	35. Synthetic Green Cover Document published which summarizes the results for the countries and synthetic reports	6/3

9) Submitting the data base to SPIA for storage and subsequent dissemination on the Internet	36. Data documentation manual drafted	12/1
	37. Data sets submitted for storage and for dissemination on the Internet	4/3

**Objective 3 To gain a more comprehensive understanding of the impact of genetic crop improvement on poverty, nutrition, and food security**

Activities	Milestones	Target date (Month/Year)
10) Planning the selection of studies for comprehensive impact assessment	38. Brief review and stock taking completed for gaps in the impact assessment literature on varietal change at the project initiation meeting	1/1
	39. Proposals elicited for competitive grant funding	3/1
	40. Peer-review panel formed	3/1
	41. Proposals selected	6/1
11) Carrying out the proposed research	42. Proposed research carried out	6/2
12) Data analysis, reporting, and recommendations for Phase II	43. Report drafted for each impact assessment proposal	12/2
	44. Brief synthesis report covering all proposals drafted	1/3
	45. Peer Review Reports completed	2/3
	46. Reports revised	3/3
	47. Presentation given on revised impact assessment reports and synthesis report in Ending Phase I workshop	4/3
	48. Draft recommendations for impact assessment in Phase II	4/3
	49. Publication plans finalized for the reports in addition to the Green Cover Document	4/3
	50. Synthetic Green Cover Document published which summarizes the results of the impact assessment research and the synthetic reports	6/3

## V. Evaluation and Dissemination

The project generates a number of easily identifiable activities and outputs (data, methods, studies) so monitoring will be relatively routine. On the other hand, evaluation will be challenging because of the difficulty in identifying the outcomes and impacts generated by improved information and policy findings, and because of the short duration of the project.

The Project Steering Committee will oversee the project and ensure overall quality. SPIA, who supplies three members to the steering committee, is well respected by investors and centers, has a strong track record of facilitating impact assessment across the CGIAR system, and has implemented peer reviews of center impact assessment work in a range of thematic areas. One of the Bioversity staff members is an economist with experience in impact assessment, and is the impact assessment focal point for the Center. The other is the Director of Finance at Bioversity.

Funds have been allocated to support a part-time coordinator who will be tasked with day-to-day management and monitoring and reporting on progress to the PSC. The coordinator's position is flexible as that person will work full time during peak stages of the life of the project and significantly less than full time during other times, particularly when field research is being carried out. Peak times correspond to preparations for the project initiation and final workshops and to punctual visits for the monitoring of

adoption and impact surveys. The coordinator will also contribute substantively to the work in terms of design and synthesis. The prospective part-time coordinator is a highly respected agricultural economist with considerable CGIAR-wide and Center impact assessment experience, including experience in the 1998 Initiative. He is known by the majority of the Center participants.

Evaluation will mainly be carried out via external peer review of Center reports and during the final workshop. Lessons learned will feed into a prospective Phase 2 project.

## **VI. Key Partners/ Sub-Grantees (“Who Implements”)**

The CGIAR centers are key partners in this proposal. Approximately 80% of project funds will be sub-granted for data collection and analysis, and the bulk of this is expected to go to CGIAR centers. A few unidentified partners may come into the project through objective three which includes an open RFP. NARSs will also be involved in most of the sub-grants.

The project will be coordinated through Bioversity and the Standing Panel for Impact Assessment of the CGIAR’s Science Council. SPIA has a long record of carrying out or facilitating the conduct of high quality impact assessment in the CGIAR. SPIA organized and effectively implemented the 1998 Initiative and has continued to facilitate impact assessment on poverty and livelihoods, natural resource management and the environment, and agricultural policy. SPIA has continued to facilitate overall impact assessment in the CGIAR through workshops and knowledge sharing. Currently, SPIA is staffed by a part time Chair, two part-time panel members representing different disciplinary perspectives, and one full time professional impact assessment specialist based in the SC Secretariat at FAO in Rome.