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Costs and Benefits of CGIAR–NARS Research in Sub-Saharan Africa

News of continuing conflict and periodic famine in parts of sub-Saharan Africa (SSA) dominates the headlines. Since its inception in 1971, the Consultative Group on International Agricultural Research (CGIAR) has allocated over 40 per cent of its resources to agricultural research and capacity building in this region. Although this has amounted to almost US$5.8 billion in expenditure (in 2004 US$), little assessment has been made of the overall impact on the livelihoods, health, and prosperity of people in the region. Despite such substantial expenditure, the question remains: Have the investments made in SSA by CGIAR and national agricultural research systems (NARS) partnerships been justified by the benefits produced?

To address stakeholder concerns about this question, the CGIAR Science Council's Standing Panel on Impact Assessment (SPIA) commissioned an independent analysis to assess the level of regional impact of CGIAR–NARS investments in SSA.

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Identifying impact assessment studies

The analysis used a four-pronged approach. Firstly, a comprehensive inventory amassed 171 studies that either assessed the impact of previous CGIAR research in SSA or identified the adoption of technologies introduced to the region by CGIAR–NARS partnerships. The studies were attributable, at least in part, to 12 of the 15 CGIAR centers, but three of these, the Africa Rice Center (WARDA; formerly West Africa Rice Development Association), the International Institute of Tropical Agriculture (IITA), and the Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT), were predominant. Correspondingly, most of the research focused on eastern and West Africa, the principal mandate areas of these three centers. Most of the studies did not go further than the adoption of research

outputs or technologies. In terms of the types of impact assessed, a majority looked at the economic impacts but few measured the social, environmental, or health impacts of the research. Although a cause for concern, this characteristic is not unique to SSA but can be seen across impact assessment studies worldwide.

The 171 studies initially identified were pared down to a subset of 52, which documented large-scale technology adoption and went on to assess economic, social, and environmental impacts. An improved crop variety was the most commonly documented research output, although farm and soil management practices also featured significantly. Notable by their absence in this subset were studies pertaining to biodiversity conservation, policy-oriented research, and soil fertility.

A final subset of 23 studies was selected for meta-analysis. These were chosen primarily because they attempted to assess technologies developed by a CGIAR research center in partnership with NARS and extrapolated aggregate levels of economic impacts over a measured time period. Studies excluded at this point tended merely to document adoption levels, or effects on early adopters. This final subset of studies represented three major types of research output: improved crop varieties; improved farm inputs and management practices; and biological pest control.

Towards a rigorous analysis

The aggregate economic benefits of the selected studies were calculated using a meta-analysis approach, a technique that enables generalized patterns to be identified from particular case observations. Specifically, the authors considered how the documented benefits of the CGIAR–NARS research in SSA compared with the associated investments by the partners in the region. The study was unique in that it compared benefits with a comprehensive estimate of all contributory research costs in the region, rather than those of CGIAR agencies alone.

The authors determined the credibility of each of the 23 impact studies included in the meta-analysis by adopting a review framework previously developed by SPIA.[1] This framework consisted of principles, criteria, and indicators for assessing the studies' analytical rigor. The authors divided the analysis into three different scenarios according to the rigor of the impact assessment methodology, progressively excluding studies as the applied criteria tightened. This produced three different estimates of levels of benefits: 'potential'; 'plausible'; and 'substantially demonstrated'. This variation accommodated the construction of three basic scenarios of aggregate benefits based on analytical rigor, ranging from comprehensive coverage of all 23 studies (potential benefits) to only 9 studies that provided rigorous evidence of benefits (substantially demonstrated) (see Table 1).

In addition, the authors superimposed two alternative time horizons regarding the period for which the benefits lasted: up to the year of the analysis, 2004 (*ex post*); or, for at least a 10-year period which spanned years prior and subsequent to the analysis (*ex post* + *ex ante*). The former estimate imposed extremely conservative constraints on the analysis, whereas the

Table 1.
Number of studies included in the three scenarios of the meta-analysis

	Scenario 1 Potential benefits	Scenario 2 Plausible benefits	Scenario 3 Substantially demonstrated benefits
Number of studies	23	19	9
Criteria	All-inclusive	Studies with an average score of more than 1.5 for transparency and more than 1.0 for analytical rigor	Studies with an average score of more than 1.5 for both transparency and analytical rigor

latter provided what would generally be seen as a more realistic timeframe for benefit flows.

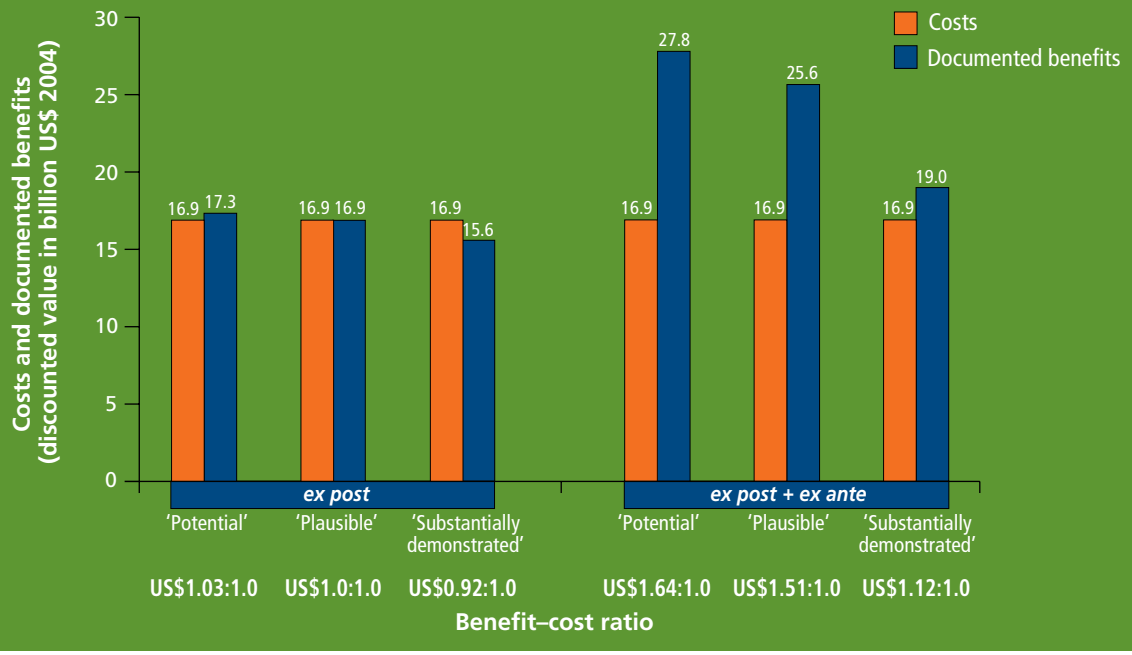
In total then, six estimates of the aggregate benefits of CGIAR–NARS research in SSA were produced under varying degrees of analytical conservatism (see Figure 1). These were then compared with the total costs of the CGIAR–NARS partnership investment in SSA for the period 1966–2004 (estimated to be US$9.2 billion or a 2004 value of US$16.9 billion) to address the following question: How do the documented total benefits of research in SSA compare with the investments to date?

A considerable achievement

The analysis found that, in all but one of the six scenarios considered, the estimated total benefits documented in the reviewed studies exceeded the total costs of all the research conducted by the CGIAR–NARS partnerships to date. Only in the scenario where the most stringent conditions were imposed, i.e., when only the most unassailable research benefits were included in the analysis and they were presumed to stop in 2004, was a benefit–cost ratio of less than 1 produced (0.92 in this case). However, for all the other five scenarios, the benefit–cost ratio ranged from 1.0 to 1.64. Thus, in the best case, 1 dollar of investment was estimated to yield at least 1 dollar and 64 cents of return, while in the worst, benefits were slightly lower than costs. Note that the benefit–cost ratios derived from the meta-analysis are the most conservative lower-bound estimates and do not reflect absolute values. The fact that this small number of impact assessment case studies results in benefits that exceed the costs of all activities in the region in almost all scenarios, indicates a considerable achievement on the part of the CGIAR centers and their partners.

Which factor had most influence over the benefit–cost ratios? Overall, varying the length of time over which benefits were estimated to have accrued produced a much greater range in those benefits than varying the stringency of the studies included in the analysis. This occurred largely because a single study on cassava mealybug control accounted for the vast majority of benefits in all the scenarios, while other smaller studies that were not included in the more selective scenarios did not contribute to aggregate benefit levels substantially.

Figure 1. Comparison of calculated costs and estimated benefits of joint CGIAR–NARS investments under three estimates of aggregation of economic impacts and two time periods



How realistic are the lower-bound benefit–cost ratios produced by the analysis? In the analysis, the exclusion of some recognized benefits from research was either conscious or unavoidable. Benefits that were not exclusive to SSA (that spilled either into or out of the region) were excluded by the authors. Estimates of the benefits of one particular area of research (crop germplasm improvement) covered eight food crops – beans, cassava, maize, millet, potato, rice, sorghum, and wheat – which together contributed US$2.4 billion towards the estimated total potential benefits of US$17.3 billion. However, within this group of crops, the benefits for millet, potato, and sorghum did not cover a comprehensive geographical area but were assessed only from the documented adoption of specific varieties in specific countries. Thus, in total, benefits were estimated only for approximately 8.9 million hectares planted with improved species, leaving 2.3 million hectares excluded from the analysis. This certainly suggests that the estimated benefit of US$2.4 billion for research into crop germplasm improvement was an underestimate.

The absence in the analysis of several types of CGIAR–NARS research is notable and consideration was given as to whether the missing benefits that should be associated with this research were due to the lack of assessment, or to lack of impact itself. For some commodity research (such as that on groundnut, sorghum, and rice), as well as for natural resource management, the evidence of documented adoption suggests that missing benefits are principally due to lack of assessment rather than lack of impact. If this is the case, the benefits included in the analysis are an underestimate of true benefits.

The authors acknowledge some limitations that can be improved upon in future impact assessment analyses. Specifically, the limited number of studies included in the assessment made it difficult to conduct a comprehensive analysis of the CGIAR's total investment portfolio. In addition, the vast majority (almost 85 per cent) of documented benefits came from research into biological pest control (a field which was, in turn, overwhelmingly dominated by one intervention – the control of cassava mealybug). Most other benefits were derived from research into crop germplasm improvement, leaving only a paltry 1 per cent of total benefits derived from other activities. This imbalance of research coverage certainly places restrictions on the extrapolation of the results.

The evidence from this analysis shows that total benefits fully recover total CGIAR–NARS investments to date in SSA under all but the most stringent conditions of analysis. Only in the most conservative scenario – in which demonstrated benefits to 2004 only were considered – did the aggregated benefits fail to cover the total investments. Here, the estimated deficit was US$1.3 billion However, several missing or non-quantified estimates of 'plausible' or 'substantially demonstrated' benefits for which adoption was documented, and the limits placed on the length of time over which the benefits extended, suggest that the actual deficit may be lower than reported in this assessment, or non-existent. The benefit–cost ratios reported in the study should therefore be viewed as the lower bounds of possible ratios, which are likely to be substantially higher in reality.

Notes

1 The full version of the study on which this brief is based is:
Maredia M.K. and Raitzer D.A. 2006. *CGIAR and NARS Partner Research in Sub-Saharan Africa: Evidence of Impact to Date*. Working Paper. Science Council Secretariat: Rome, Italy.
The study is available at http://impact.cgiar.org/

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