Research Quality at ICRISAT:
Separating the grain from the chaff

Ma Cynthia S Bantilan, Subhash Chandra, Dyno Keatinge
and Pradeep Mehta

1. Introduction and objectives

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is one of the agriculture research centers of the Consultative Group on International Agricultural Research (CGIAR), which is an informal association of over 50 members that supports a network of 15 international research centers in agriculture, forestry and fisheries. The CGIAR aims, through its support to the Centers, to contribute to promoting sustainable agriculture for food security in developing countries. Because the Centers constitute the core of the CGIAR, the effectiveness of ICRISAT and other Centers is crucial to the continued success of the CGIAR as a system. The CGIAR has established a tradition of external reviews to provide a mechanism of transparency and accountability to the members and other stakeholders of the CGIAR. The monitoring of quality of science is important to ensure that the Centers are producing transparent and quality research outputs that align with the agenda of the CGIAR. External Program Reviews (EPR) provide a measure of central oversight and serve as an essential component of the CGIAR's accountability system. It complements the Center Commissioned External Reviews (CCERs) by providing a CGIAR-commissioned comprehensive external assessment of the Center's program and management, especially its relevance and quality of research and future directions. These reviews assess the mission, priorities and strategies, relevance and quality of science, effectiveness and efficiency of research leadership and program management and accomplishments and impact.

The most recent EPR of ICRISAT in 2003 focused primarily on the relevance and quality of science. Relevance relates to researching the "*right things*" to address the system's goal. Quality relates to researching the "*right things well*." According to the guidelines by the CGIAR, for science to be *relevant*, it should address practical problems and issues whose solutions will have measurable, significant impact on the goals of the system. Thus, the relevance of the identified research priorities and strategies to the CGIAR goals and mission, and the nature of the planning and consultation process, including ex-ante analyses of need and potential impact to formulate the priorities and strategies, are important elements in defining relevance. *Quality of science* includes aspects related to the correct formulation of hypotheses, the appropriateness of scientific inputs, research methodologies and processes, and research outputs and outcomes.

Achieving and promoting quality of science is the benchmark by which ICRISAT attempts to fulfill its mission of effectively addressing research-for-development issues in the Semi Arid Tropics (SAT). A number of processes for planning and monitoring science quality are in place as outlined in section 2.3. ICRISAT activities like the Edialog[1] and Crazy Ideas Hour[2] provide a forum for staff to voice their views and concerns about science and related issues. The recent views of scientists in these fora highlight their concern for relevance and quality of science, especially in the light of the competitively changing external environment. The scientists recognize the importance of the need to focus on quality of research in order to bring credibility to the Institute and in increasing the confidence of donors in the Institute's capacity to effectively deliver international public goods in a timely fashion.

This paper aims (1) to provide a background and overview of the mechanisms that are in place for ensuring science quality at ICRISAT and (2) to assess how scientists perceive the relative significance of the range of research outputs produced by ICRISAT. The results of this assessment are intended to more objectively monitor the quality of science and facilitate the external review processes. The first

1. A platform to discuss issues confronting the Center and build consensus through virtual interaction among the staff of ICRISAT.
2. An informal gathering of the staff to elicit ideas and opinions on the key issues confronting ICRISAT.

objective is covered in section 2. The methodology used and the results obtained to meet the second objective are presented in sections 3 and 4. Section 5 presents an outline of possible future directions to enhance research quality at ICRISAT.

2. Research at ICRISAT

2.1 The research continuum

In the three decades of ICRISAT's history, its scientific (and training) portfolio has continued to evolve in response to both the changing regional and global priorities and opportunities in the SAT, the needs of National Agricultural Research System (NARS) partners as well as the research requirements of development investors. In the last 10 years, this evolutionary change has been not only rapid but also far reaching as the emphasis was refocused from the principal target of improving crop and livestock productivity to that of achieving impact on sustainable livelihoods, poverty eradication, food security and the protection of environmental resources. These changes have considerably expanded the fields of research in ICRISAT which required it to engage itself across the research for development continuum encompassing basic, strategic, adaptive and applied research. Changing demands also encouraged the production of a whole range of research outputs.

As the Institute was established for the SAT in the early 1970s, the Institute engaged in strategic and basic research, eg, development of breeding populations and germplasm characterization. In later years, scientists increasingly engaged in both applied (the development of technology with testing leading to an identifiable product) and adaptive research (the final stages of testing leading to release by the national programs). As an international Institute, International Public Goods (IPGs) are considered important research outputs for the Institute. Of late, scientists have also been required to be involved in activities like producing public awareness flyers that fall at the most applied end of the research continuum.

The question that this scenario requires us to seriously address is "Do we need to work across the whole research continuum; should we be working only for IPGs; or should we restrict the Institute to strategic and basic research rather than working to produce the present wide range of research outputs?"

In 2003, ICRISAT has organized its research along six global themes:

Global Theme 1: Harnessing biotechnology for the poor

Global Theme 2: Crop improvement, management and utilization for food security and health

Global Theme 3: Water, soil and agro-diversity management for ecosystem resilience

Global Theme 4: Sustainable seed supply systems for productivity

Global Theme 5: Enhancing crop-livestock productivity and systems diversification

Global Theme 6: SAT futures and development pathways

2.2 The research process

The process of research to solve a rigorously identified practically relevant problem involves the following sequence of steps which is the responsibility of individual scientists to ensure theoretical soundness and methodological rigor:

a. Formulation of objectives/hypotheses
b. Formulation of an objective-driven research protocol that includes
   - Selection of treatments and/or research entities to be studied

- What will be measured? Selection of study variables
- At what level(s) will it be measured? eg, plant, plot, farmer, household
- How and when will it be measured? Measurement protocols
- Where will it be measured? Target environment(s)
- Identification of possible sources of bias and variation
- Selection of experimental/sampling design and number of replications and/or sample size
- Data entry and management protocol
- Data analysis protocol
- Who will do what and when?

c. Proper execution of the research protocol to generate high quality data
d. Data screening to check for possible errors
e. Data analysis
f. Interpretation of results
g. Publication of findings
h. Monitoring and evaluation
i. Impact assessment

These aspects of the research process are discussed and agreed by research teams working on a common problem.

2.3 Science quality

The quality of any scientific study could be determined from the quality of its outputs, which, in turn, depends on the extent to which the study has assiduously followed the steps of the *research process* as outlined above. This in turn depends on the quality and professional competency of staff conducting the study and, of course, the level of funding they have to execute the research. Science quality therefore has broadly four determinants: inputs, processes, outputs and performance, and monitoring and evaluation with the first three determinants discussed below.

2.3.1 The inputs

As a foundation of the quality assurance process, ICRISAT has an established transparent selection process and incentives to attract and retain the highest quality of staff. To continually maintain the quality of science, the staff are provided with training opportunities within budget constraints. These include among others:

- Institute level scientific seminars
- External feedback and peer review on scientific papers and draft grant proposals prior to submission
- Workshops and seminars in writing successful research grant proposals
- Seminars on topics that impact upon research effort (eg, Intellectual Property (IP), research commercialization)
- Guest speakers, eg, prominent researchers invited to present their research interests and discuss their research findings
- Training workshops on research tools, which include, among others, biometrics and biometric computing software.

Competitive research funding and rewards to staff, in the form of appreciation letters and monetary incentives, are in place to further boost performance and quality of research.

2.3.2 The processes

The processes include the following issues:

1. Standards and code of practice. ICRISAT is committed to the highest possible quality standards in the conduct of its research and complies with relevant national and international codes of practice. Individual researchers maintain these standards through supervision of their research support staff and students, including design of research protocols, collection and recording of data, biometric analysis, interpretation of results, preparation of manuscripts for publication and presentation of research outputs. In this endeavor, the Biometrics Unit, as and when approached, provides advice to staff and their students on research design and data analysis. The Unit also organizes need-driven training courses for the staff/students in applied biometrics and biometric computing software.

2. Promotion and support of research. The Program Committee of the Governing Board and the Institute's Research Committee (RC) are the highest bodies that plan and regularly monitor research quality in ICRISAT. The RC, chaired by the Deputy Director General–Research (DDG-R) with the Global Theme Leaders (GTLs) and the Regional Representatives as its members processes and recommends Institute's research plan and policies to Management Group (MG) and eventually to Governing Board (GB). These plans provide appropriate research review mechanisms and performance indicators. Besides, two global meetings are held two times a year to review the progress of research and approve strategic plans. The development of the Institute's strategic plan provides for participation and strategic partnerships among diverse stakeholders, considering the Institute's comparative advantage and recognized excellence in implementation and delivery of research outcomes. The Institute's research implementation builds on its strengths through collaborative partnerships and proper management of IP issues.

The Impact Assessment Unit (IAU) and Biometrics Unit provide the necessary technical backstopping to staff. The IAU provides technical backstopping for setting research priorities and assessing impact to ensure relevance of research. The Biometrics Unit provides advice on research design and data analysis to facilitate scientific rigor.

The Project Development and Marketing Office (PDMO), in collaboration with the DDG-R and the GTLs, liaises with funding agencies and promotes links with potential sponsors of research and commercial partners. It also actively encourages staff to seek funding opportunities and assists them to prepare successful applications. Seminars are organized to improve grant applications. The resultant feedback helps improve the application and also provides a form of "quality" training for staff.

3. Reviews. Under the Performance Management policy of the Institute, the GTLs and the DDG-R regularly review the performance of staff. This review addresses areas of research goals and achievements. The criteria for the annual evaluation include, among others

- Publications
- Training and Partnerships
- International Public Goods (IPGs)
- Resource Mobilization

4. Intellectual Property (IP) and commercialization. The Office of the DDG-R has initiated monitoring of Intellectual Property issues and provides guidelines for research collaboration with partners with a view to encourage staff to be active in conducting applied research, contract research and consultancies, and commercializing their IP. Current IP related initiatives include

- IP awareness through an Intranet web site and forum meetings by inviting IP specialists.
- Negotiations with prospective private sector partners.

- Timely measures to register trademarks/brands.
- Contracts for out-sourcing specific biotechnological research.
- Effective consultation on various IP issues with the CGIAR Central Advisory Service and IP specialists within CG Centers.
- Taking stock of IP assets through a formal disclosure process.
- Training programs for scientists on various IP issues, plant variety protection, negotiation, drafting skills etc.
- Execution of various agreements by incorporating IP clauses (viz. Memoranda of Understanding/ Agreement, Material Transfer Agreements, Confidentiality Agreements etc.)

2.3.3 The outputs and performance

The whole range of outputs of research at ICRISAT is classified into four broad categories: Products, Editing, Writing and Training. These are analyzed in section 4. ICRISAT has identified these as output indicators against which the research performance of each staff member is planned to be regularly monitored. With decline in funding resources, ICRISAT research management has reiterated the need to focus its research efforts and resources in key areas of proven excellence. Over the years, there has been a progressive consolidation of research effort. As a result of this exercise, the Institute reduced (in last two years) the number of its research portfolios to six themes from 12 projects. Medium Term Plan (MTP) documents give the list of outputs and milestones for these themes as it is planned in cycles of three years.

ICRISAT recognizes the importance of benchmarking its research performance to assess the relative standing of its staff at national and international levels. In this regard, account is taken of prestigious national and international awards and invitations as keynote speakers. Where appropriate, consideration is given to meritorious achievements through the awarding of certificates and remuneration. Among the awards presented annually are

- *The Doreen Margaret Mashler Distinguished Scientific Achievement Award* – This is a gift from Dr. William T Mashler, former Chairman of ICRISAT Governing Board. The purpose of the award is to provide recognition of outstanding scientific achievement in the biological or social sciences contributing to ICRISAT's mandate, encourage scientific excellence among the research staff, reward creative scientific endeavor, and create a perpetual memorial.
- *The Millennium Science Award for outstanding scientific achievement* – This award is modeled after the CGIAR Chairman's Annual Awards, to ensure that the staff members chosen to be submitted for the CG Award consideration deserve the highest internal recognition whether or not they are chosen in the system wide selection process. The following are the six categories of this award – Outstanding Scientist, Promising Young Scientist, Outstanding Scientific Support Team, Outstanding Partnership, Outstanding Scientific Article and Outstanding Journalist.

2.4 The problem of assessment

Previously and as recently as 2002, the quality of scientific outputs were rather crudely assessed. Of "scoring" value under the old system were things such as the number of varieties released, the number of higher degree students trained, the overall number of trainees, the number of workshop papers presented and finally the number of scientific journal articles published. In the latter case, attempts were also made to make a bibliometric analysis in which statistics such as the average impact factor of published journal articles or the number of citations per article was considered. Concentration on

bibliometric analysis totally ignores a whole range of products of relevance to the Institute within the context of its mandate. An alternative mechanism of evaluation which recognizes all important research products will therefore be more appropriate. Increasing the relevance of impact-oriented products is also noted. What is needed is a system by which all "creditable" outputs can be considered and if possible to provide an appropriate weighting by which their totality can be calculated per scientist or per institution. There certainly is a need for a mechanism to enforce and measure science quality in a more realistic and comprehensive way.

For example, today in a world dominated by the need for impact, what relative value should be placed on a paper about cropping systems in the Sahel in the Australian Journal of Agricultural Research (Impact factor around 0.7) versus the same paper being published in the African Crop Science Society Journal (Impact not calculable but assumed to be 0)? This judgment also has to be made within the context of the intended recipient audience in which the impact is to occur. It is assumed that ICRISAT's principal target audience in this case is in fact NARS scientists in Africa. The cost of the annual subscription to the Australian Journal is around $700 (beyond what most NARS libraries can afford) and that of the African Journal about $50. Moreover, most of the papers in the latter Journal are presently also given at the annual African Crop Science Society Meeting which is well attended by African NARS scientists. Impact-oriented measurement requires higher weights to outputs reaching the ultimate clientele.

A second example of this problem would be what relative weight should one ascribe to a patent description of a gene for a specific beneficial trait versus the production of a community plan for improved watershed management? These are very difficult questions to resolve but they do need to be addressed if a relatively equitable system to judge scientific output is to be devised.

3. Methodology

A comprehensive list of 97 relevant scientific outputs was prepared in consultation with nearly all the scientists at the Global Planning Meeting in December 2002. These outputs were placed into four broad categories: *Products*, *Training*, *Writing* and *Editing* (Figure 1). As listed in Figures 2A and 2B, *Products* contain 25, *Training* 24, *Writing* 38 and *Editing* 10 outputs.

All scientists across the Institute were individually asked in January 2003 (through email) to rate each output on a 1–10 scale in terms of its perceived benefit/significance to the Institute rather than to individual scientists, with 1 being the least important and 10 being the most important. In addition, they were asked to allocate their proportion of time per GT as part of the survey. Responses were received from 69 scientists, which represents more than 95% of all scientists in ICRISAT located in Asia and Africa.

The rating data were analyzed separately for each GT. This was done in view of the likely inherent heterogeneity in the way the different GTs might perceive the benefit of an output to the Institute. With a response rate of more than 95%, we have data from nearly the whole population of each GT. Sampling error in our inferences can therefore be considered to be effectively absent. On this basis, as also due to the responding scientists not being a random sample, formal statistical tests of significance were not used in drawing inferences.

The box-and-whisker plots showed that the data on many outputs in each category were highly skewed. Therefore, to get comparable results, we chose the median and the median absolute deviation (MAD) in preference to the mean and the standard deviation (SD) to describe respectively the location (central tendency) and the scale (dispersion) characteristics of each GT population. The former two, as

they possess the maximum possible breakdown (explosion) point of 50%, are robust non-parametric measures. The mean and the SD have a very low breakdown point of 1/N, N being the number of observations. The breakdown point is the smallest fraction of observations that have to be replaced by outliers to throw the value of the location/scale measure outside reasonable limits. For the mean and the SD, a single outlying observation alone out of N is enough to disrupt things substantially. For the median and the MAD, at least 50% of the observations have to be outliers to alter their values. These, therefore, could be expected to be much more stable than the mean and the SD.

The median and the MAD were computed for responses on each output for each Global Theme (GT) separately. For each category, the output x GT data matrix of median responses was subjected to the average linkage hierarchical cluster analysis using Euclidean distance as a measure of (dis)similarity. The results were pictorially summarized in a dendrogram to visualize how similarly the different GTs perceived the benefits of the outputs in a category.

In order to obtain an Institute-wide picture of perceived significance of an output in a given category (Products, Training, Writing or Editing), the average response for the output across the GTs was computed as a weighted median $m = \Sigma_j w_j m_j$, where $w_j=(1/s_j^2)/\Sigma_j(1/s_j^2)$ is the weight given to the median m_j and s_j is the MAD for j^{th} GT ($j = 1,\ldots,6$). This weighting scheme duly accounted for the variability in the responses within the GTs in order to obtain an objectively derived Institute-wide average response. These average responses were ranked in each category and across the categories to identify the most important Institute-wide outputs.

4. Results and discussion

This section comprises of two parts. Sub-section 4.1 discusses the heterogeneity in perceptions of scientists belonging to different disciplines on research outputs in various categories. This heterogeneity will basically reflect the disciplinary inclination of scientists in different GTs. Sub-section 4.2 discusses the results of an Institute-wide relative importance of research outputs.

4.1 Differences and similarities among Global Themes

The dendrogram in Figure 1 reflects the grouping of GTs according to their similarities of median response across the outputs in a given output category. For the products category, GT6 forms its own distinct group. In the other broad group containing the remaining five GTs, GT3 and GT5 are closer to each other. In the writing category, a similar pattern is visible, with GT2 and GT4 also falling in one cluster.

In the editing category, the GTs form two broad groups: {GT3, GT6} in one cluster, and {GT1, GT2, GT5, GT4} in another cluster. In the latter cluster, GT1 and GT2 are closer to each other. The training category exhibits two broad clusters: {GT2, GT5, GT4} and {GT1, GT3, GT6}. As in the editing category, here also GT3 and GT6 are closer to each other.

The maximum heterogeneity among GTs exists for the products category, with GT6 being separated maximally from the other GTs. In the other categories, the degree of separation among GTs, despite the apparent clustering present in the dendrograms, is not to the same extent as in the products category.

The graphs in Appendixes depict how a particular GT's median response deviates from the Institute-wide average response on different outputs in a category. The X-axis in these graphs depicts the outputs in a category in their decreasing importance for the GT concerned. The ranking of outputs in different categories in GT1 seems to follow more or less a trend that is similar to that at the Institute level. A similar result appears to hold for GT2, except that, at the far end of the spectrum in the

Products category, it shows a larger deviation from the Institute level average. GT3, GT4 and GT5 also seem to closely follow the Institute-level average trend. GT6 generally tends to give a lower rating than the Institute level rating in nearly all the four categories, the maximal deviation being for the Products category. This observation on GT6 is in line with its maximal separation from other GTs in the products category's dendrogram (Fig. 1).

4.2 Relative importance of research outputs

The four diagrams in Figures 2A and 2B depict the Institute-wide average response across the six GTs for the four categories of outputs. The X-axis in these diagrams depicts the outputs in a category in their decreasing importance. In the ***editing*** category, books, journal special issue editions, conference proceedings and papers for external journals receive higher priority. External peer reviewing of papers ranked as more important than doing the same job internally. The necessary but unrewarding task of editing Global Theme Reports is ascribed a relatively lower rank.

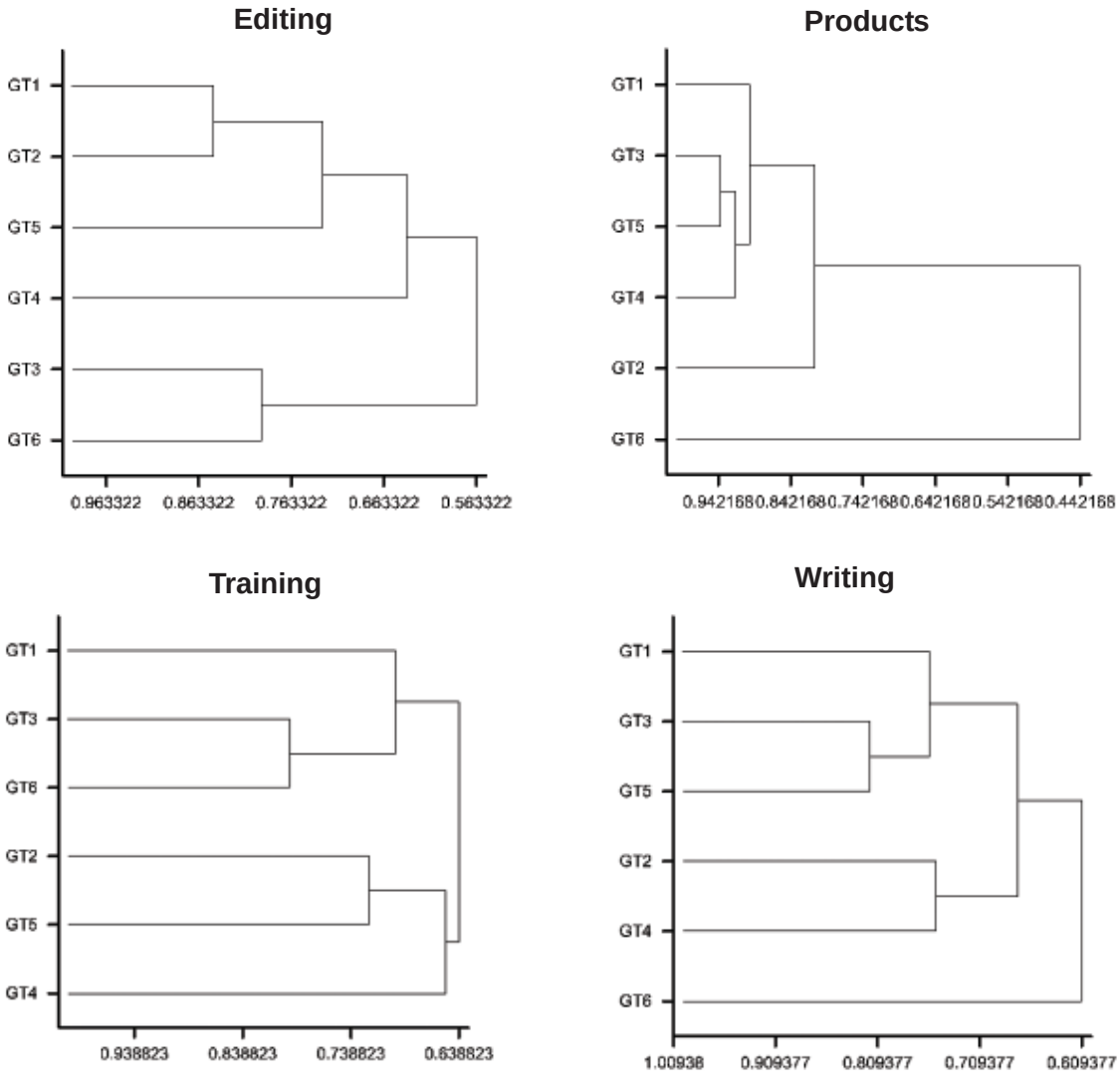


Figure 1. Average linkage dendrograms for Global Themes

For the ***training*** category, the five topmost priorities among the 24 outputs are partnership building, visitors (donors), stakeholder workshops, higher degree students and training workshops. These are followed by young scientist in-house mentoring (Rank 6), field days (Rank 7), policy briefings (Rank 8), farmer field schools (Rank 9) and training courses (Rank 10). The extension/NGO demonstration and inter-center team building fall at ranks 11 and 13. Visitors (general public for education), PR collaborations, project study tours and retreats, other students and non-degree training have been ranked as the least important.

In the case of the ***writing*** category, in a list of 38 outputs, the 10 topmost priorities are books, journal articles (hard copy), edited books, book chapters, project proposals, policy briefs, concept notes, technical bulletins, ex-post impact reports, and varietal/chemical product descriptors. The hard copy of the journal articles was ranked substantially higher than the soft copy. The high rating for concept notes and project proposal documents reflect the increasing amount of time that scientists have to spend on these activities. Conference papers, patent documents, invention disclosures, ex-ante impact reports have got the middle level importance whereas activity profiles, bibliographies, engineering blueprints and trademark establishment documents have been ranked as least important.

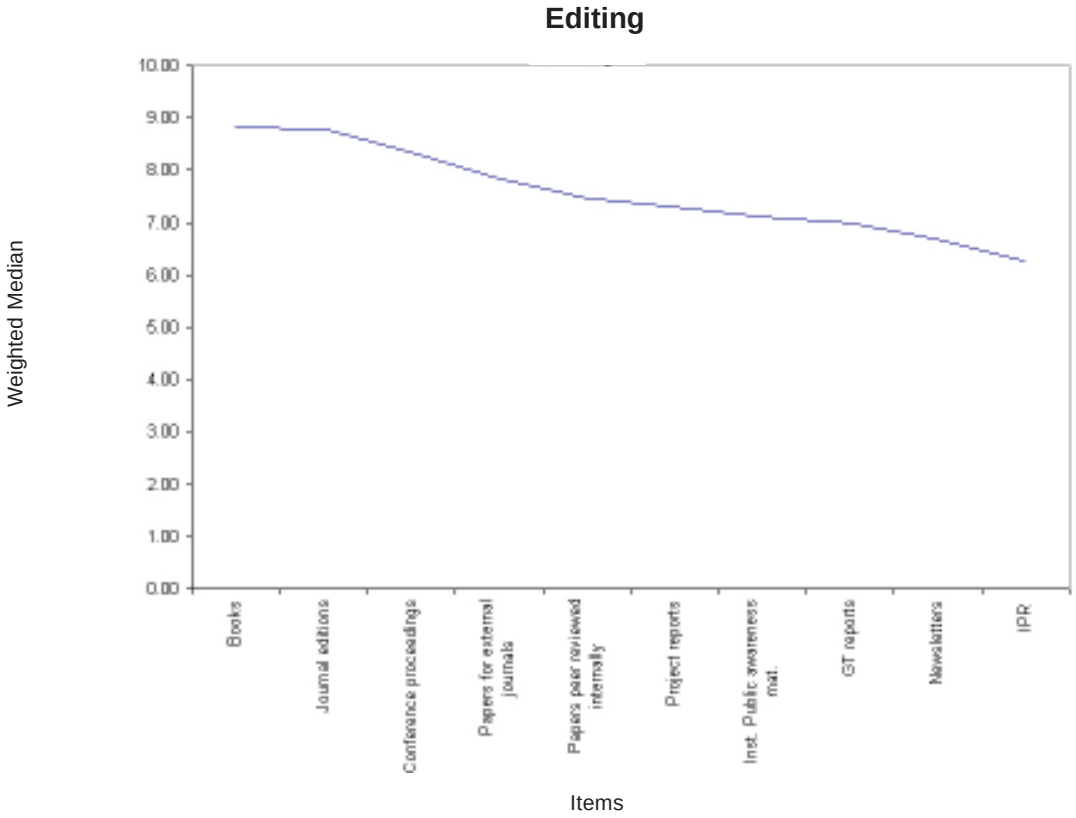
Among the 25 items in the ***products*** category, the 10 topmost priority outputs are new techniques for scaling out and up, new varieties, introgression lines for fundamental research, biotech products, new techniques, IPM strategies, INRM strategies, watershed management plans, seed system design and biotech constructs. Improved germplasm, crop/livestock integration strategies and protocols/tools fall at the middle of the range. Lower priority items include post harvest machinery, chemical products, computer software, pre-breeding derivatives, biocontrol agents and other GIS products.

Figure 3 depicts the Institute-level ranking of all (97) outputs across the four output categories based on the Institute-level average responses in the four categories. The top 20 winners are books, journal articles (hard copy), journal special issue editions, edited books, book chapters, new techniques for scaling out and up, new varieties, project proposal documents, partnership building, visitors (donors), conference proceedings, introgression lines, stakeholder workshops, biotech products, new techniques, policy briefs, higher degree students, Integrated Pest Management (IPM) strategies and Integrated Natural Resource Management (INRM) strategies.

It is clear that products related to writing activity (books, journal articles, edited books, journal special issue editions, book chapters etc.) are highly valued by the scientists. High importance ascribed to project proposal documents, partnership building and visitors (donors), reflects the increasing amount of time that scientists have to spend on these activities. They clearly recognize that this is critical activity for the continuance of the Center and its service to the SAT. Much importance is also placed on the development of appropriate strategy in INRM and IPM, which underlies the importance of the quality of International Public Goods (IPGs). Conference proceedings and stakeholder workshops have become important for the Institute in the wake of uneven funding.

Traditional areas of value such as higher degree students remains highly rated. ICRISAT scientists have retained old virtues and taken on board the new values of impact generation with new varieties, novel approaches as well as new techniques for scaling out and up. New types of activities such as policy briefs and biotech products are also on the priority list. The least preferred items across the Institute includes engineering and other blueprints, bibliographies, activity profiles, press releases and news items, along with chemical products, trademark establishment documents, computer software and post harvest machinery. The lower importance ascribed to institutional internal policy documents, internal reports and research notes and institutional change documents is a cause for concern.

As discussed in earlier section, the Institute-level picture drawn above tends to be different, if we further disaggregate and look at the discipline or scientist level. Since each discipline within an Institute



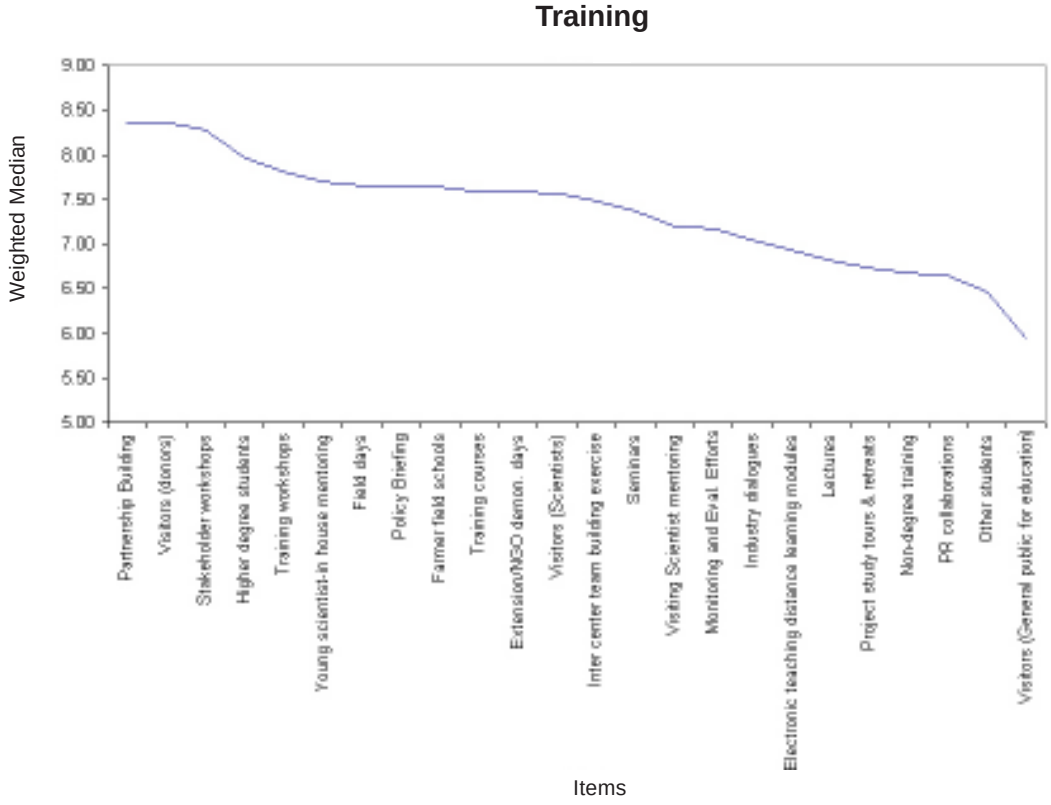


Figure 2A. Relative ranking of outputs in Editing and Training categories across Global Themes

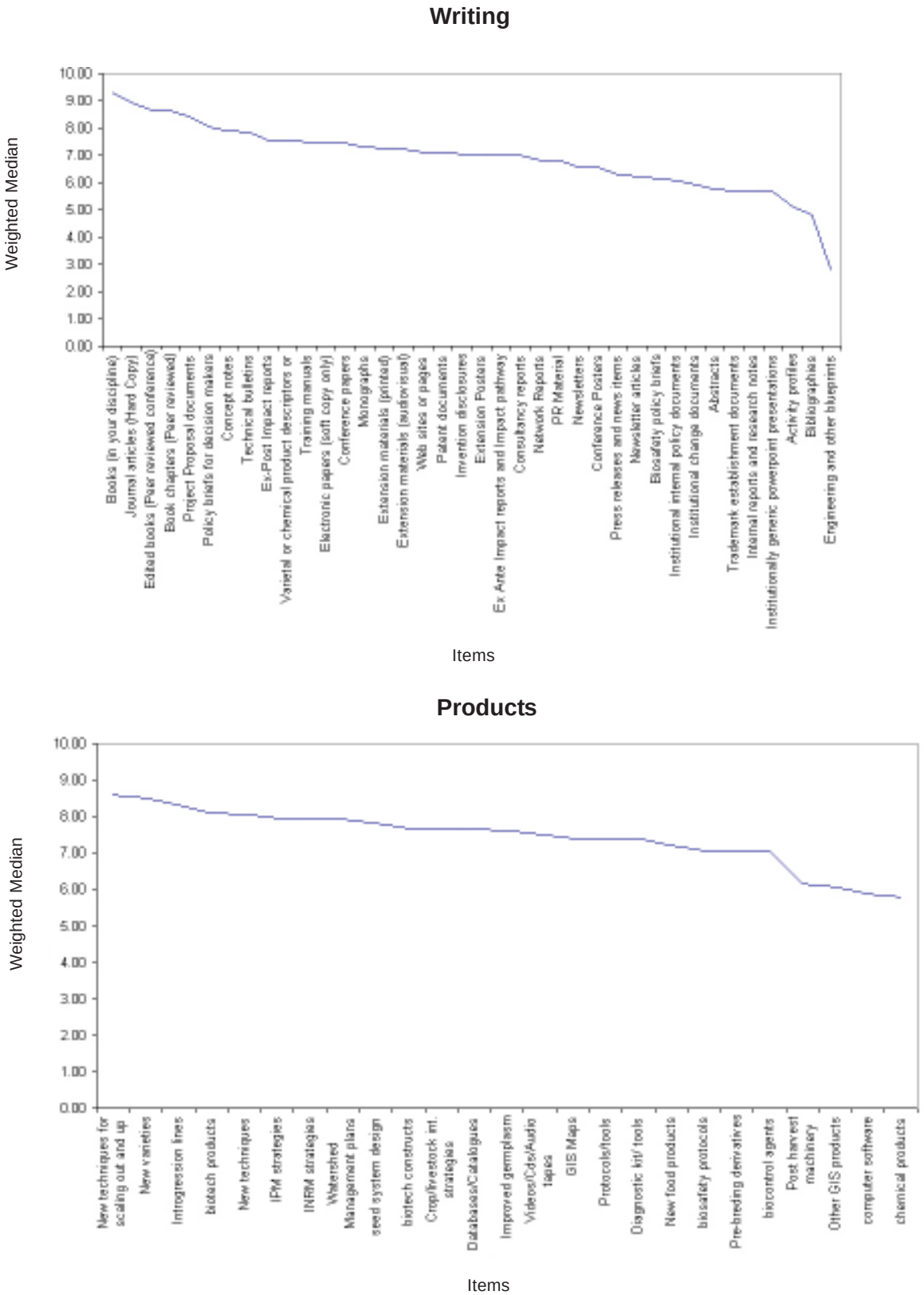
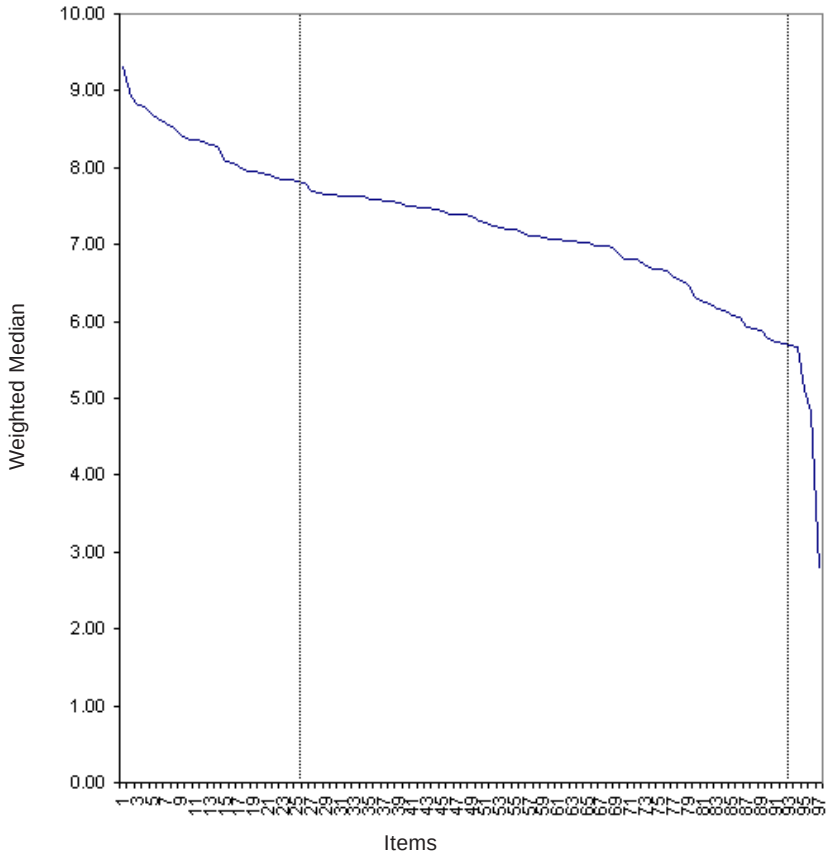


Figure 2B. Relative ranking of outputs in Writing and Products categories across Global Themes



Top 20 out of 97 items

1. Books (in your discipline)
2. Journal articles (hard copy)
3. Books
4. Journal special issue editions
5. Edited books
6. Book chapters
7. New techniques for scaling out & up
8. New varieties
9. Project proposal documents
10. Partnership building
11. Visitors (donors)
12. Conference proceedings
13. Introgression lines for fundamental research
14. Stakeholder workshops
15. Biotech products
16. New techniques
17. Policy briefs for decision makers
18. Higher degree students
19. IPM strategies
20. INRM strategies

Last 20 out of 97 items

78. Conference posters
79. Other students
80. Press releases and news items
81. IPR and patent documents
82. Newsletter articles
83. Post harvest machinary & storage design
84. Biosafety policy briefs
85. Institutional internal policy documents
86. Other GIS products
87. Visitors (general public for education)
88. Institutional change documents
89. Computer software
90. Chemical products
91. Abstracts
92. Trademark establishment documents
93. Internal reports & research notes
94. Institutional generic PPTs
95. Activity profiles
96. Bibliographies
97. Engineering & blue prints

Figure 3. Relative ranking of outputs across output categories

differs in nature, it is quite obvious that the importance of outputs also varies according to the disciplines. Furthermore, the picture at the scientist-level also tends to differ as each scientist within the same discipline has a different suite of work and projects, which results in a different set of research for development outputs. Therefore, the measures that are applied at the aggregate level may not necessarily be the most appropriate at the individual level.

5. Summary, conclusions and future directions

This paper addressed important issues concerning the assessment of quality of research and training outputs which have evolved in ICRISAT during the last three decades in response to identified priority problems in the semi-arid tropics and changing needs of its stakeholders. The broader range of scientific outputs now produced reflects a decisive expansion across the research and development continuum given the various types of strategic alliances with partners of varying research capabilities and infrastructure. Thus, a realistic and appropriate approach for assessing science quality needs to recognize all creditable outputs and an appropriate weighing system by which the totality of scientific achievement could be evaluated.

An overview of the mechanisms that are in place for ensuring science quality at ICRISAT was presented in the first two sections of the paper. It described the research for development continuum featuring the range of outputs produced by scientists along this continuum. It also presented an analysis of the relative ranking among outputs in the scientific and training portfolio.

Simple non-parametric measures were adapted to analyze the ICRISAT survey data generated in January 2003. With the response rate of more than 95%, sampling error was considered to be effectively absent. As inherent variability in responses was expected given the respondents' varying scientific disciplines, analyses were undertaken by global themes. Subsequently, a weighing scheme duly accounting for the variability in responses within the GTs was adapted to obtain an objectively derived Institute-wide average response from which the most important Institute-wide outputs were determined.

The results have been scrutinized and synthesized to determine the relative importance of the whole range of outputs and to draw implications for enhancing ICRISAT's evaluation and quality monitoring process. Several questions were answered through the above analysis:

- What research outputs are viewed by scientists as significant to the Institute?
- To what extent are these views varying within and among different disciplines or global themes?
- What measurements are appropriate in deriving an objective indicator of the relative importance of outputs, taking into account the inherent variability? What relative weighing system is implied by the results of the analysis?
- What are the implications of the findings for ICRISAT's research appraisal and monitoring system?

The top 20 most significant outputs to the Institute relate to six outputs across categories:

1. Products related to writing scientific results (books, book chapters, journal articles)
2. New techniques, new varieties
3. Project proposals, visitors (specifically donors)
4. Partnership building, stakeholders workshops
5. New products/strategies (introgression lines, biotech products, policy briefs, INRM/IPM strategies)
6. Higher degree students

The bottom 20 least significant outputs include the following:

1. Engineering and blueprints, chemical products, post-harvest machinery and storage design
2. Internal reports, institutional change documents, institutional generic PPTs, activity profiles
3. Bibliographies, abstracts, biosafety policy briefs, newsletter articles, IPR/patent documents
4. Computer software, other GIS products
5. Press releases
6. Conference posters

The analysis of data by GT groups confirmed the specific disciplinary inclinations of scientists. This was expected and accounted for in the calculation of an overall Institute average response. As shown in Figure 3, a differential weighing may be required to reflect the varying degree of significance of different outputs to the Institute.

What implications can be drawn from the findings of this paper, particularly for enhancing the current mechanisms for monitoring science quality?

First, the paper featured three components of quality: inputs, processes and output/performance. The discussion in this paper on inputs and processes was a qualitative account of the current mechanisms in place at ICRISAT for ensuring science quality. It calls for comprehensive science

quality monitoring which includes measurements for inputs and processes, along with measurements for outputs and performance. Inclusion of the "processes" dimension relates to introducing "institutional learning" in the evaluation strategy.

Second, the analysis by GTs presented interesting distinctive rankings which imply reasonable GT-specific varying attribution of importance to outputs. The overall Institute-wide picture provided a reasonable basis for arriving at appropriate weights for the top 20 outputs according to their GT-specific relative importance. The results suggest higher weighting for outputs in the top range of the scale, and relatively lower weights for outputs at the bottom end. This type of differential weighing scale may serve as a basis for refining the present scientists performance evaluation system.

Third, the output types given top-most significance are consistent with the set of outputs included in the evaluation criteria currently used (see section 2.3) by ICRISAT Research Management, namely publications, training and partnership, IPGs, and resource mobilization. New products, more in line with IPGs such as biotech products, INRM and IPM strategies and policy briefs, are added to the list. This has strong implications on the need to review and enhance the current system of ensuring quality and rigor of research outputs, many of which are eventually disseminated through journal articles and books, or represented by tangible IPGs such as new varieties, techniques, biotech products, policy briefs, among others. The above results have specific implications for the need to empower the scientific quality assurance mechanisms specifically of the DDG-R and the GTLs through the Research Committee. Empowerment of scientific rigor and quality control through the Biometrics Unit and effective implementation of priority setting and impact assessment backstopping by the Impact Assessment Unit need to be institutionalized. The importance given to publications implies a need to address proactive measures for IRMO and PDMO to ensure quality/timely documentation and publication of research products.

Fourth, specific concerns were raised in the paper regarding scientists' attribution of lower ranks to institutional level reports, IPR documents and biosafety policy briefs. While these documents are critically important to ICRISAT Management, it is apparent that scientists view this otherwise. Appropriate consideration may be required by ICRISAT research management on how to handle the needed tradeoffs between Institute level documents critical to the Management and the Governing Board and journal articles.

Fifth, the importance attributed to project proposals, donor visitors, partnership building and stakeholder workshops has important implications for PDMO. Increasing awareness of the importance of scientists' attention to resource mobilization has been motivated by the continuing decline in unrestricted or core funds. As a result, a significant increase in time has been allocated to both project proposal development and follow-up. Improved donor intelligence is required to facilitate the effectiveness of scientists' efforts in this regard.

Sixth, the data collected through the survey provides important information about the wide range of outputs produced by the Institute. The ranking assigned to the outputs gives a useful picture of the critical or vital outputs for the Institute as a whole. In addition, the toolbox, which represents all set of outputs of the Institute, also may be used as a guideline to monitor or evaluate the performance of the scientists and to keep the balance across the whole range of outputs by prioritizing them according to the objectives. For example, each scientist is usually engaged in different set of projects and accordingly their priorities, objectives and hence outputs differ from their colleagues within the same discipline. Thus, the ranking system is useful for the head of the discipline to determine or identify the set of important outputs at the discipline and scientist level. This information can be used to formulate a strategy so as to keep the balance of the activities by proper allocation of time and resources. This kind of system also encourages more openness, flexibility and transparency in the system.

Seventh, what is needed next is to incorporate the range of the top-most outputs in a future evaluation process. What may be required is determination of "Total Output Quality" of individual scientists. This is difficult to ascribe in retrospect, but in future, it might be introduced in the existing appraisal system. This will require GT specific research output identification and their evaluation. This may be used as a reference point for monitoring staff performance. It also might be used to assess performance among staff within a GT, given an appropriate quantitative indicator determined for the GT. Finally, an aggregate measure of an overall score for the Institute may be used to compare performance across GTs and evaluation periods.

Finally, due to the very diverse nature of outputs from the global/regional projects being executed by international research centers that are in all stages of the project life cycle, it is suggested that a decentralized process using nested institutional, regional and project logframes would be a powerful tool in helping to identify milestones for institutional, regional and individual evaluation.

6. References

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Randall Brown J and **Ceyhun Ozgur**. 2002. Assessment of Research Quality. http://www.sbaer.uca.edu/Research/2002/dsi/papers/415.pdf. 6 pp.

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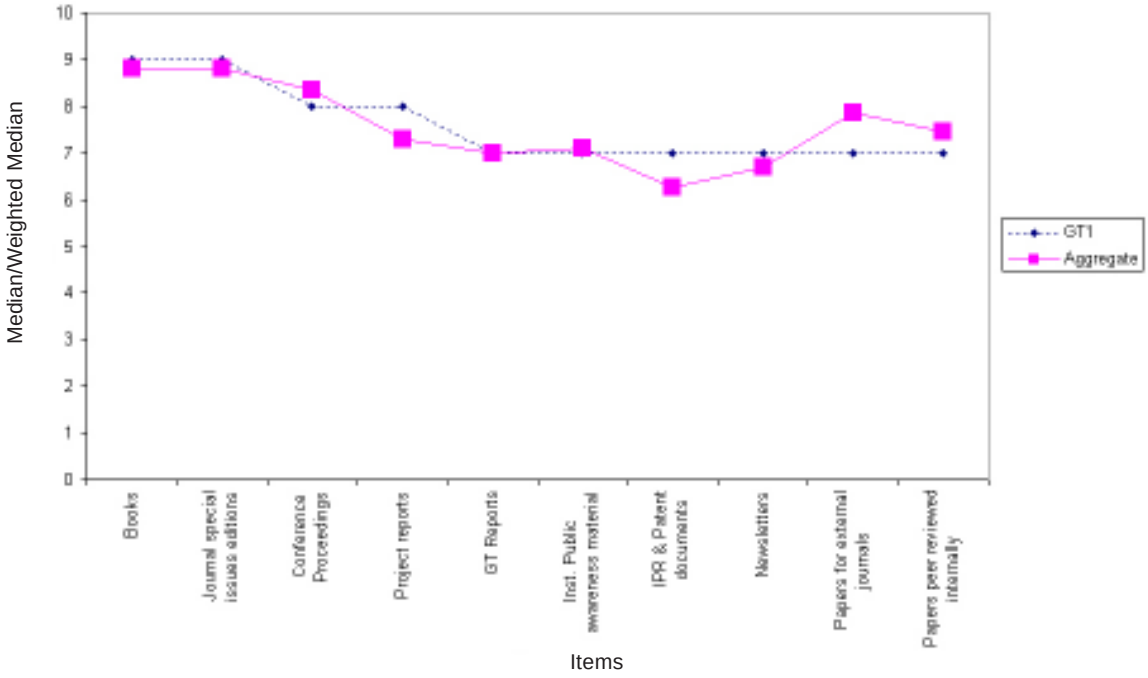
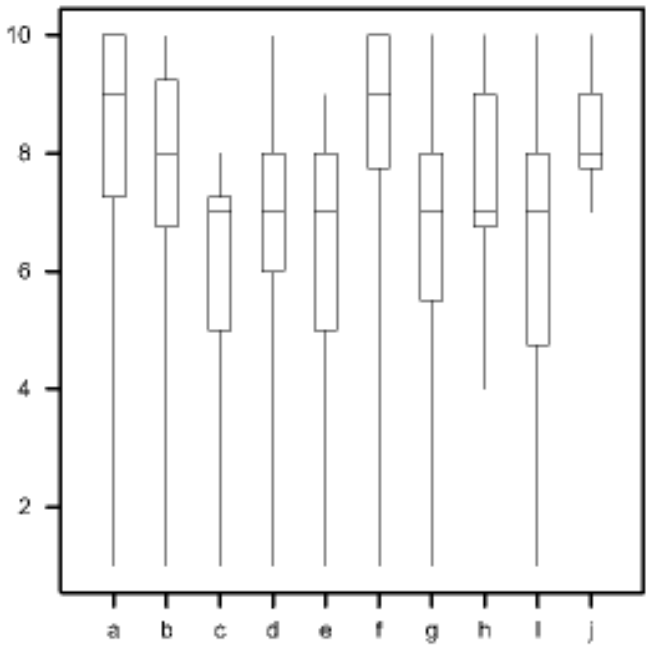
Appendix 1. Distribution of responses (Boxplots) and relative ranking of outputs in Global Theme 1.

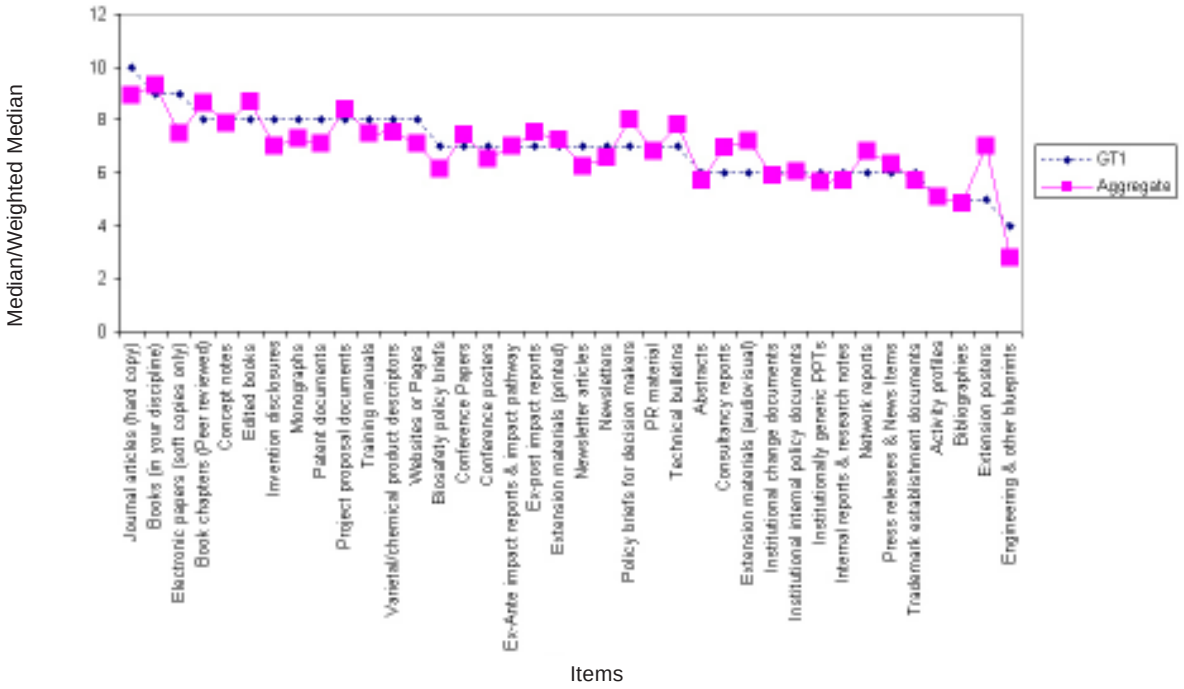
Editing

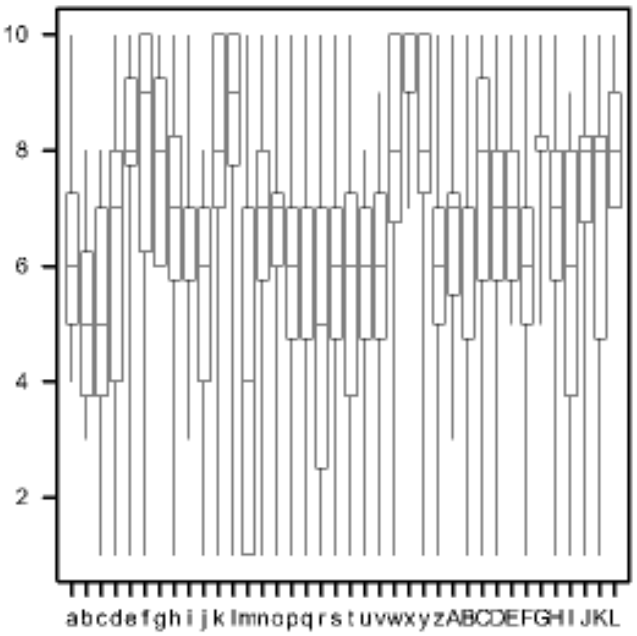




a – Books (your discipline, you are one of the principal editors)
b – Conference proceedings (your discipline, you are one of the principal editors)
c – Global Theme reports (For ICRISAT)
d – Institutional public awareness material
e – IPR and patent documents
f – Journal special issue editions (your discipline, you are one of the principal editors)
g – Newsletters
h – Paper for external journals (Assume you are doing 5 per year)
i – Papers peer reviewed internally for colleagues (Assume you are doing 5 per year)
j – Project reports (For donors)

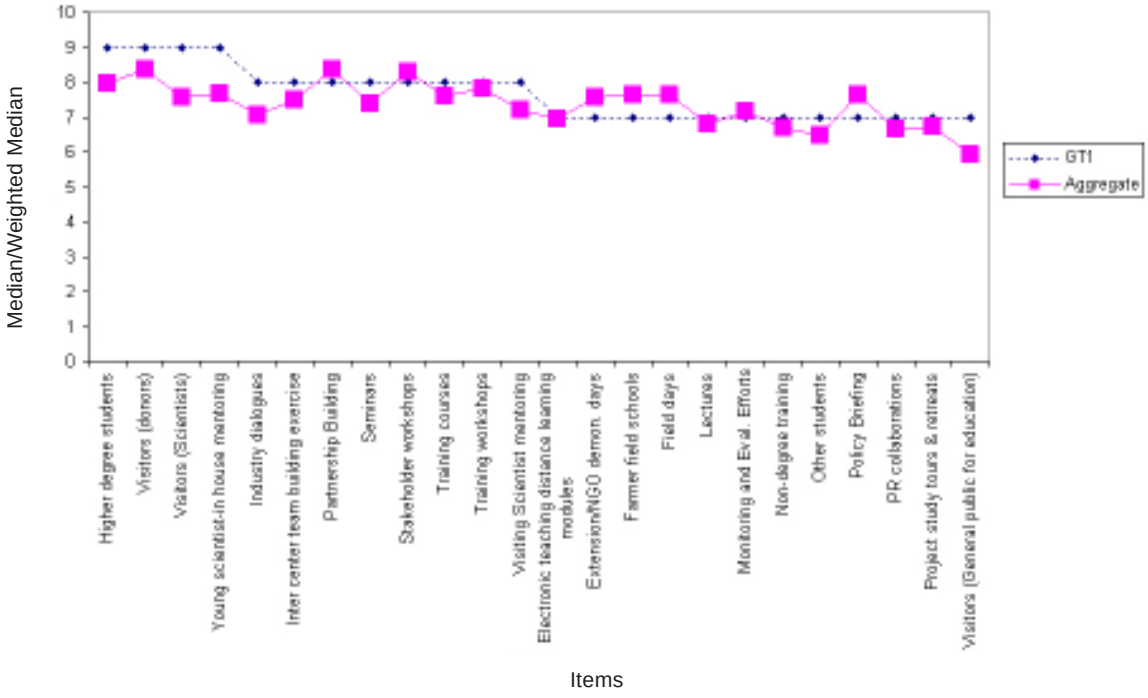
Writing

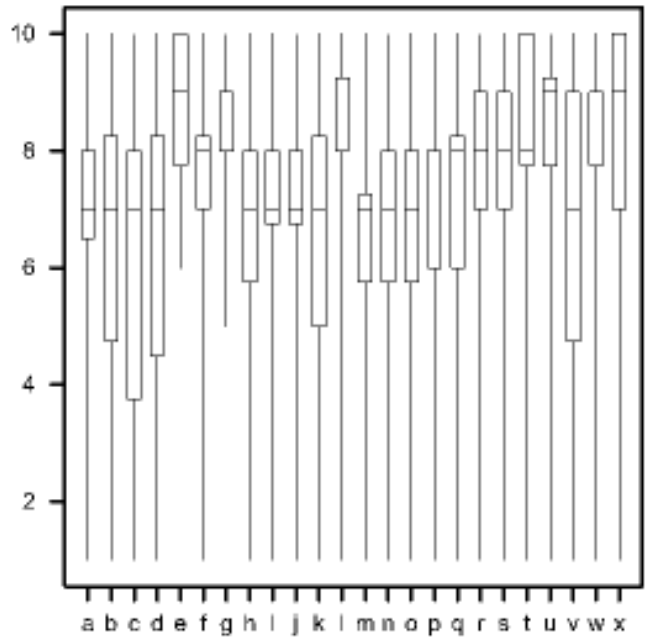




a – Abstracts
b – Activity profiles
c – Bibliographies
d – Biosafety policy briefs
e – Book chapters (peer reviewed in your area of specialization)
f – Books (in your discipline)
g – Concept notes
h – Conference papers
i – Conference posters
j – Consultancy reports
k – Edited books (peer reviewed conference proceedings etc)
l – Electronic papers (soft copy only)
m – Engineering and other blue prints
n – Ex-ante impact reports and impact pathway studies
o – Ex-post impact reports
p – Extension materials (audiovisuals)
q – Extension materials (printed)
r – Extension posters
s – Institutional change documents
t – Institutional internal policy documents
u – Institutionally generic power point presentations
v – Internal reports and research notes
w – Invention disclosures
x – Journal articles (hard copy)
y – Monographs
z – Network reports
A – Newsletter articles
B – Newsletters
C – Patent documents
D – Policy briefs for decision-makers
E – PR material
F – Press releases and new items
G – Project proposal documents
H – Technical bulletins
I – Trademark establishment documents
J – Training manuals
K – Varietal or chemical product descriptors or germplasm registration notes
L – Websites or pages

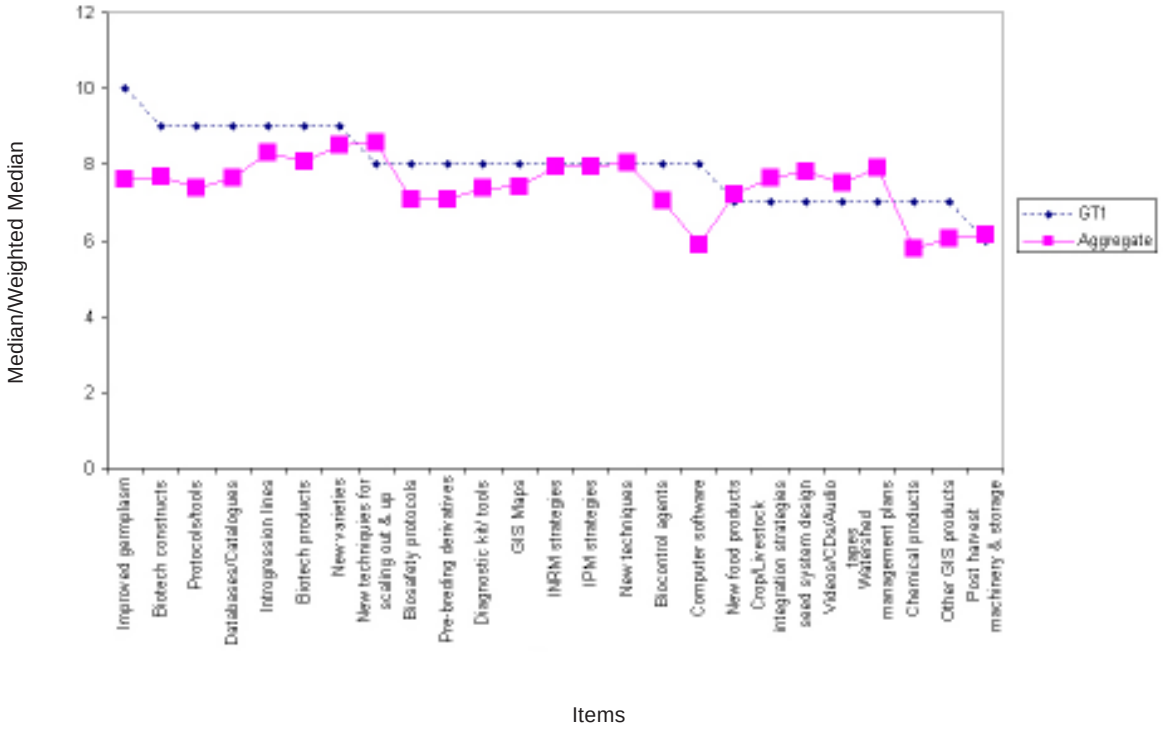
Training

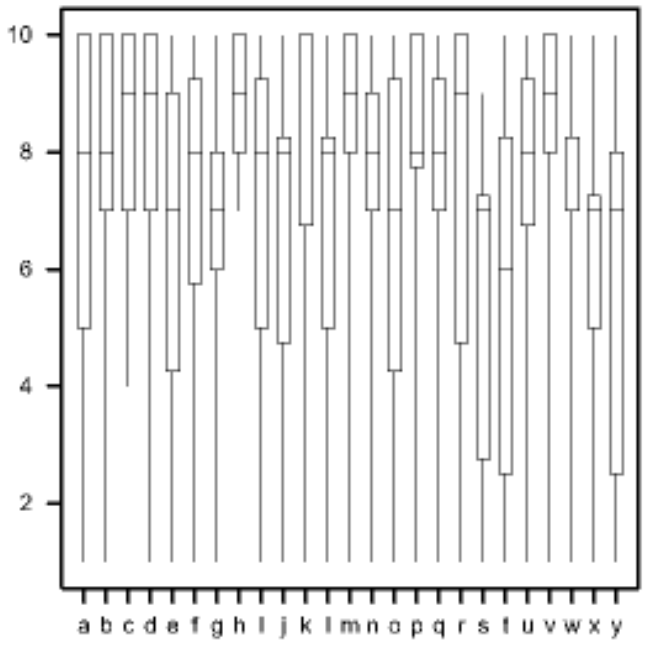




a – Electronic teaching distance learning modules
b – Extension/NGO demonstration days
c – Farmer field schools
d – Field days
e – Higher degree students
f – Industry dialogues
g – Intercenter team building activities
h – Lectures
i – Monitoring and evaluation efforts
j – Non-degree training
k – Other students
l – Partnership building
m – Policy briefings
n – PR collaborations
o – Project study tours and retreats
p – Seminars
q – Stake holder workshops
r – Training courses
s – Training workshops
t – Visiting scientist mentoring
u – Visitors (donors)
v – Visitors (general public for education)
w – Visitors (scientists)
x – Young scientist in-house mentoring

Products





a – Biocontrol agents
b – Biosafety protocols
c – Biotech constructs
d – Biotech products
e – Chemical products
f – Computer software
g – Crop/Livestock integration strategies
h – Databases/Catalogues
i – Diagnostic kit/ tools
j – GIS maps
k – Improved germplasm
l – INRM strategies
m – Introgression lines for fundamental research
n – IPM strategies
o – New food products
p – New techniques
q – New techniques for scaling out and up
r – New varieties
s – Other GIS products
t – Post harvest machinery and storage design
u – Pre-breeding derivatives
v – Protocols/Tools
w – Seed system design
x – Videos/CDs/Audio tapes
y – Watershed management

For GT1 scientists, in the case of *editing*, books, journal special issue editions, conference proceedings and project reports for donors are all rated highly.

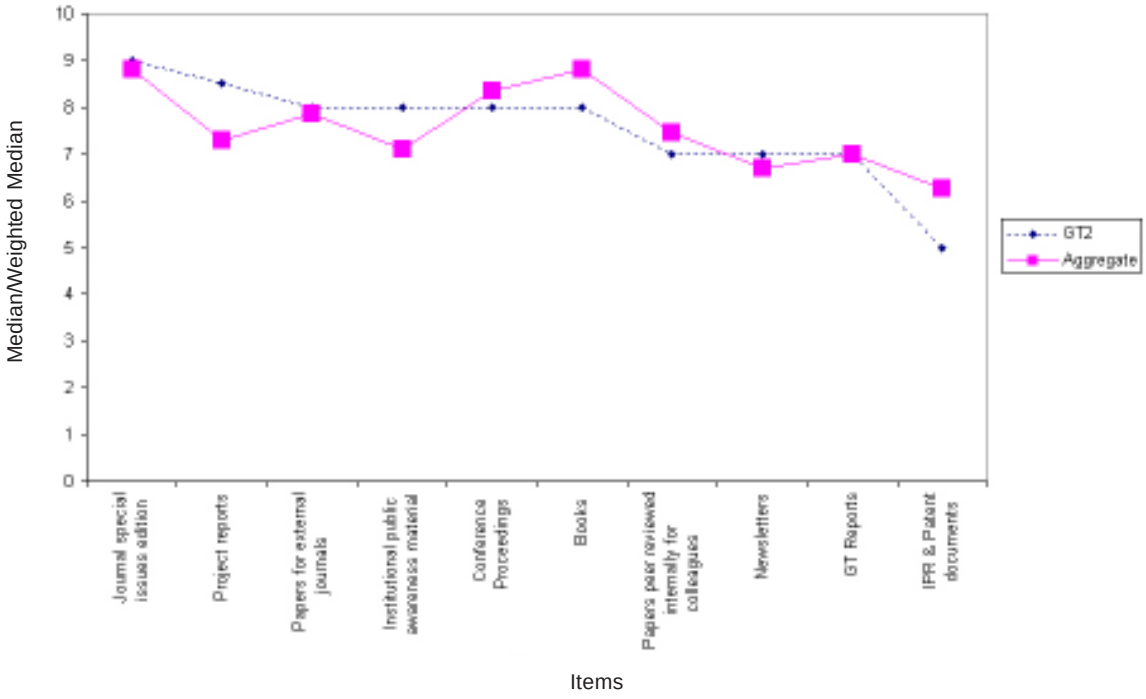
For *writing*, the hard copy of the journal articles is rated highest, higher than the soft copy. Very high importance is also ascribed to books, book chapters, edited books, monographs, patent documents, concept notes and project proposal documents. Varietal or chemical product descriptors of germplasm registration notes and invention disclosures also remain on the priority list. Extension material (printed), ex-ante and ex-post impact reports, PR material received middle level support whereas extension posters, activity profiles, bibliographies and engineering blueprints are rated of comparatively low value.

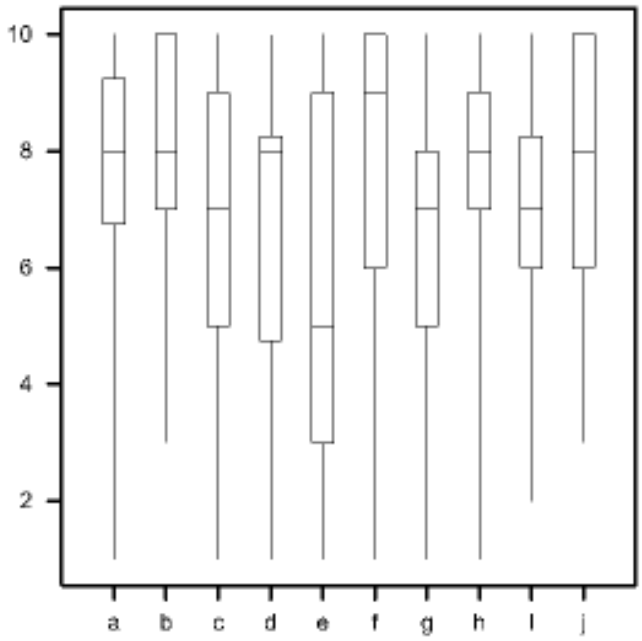
For *training*, higher degree students, visitors (donors, scientists), industry dialogues and young scientist in-house mentoring are rated substantially high. Also, partnership building, inter-center team building activities and stakeholder workshops are on the priority list of this GT. Policy briefing, other students, project study tour, PR collaborations and visitors (general public for education) are low priority for these scientists.

In the *products* category, improved germplasm, biotech constructs, protocols/tools, new varieties, introgression lines for fundamental research, database/catalogues and biotech products are rated substantially high. Other items such as crop and livestock integration strategies, seed system design, post harvest machinery, chemical products and watershed management are rated low.

Appendix 2. Distribution of responses (Boxplots) and relative ranking of outputs in Global Theme 2.

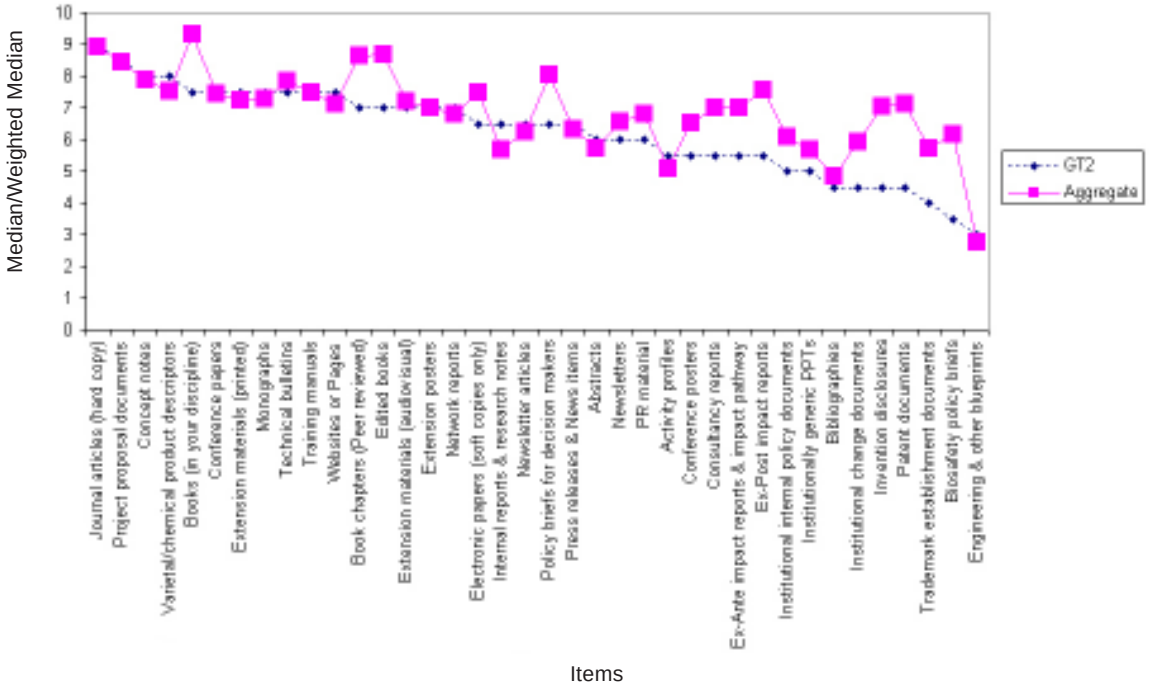
Editing

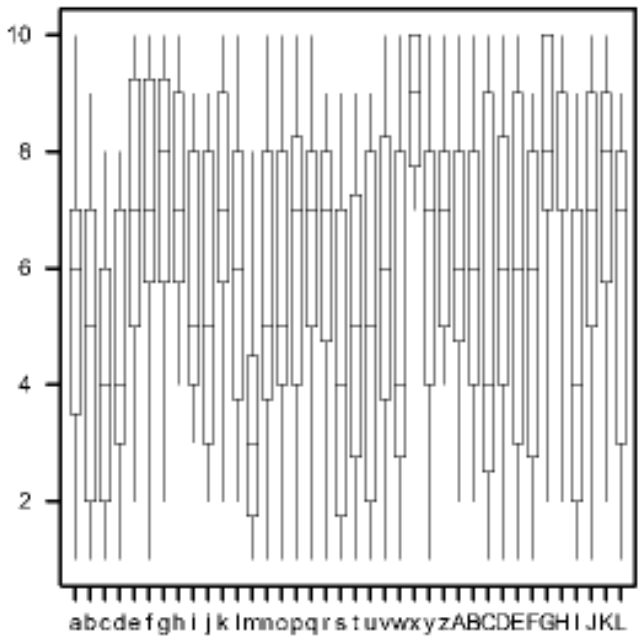




a – Books (your discipline, you are one of the principal editors)
b – Conference proceedings (your discipline, you are one of the principal editors)
c – Global Theme reports (for ICRISAT)
d – Institutional public awareness material
e – IPR and patent Documents
f – Journal special issue editions (your discipline, you are one of the principal editors)
g – Newsletters
h – Paper for external journals (assume you are doing 5 per year)
i – Papers peer reviewed internally for colleagues (assume you are doing 5 per year)
j – Project reports (for donors)

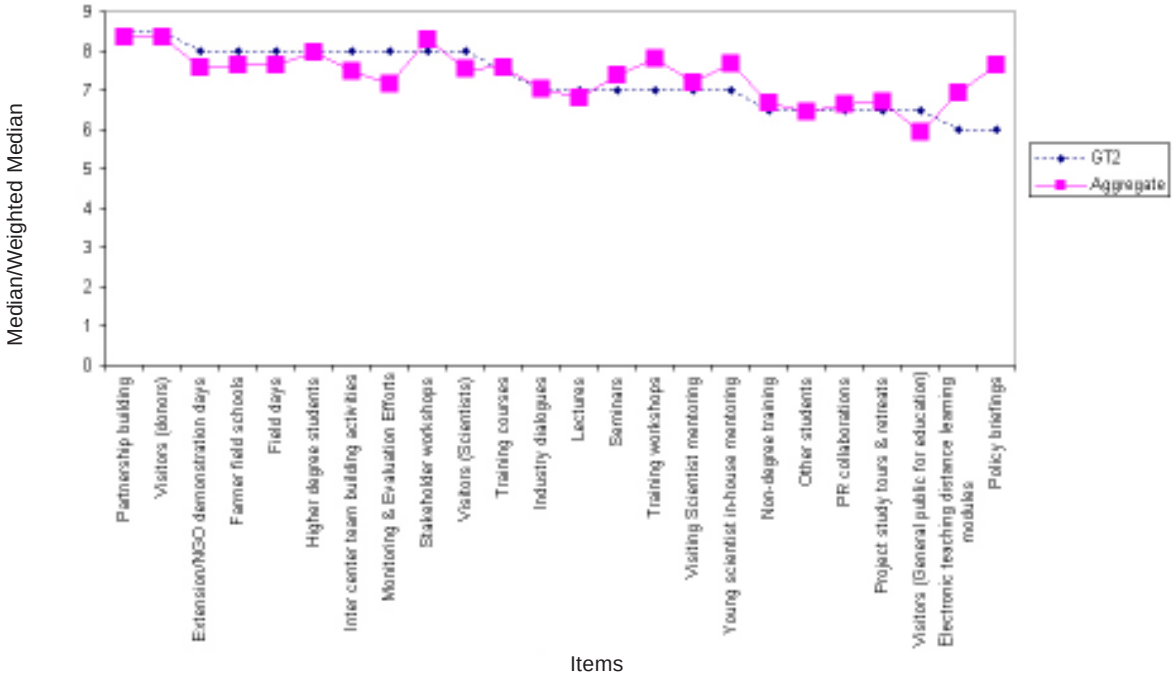
Writing

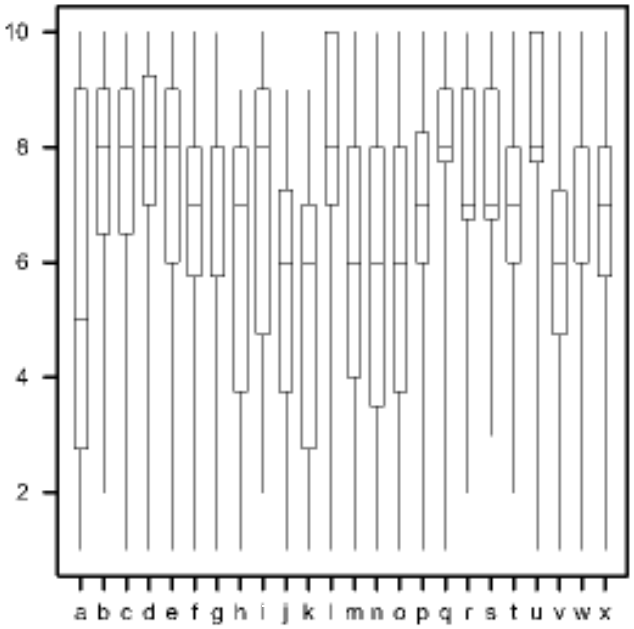




a – Abstracts
b – Activity profiles
c – Bibliographies
d – Biosafety policy briefs
e – Book chapters (peer reviewed in your area of specialization)
f – Books (in your discipline)
g – Concept notes
h – Conference papers
i – Conference posters
j – Consultancy reports
k – Edited books (peer reviewed conference proceedings etc)
l – Electronic papers (soft copy only)
m – Engineering and other blue prints
n – Ex-ante impact reports and impact pathway studies
o – Ex-post impact reports
p – Extension materials (audiovisuals)
q – Extension materials (printed)
r – Extension posters
s – Institutional change documents
t – Institutional internal policy documents
u – Institutionally generic power point presentations
v – Internal reports and research notes
w – Invention disclosures
x – Journal articles (hard copy)
y – Monographs
z – Network reports
A – Newsletter articles
B – Newsletters
C – Patent documents
D – Policy briefs for decision-makers
E – PR material
F – Press releases and new items
G – Project proposal documents
H – Technical bulletins
I – Trademark establishment documents
J – Training manuals
K – Varietal or chemical product descriptors or germplasm registration notes
L – Websites or pages

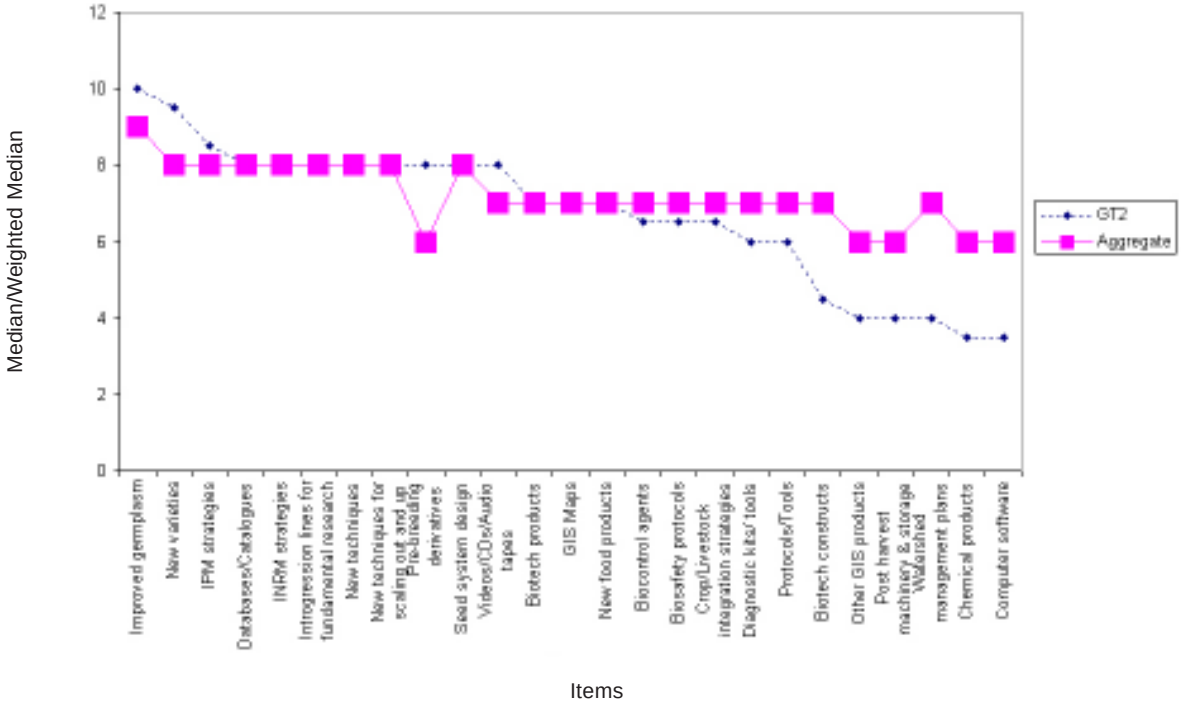
Training

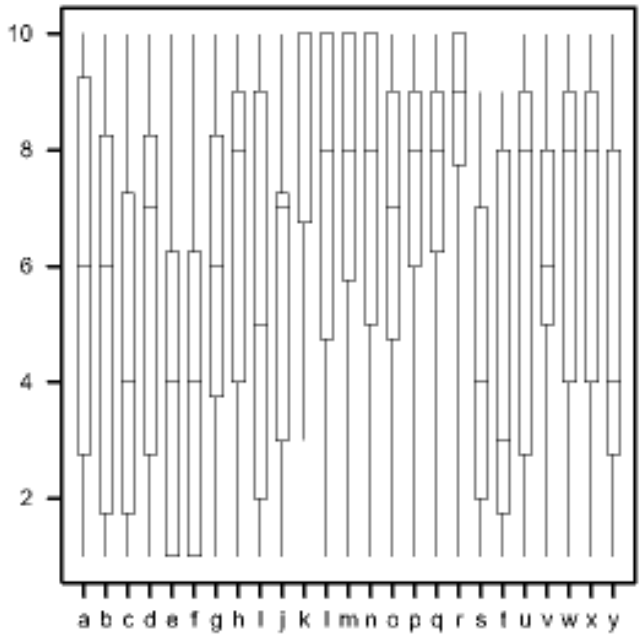




a – Electronic teaching distance learning modules
b – Extension/NGO demonstration days
c – Farmer Field schools
d – Field days
e – Higher degree students
f – Industry dialogues
g – Intercenter team building activities
h – Lectures
i – Monitoring and evaluation efforts
j – Non-degree training
k – Other students
l – Partnership building
m – Policy briefings
n – PR collaborations
o – Project study tours and retreats
p – Seminars
q – Stake holder workshops
r – Training courses
s – Training workshops
t – Visiting scientist mentoring
u – Visitors (donors)
v – Visitors (general public for education)
w – Visitors (scientists)
x – Young scientist in-house mentoring

Products





a – Biocontrol agents
b – Biosafety protocols
c – Biotech constructs
d – Biotech products
e – Chemical products
f – Computer software
g – Crop/Livestock integration strategies
h – Databases/Catalogues
i – Diagnostic kit/ tools
j – GIS maps
k – Improved germplasm
l – INRM strategies
m – Introgression lines for fundamental research
n – IPM strategies
o – New food products
p – New techniques
q – New techniques for scaling out and up
r – New varieties
s – Other GIS products
t – Postharvest machinery and storage design
u – Pre-breeding derivatives
v – Protocols/Tools
w – Seed system Design
x – Videos/CDs/Audio tapes
y – Watershed management

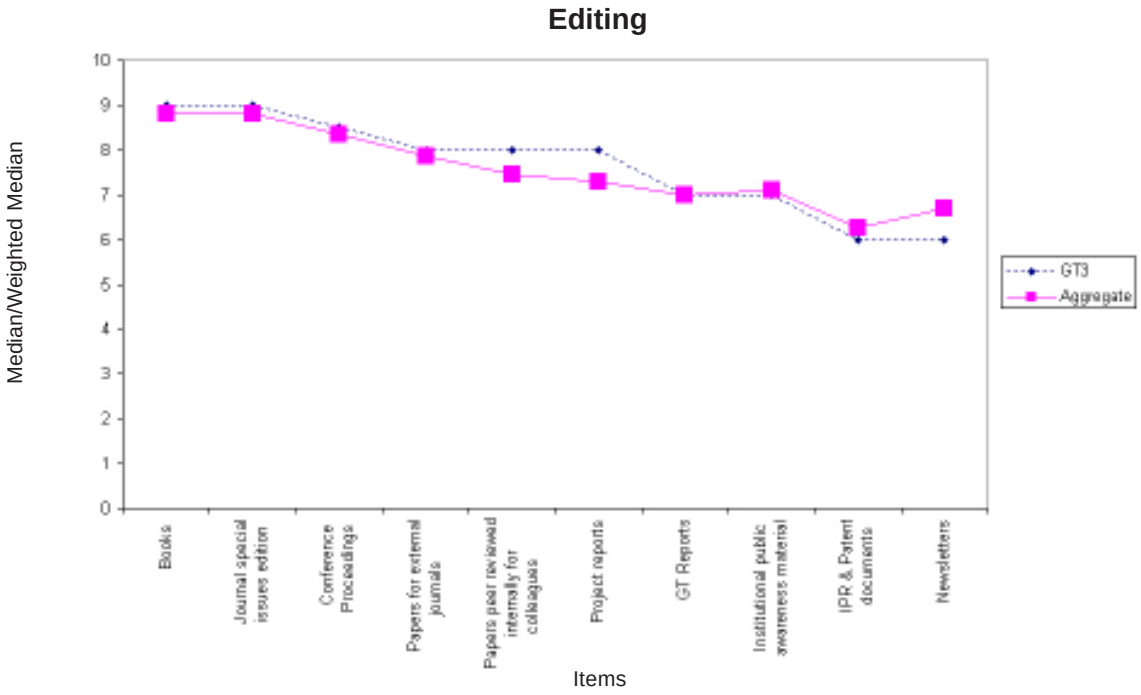
For GT2 scientists, in the case of *editing*, journal special issue editions and project reports for donors are all rated highly. Books are not at the topmost list, though high priority is given to them along with conference proceedings. Also the external peer reviewing of papers is seen to be a more important job than doing the same job internally.

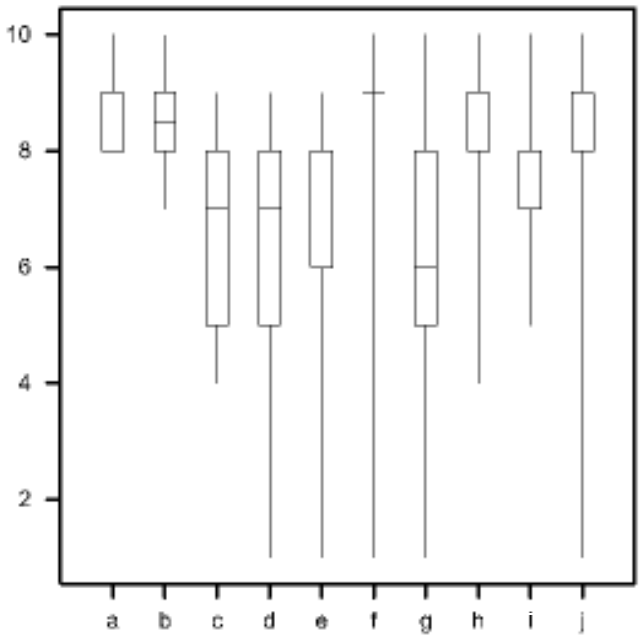
For *writing*, the hard copy of the journal articles was rated highest, substantially higher than the soft copy. Very high importance is also ascribed to books, book chapters and edited books, monographs, conference papers, technical bulletins, concept notes and project proposal documents. Varietal or chemical product descriptors of germplasm registration notes also remain on the priority list. Conference posters, ex-ante and ex-post impact reports, policy briefs for decision makers, PR material, and newsletters received middle level support whereas biosafety policy briefs, trademark establishment documents, patent documents, invention disclosures and engineering blueprints are rated of comparatively low value.

For *training*, partnership building, higher degree students, extension/NGOs demonstration days, visitors (donors and scientists), inter-center team building activities, farmer field schools, field days and stakeholder workshops are rated substantially high. Policy briefing, other students, PR collaborations and visitors (general public for education) are low priority for these scientists.

In the *products* category, improved germplasm, new varieties, IPM strategies, video/CDs, seed system design, new techniques for scaling out and up, and pre-breeding derivatives are rated substantially high. Other items such as crop and livestock integration strategies, biotech products, biotech constructs, post harvest machinery, chemical products, computer software and watershed management are rated low.

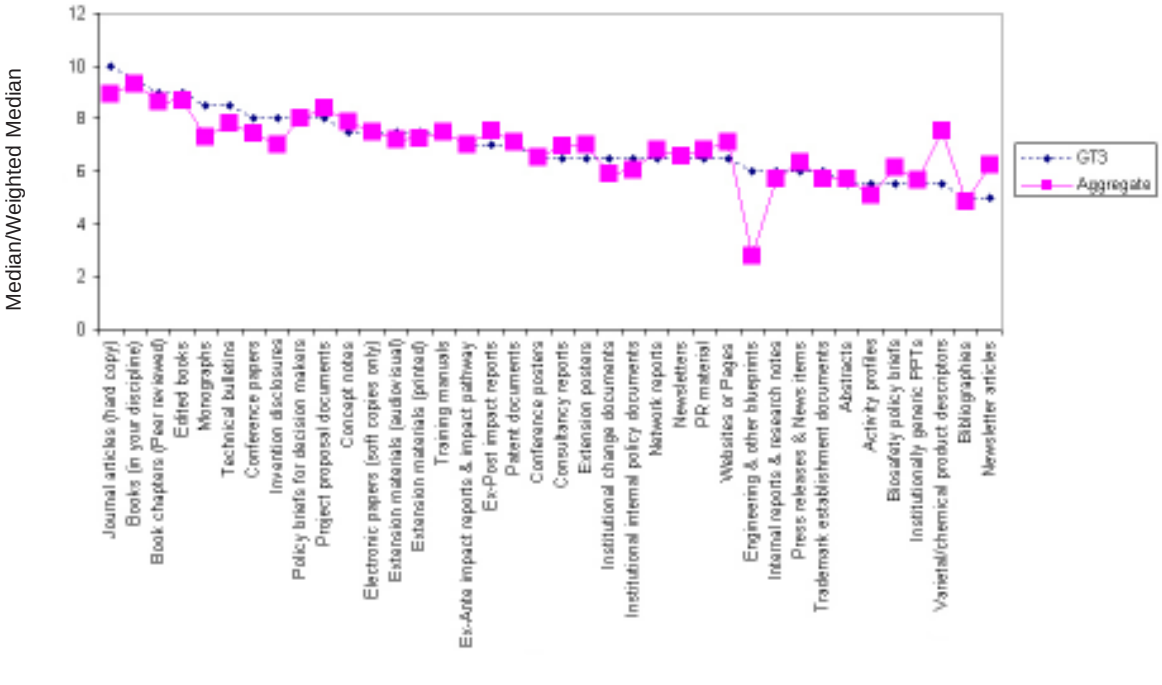
Appendix 3. Distribution of responses (Boxplots) and relative ranking of outputs in Global Theme 3.

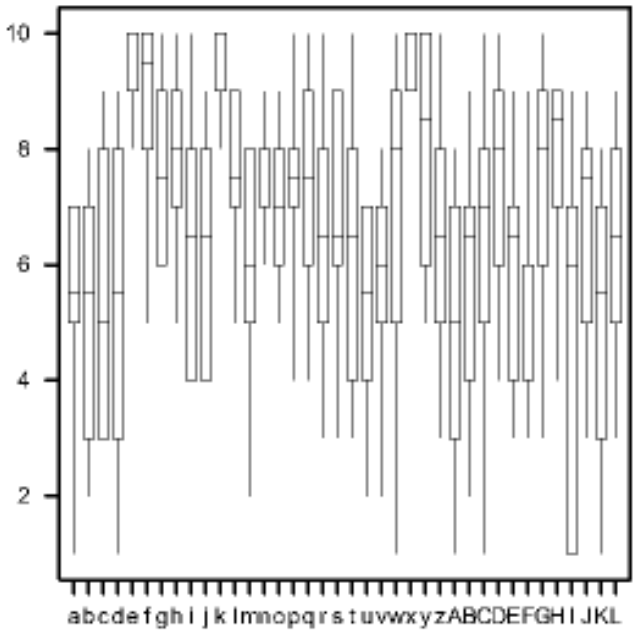




a – Books (your discipline, you are one of the principal editors)
b – Conference proceedings (your discipline, you are one of the principal editors)
c – Global Theme reports (for ICRISAT)
d – Institutional public awareness material
e – IPR and patent documents
f – Journal special issue editions (your discipline, you are one of the principal editors)
g – Newsletters
h – Paper for external journals (assume you are doing 5 per year)
i – Papers peer reviewed internally for colleagues (assume you are doing 5 per year)
j – Project reports (for donors)

Writing





a – Abstracts
b – Activity profiles
c – Bibliographies
d – Biosafety policy briefs
e – Book chapters (peer reviewed in your area of specialization)
f – Books (in your discipline)
g – Concept notes
h – Conference papers
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w – Invention disclosures
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E – PR material
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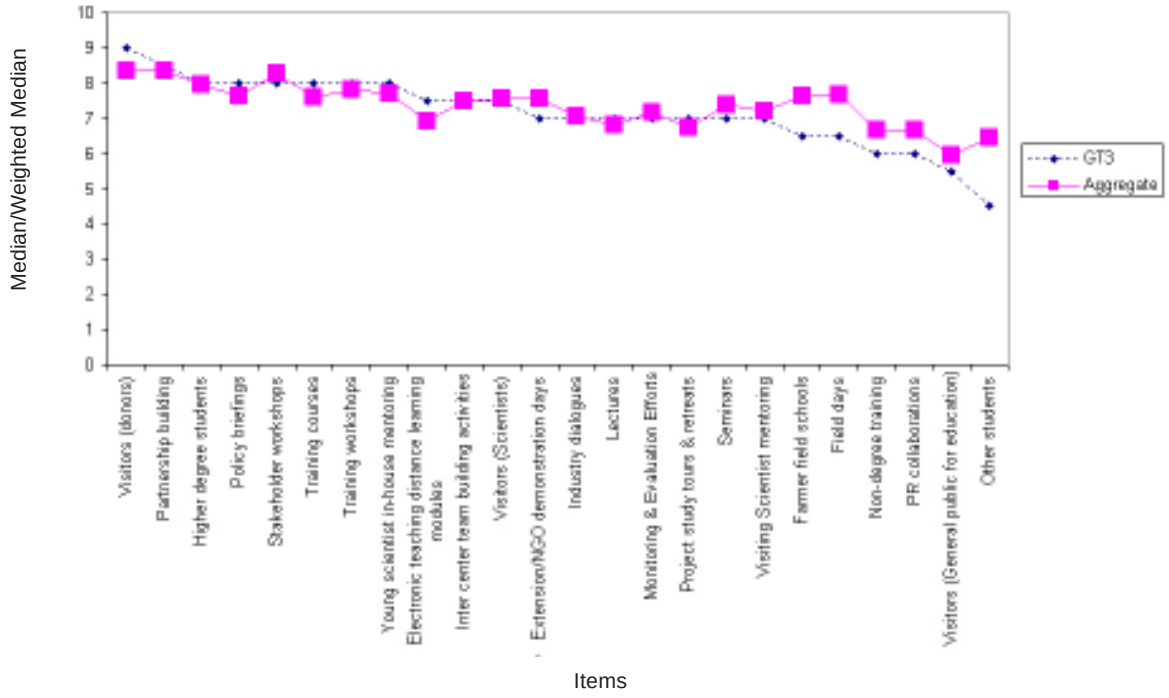
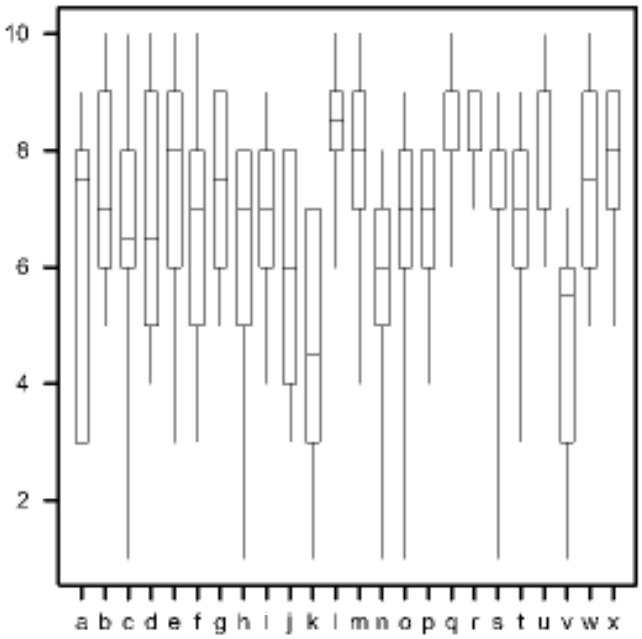
I – Trademark establishment documents
J – Training manuals
K – Varietal or chemical product descriptors or germplasm registration notes
L – Websites or pages

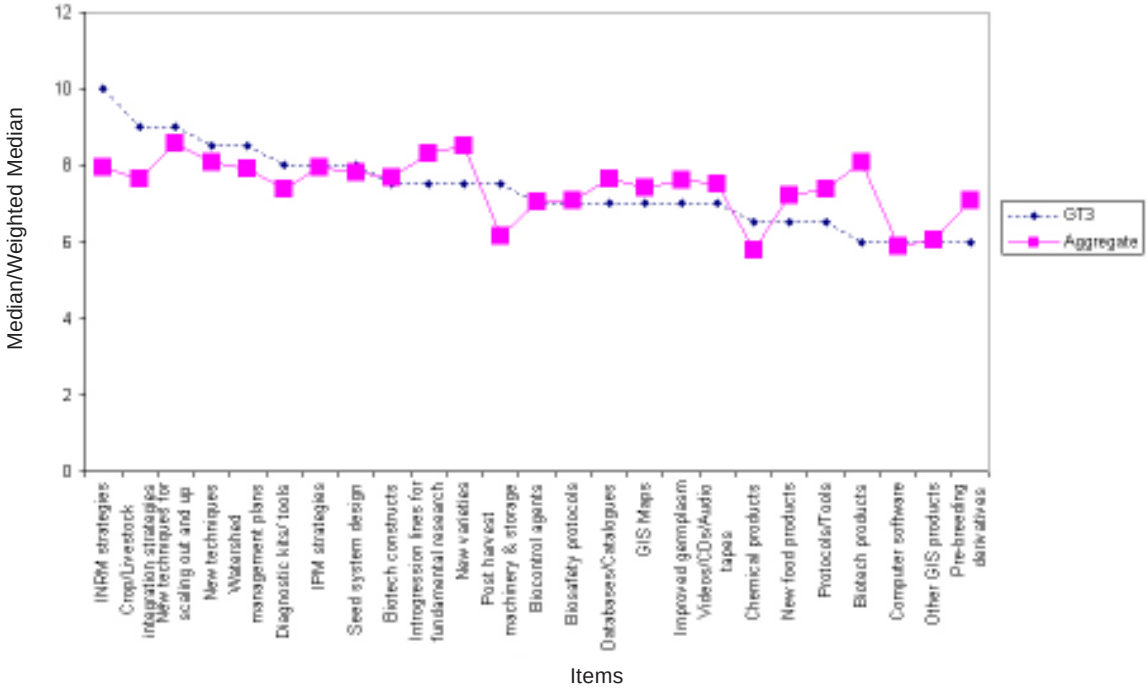
Training

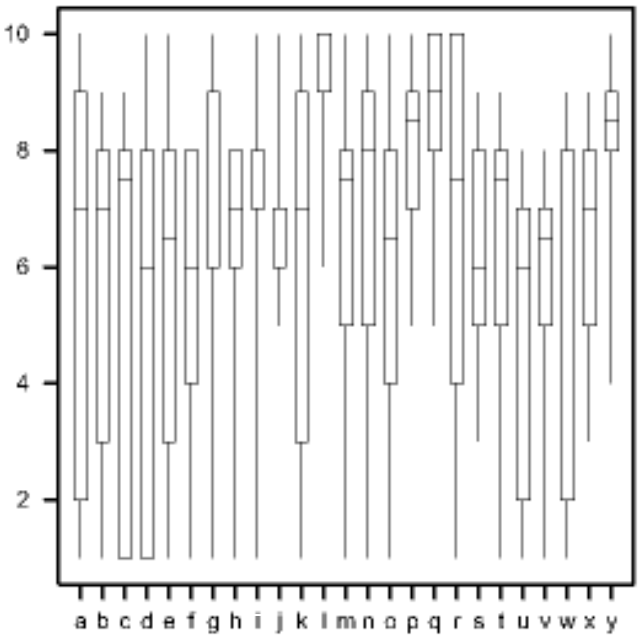




a – Electronic teaching distance learning modules
b – Extension/NGO demonstration days
c – Farmer field schools
d – Field days
e – Higher degree students
f – Industry dialogues
g – Intercenter team building activities
h – Lectures
i – Monitoring and evaluation efforts
j – Non-degree training
k – Other students
l – Partnership building
m – Policy briefings
n – PR collaborations
o – Project study tours and retreats
p – Seminars
q – Stake holder workshops
r – Training courses
s – Training workshops
t – Visiting scientist mentoring
u – Visitors (donors)
v – Visitors (general public for education)
w – Visitors (scientists)
x – Young scientist in-house mentoring

Products





a – Biocontrol agents
b – Biosafety protocols
c – Biotech constructs
d – Biotech products
e – Chemical products
f – Computer software
g – Crop/Livestock integration strategies
h – Databases/Catalogues
i – Diagnostic kit/ tools
j – GIS maps
k – Improved germplasm
l – INRM strategies
m – Introgression lines for fundamental research
n – IPM strategies
o – New food products
p – New techniques
q – New techniques for scaling out and up
r – New varieties
s – Other GIS products
t – Postharvest machinery and storage design
u – Pre-breeding derivatives
v – Protocols/Tools
w – Seed system design
x – Videos/CDs/Audio tapes
y – Watershed management

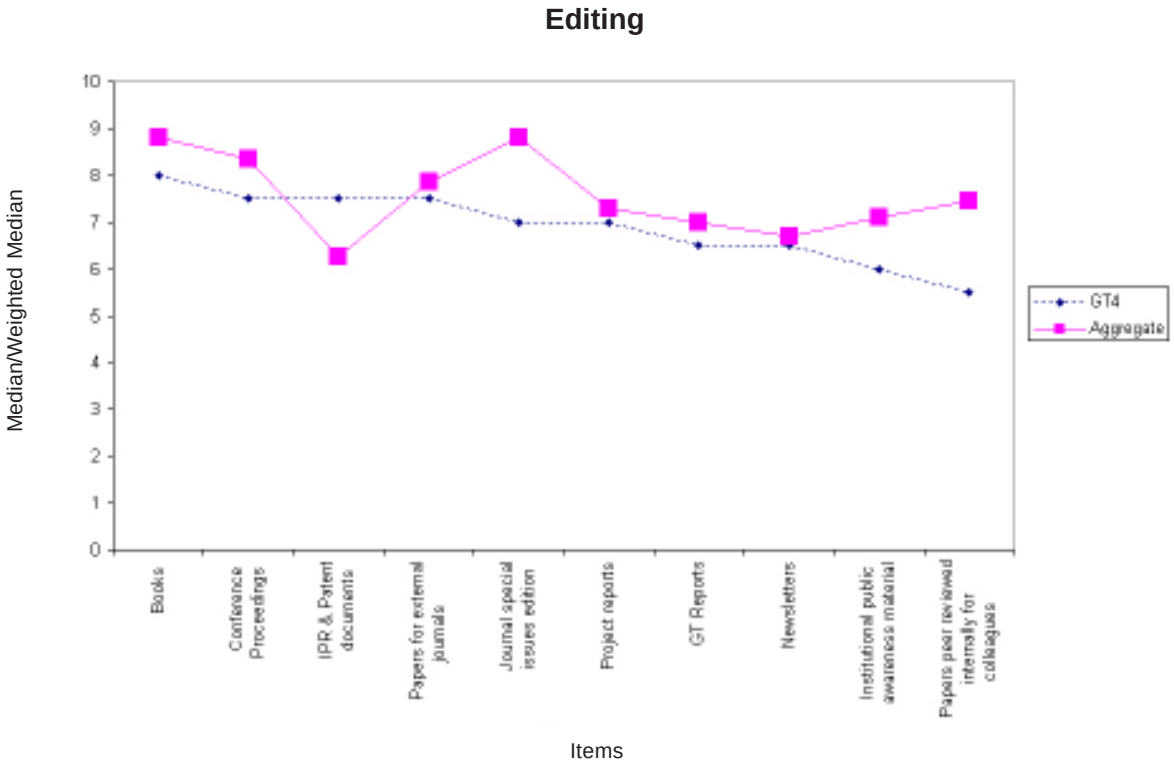
For GT3 scientists, in the case of *editing*, books, journal special issue editions and conference proceedings are all rated highly. IPR documents and newsletters are rated low.

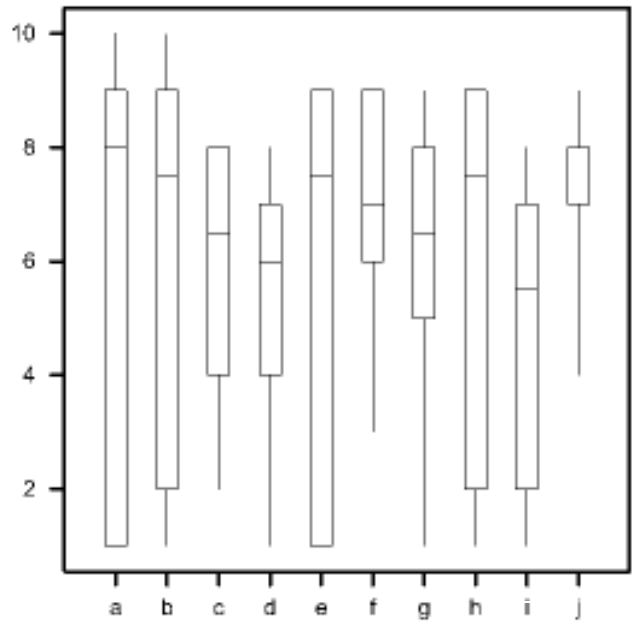
For *writing*, again the hard copy of the journal articles is rated highest, substantially higher than the soft copy. Very high importance is also ascribed to books, book chapters and edited books, concept notes, monographs, technical bulletins and project proposal documents. Extension posters, ex-ante and ex-post impact reports, PR material, newsletters received middle level support whereas varietal or chemical product descriptors of germplasm registration notes, biosafety policy briefs and bibliographies are rated of comparatively low value.

For *training*, visitors (donors), partnership building, higher degree students, policy briefings, stakeholder workshops and training courses and workshops are rated substantially high. Field days, farmer field schools, other students, PR collaborations, non-degree training and visitors (general public for education) are low priority for these scientists.

In the *products* category, INRM strategies are rated the top priority followed by crop/livestock integration strategies, new techniques for scaling out and up, new techniques, watershed management and diagnostic kits and tools. Other items such as improved germplasm, protocols/tools, biotech products, computer software, other GIS products and pre-breeding derivatives are rated low.

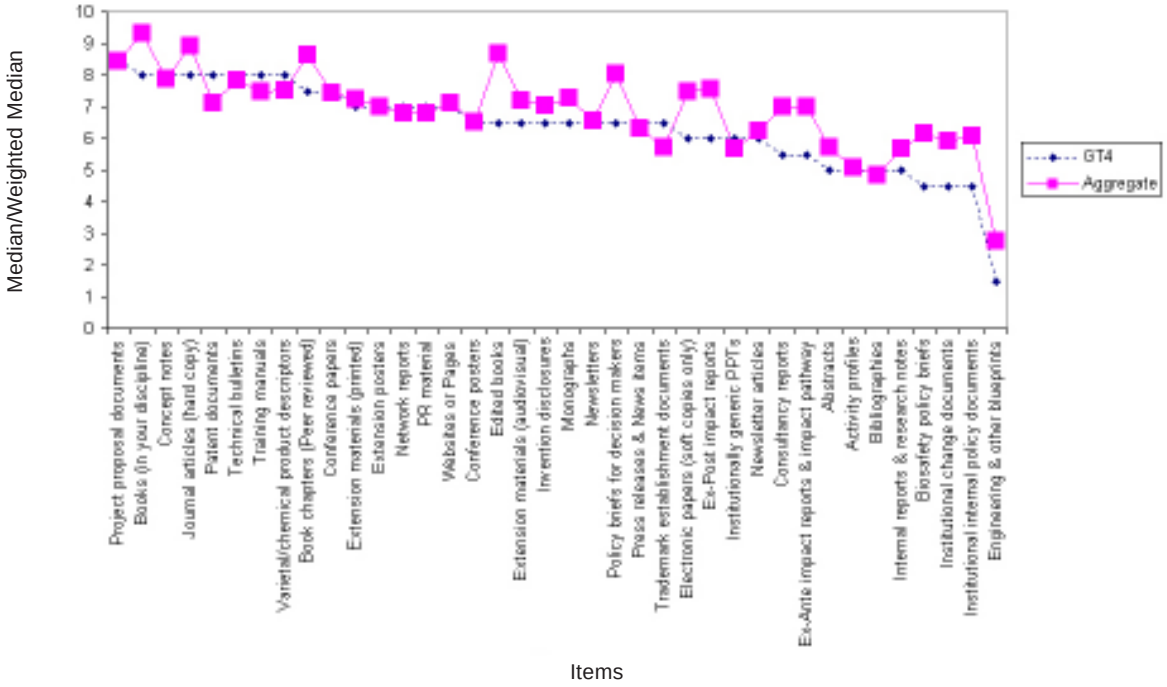
Appendix 4. Distribution of responses (Boxplots) and relative ranking of outputs in Global Theme 4.

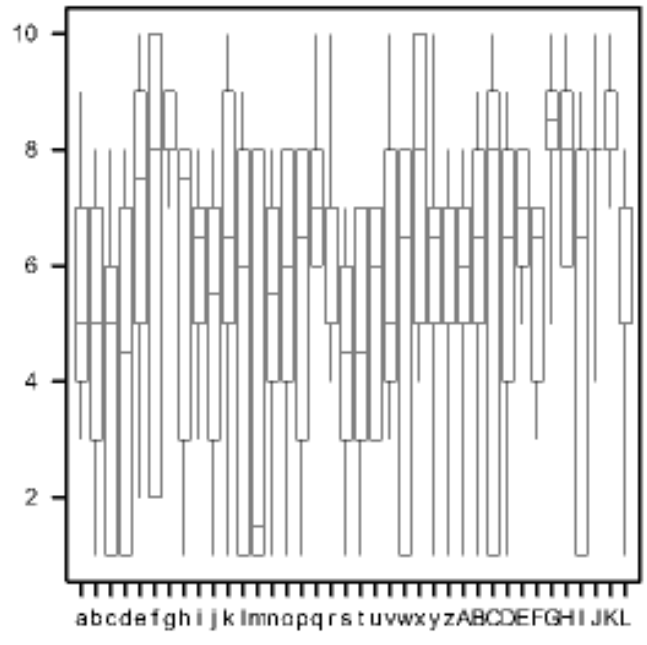




a – Books (your discipline, you are one of the principal editors)
b – Conference proceedings (your discipline, you are one of the principal editors)
c – Global Theme reports (for ICRISAT)
d – Institutional public awareness material
e – IPR and patent documents
f – Journal special issue editions (your discipline, you are one of the principal editors)
g – Newsletters
h – Paper for external journals (assume you are doing 5 per year)
i – Papers peer reviewed internally for colleagues (assume you are doing 5 per year)
j – Project reports (for donors)

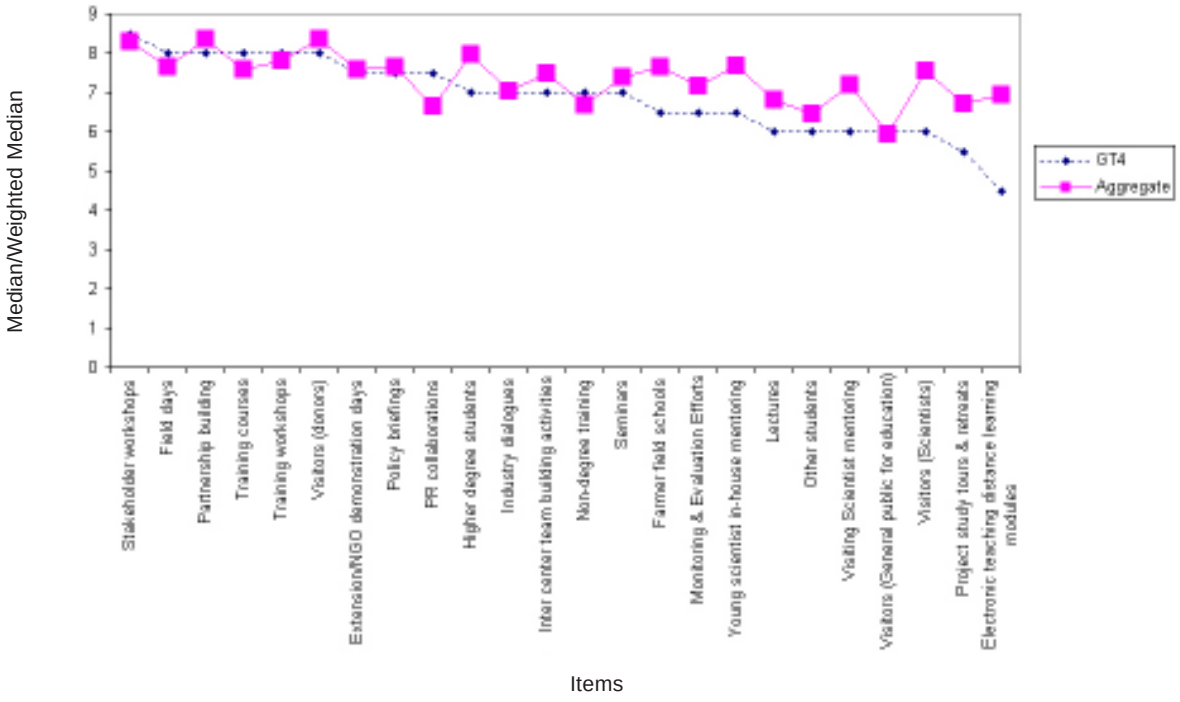
Writing

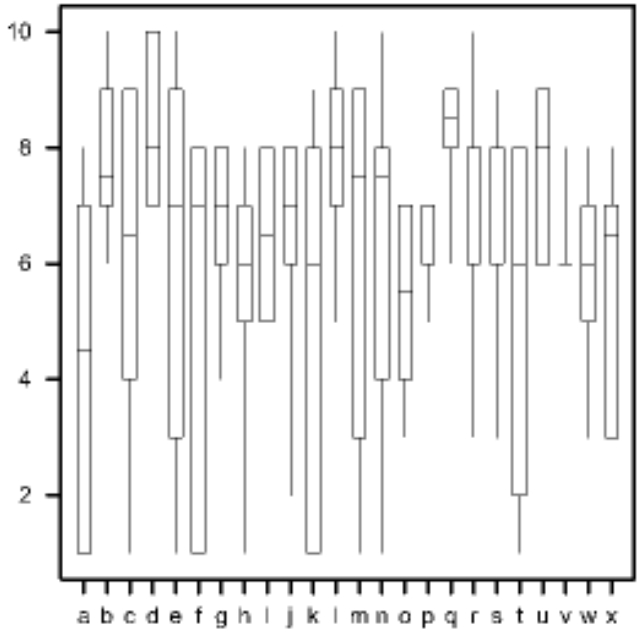




a – Abstracts
b – Activity profiles
c – Bibliographies
d – Biosafety policy briefs
e – Book chapters (peer reviewed in your area of specialization)
f – Books (in your discipline)
g – Concept notes
h – Conference papers
i – Conference posters
j – Consultancy reports
k – Edited books (peer reviewed conference proceedings etc)
l – Electronic papers (soft copy only)
m – Engineering and other blue prints
n – Ex-ante impact reports and impact pathway studies
o – Ex-post impact reports
p – Extension materials (audio visuals)
q – Extension materials (printed)
r – Extension posters
s – Institutional change documents
t – Institutional internal policy documents presentations
u – Institutionally generic power point
v – Internal reports and research notes
w – Invention disclosures
x – Journal articles (hard copy)
y – Monographs
z – Network reports
A – Newsletter articles
B – Newsletters
C – Patent documents
D – Policy briefs for decision-makers
E – PR material
F – Press releases and new items
G – Project proposal documents
H – Technical bulletins
I – Trademark establishment documents
J – Training manuals
K – Varietal or chemical product descriptors or germplasm registration notes
L – Websites or pages

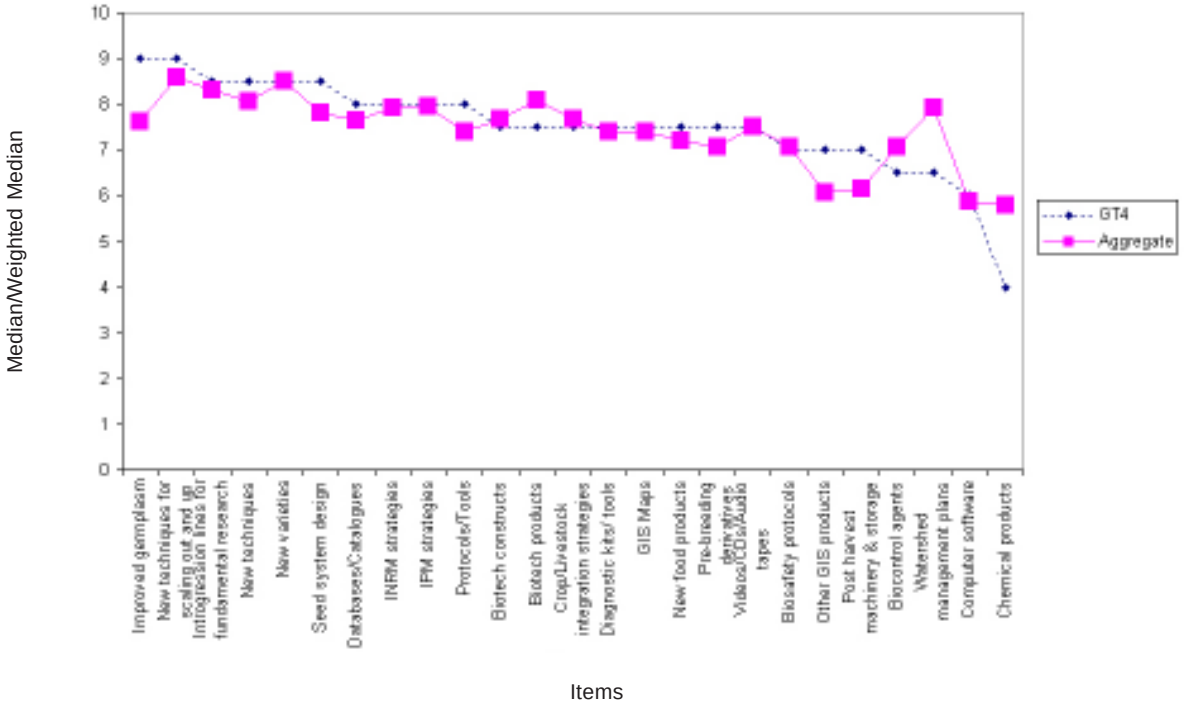
Training

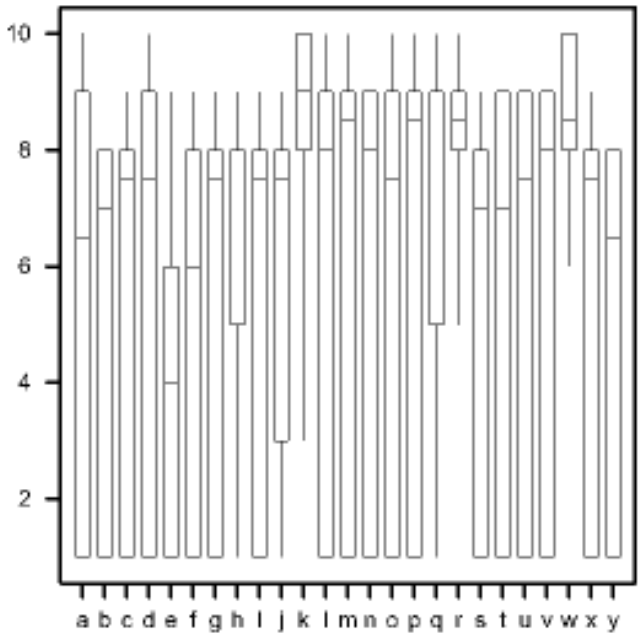




a – Electronic teaching distance learning modules
b – Extension/NGO demonstration days
c – Farmer field schools
d – Field days
e – Higher degree students
f – Industry dialogues
g – Intercenter team building activities
h – Lectures
i – Monitoring and evaluation efforts
j – Non-degree training
k – Other students
l – Partnership building
m – Policy briefings
n – PR collaborations
o – Project study tours and retreats
p – Seminars
q – Stake holder workshops
r – Training courses
s – Training workshops
t – Visiting scientist mentoring
u – Visitors (donors)
v – Visitors (general public for education)
w – Visitors (scientists)
x – Young scientist in-house mentoring

Products





a – Biocontrol agents
b – Biosafety protocols
c – Biotech constructs
d – Biotech products
e – Chemical products
f – Computer software
g – Crop/Livestock integration strategies
h – Databases/Catalogues
i – Diagnostic kit/ tools
j – GIS maps
k – Improved germplasm
l – INRM strategies
m – Introgression lines for fundamental research
n – IPM strategies
o – New food products
p – New techniques
q – New techniques for scaling out and up
r – New varieties
s – Other GIS products
t – Postharvest machinery and storage design
u – Pre-breeding derivatives
v – Protocols/Tools
w – Seed system design
x – Videos/CDs/Audio tapes
y – Watershed management

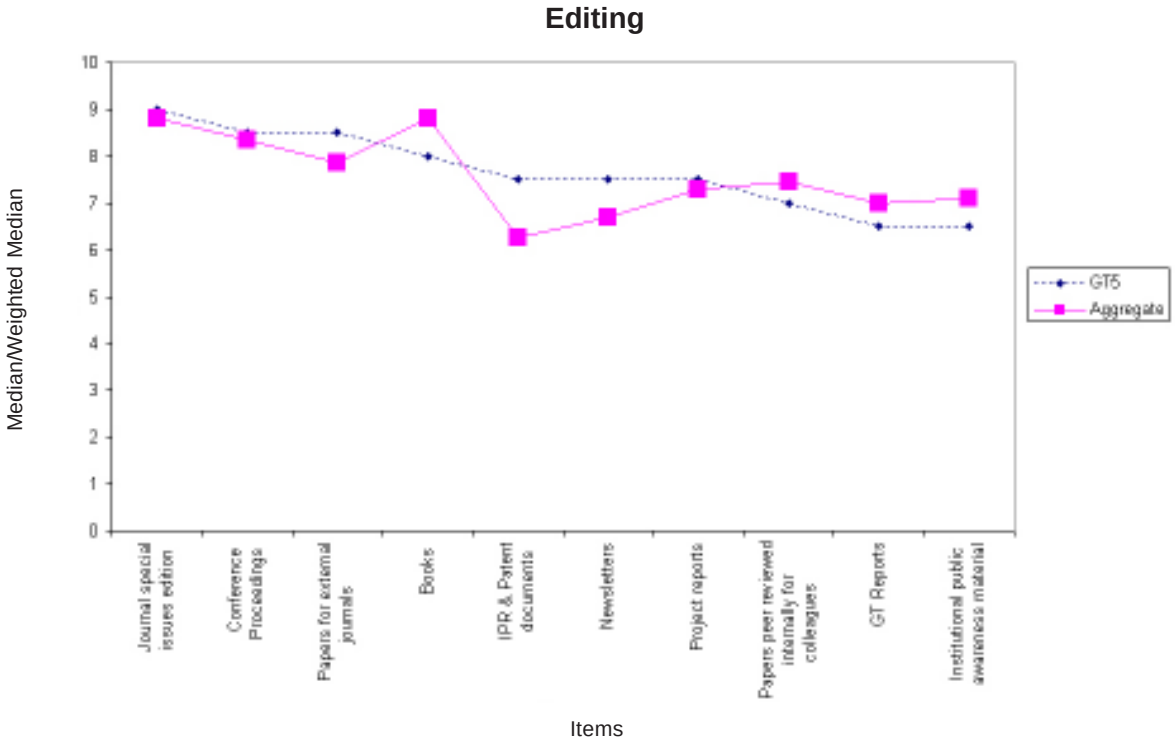
For GT4 scientists, in the case of *editing*, books and conference proceedings are all rated highly. IPR and patent documents are seen as important items as compared to journal special issue editions and project reports for donors. External peer reviewing of papers is seen to be a more important job than doing the same job internally.

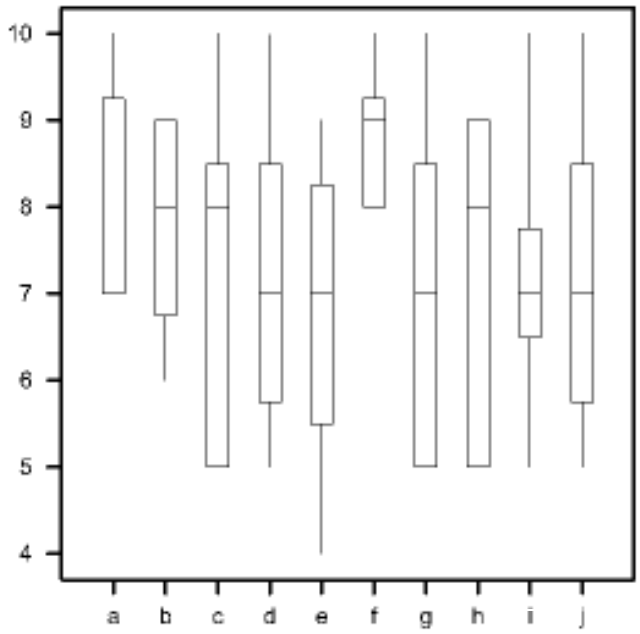
For *writing*, very high importance is ascribed to concept notes, project proposal documents, books, hard copy of the journal articles, patent documents and technical bulletins. Varietal or chemical product descriptors of germplasm registration notes also remain on the priority list of the scientists. Extension material (printed), edited books, policy briefs for decision makers, ex-ante and ex-post impact reports, PR material, received middle level support whereas biosafety policy briefs, institutions internal policy documents, institutional change documents and engineering blueprints are rated of comparatively low value.

For *training*, partnership building, visitors (donors), stakeholder workshops, field days are rated substantially high. Also, higher degree students, training courses and workshops and policy briefings are on the priority list of GT4. Project study tours and retreats, other students and visitors (general public for education and scientists) are low priority for these scientists.

In the *products* category, improved germplasm, new techniques for scaling out and up, new techniques, new varieties, seed system design and introgression lines for fundamental research are rated substantially high. Other items such as biotech products, biocontrol agents, computer software, chemical products and watershed management are rated low.

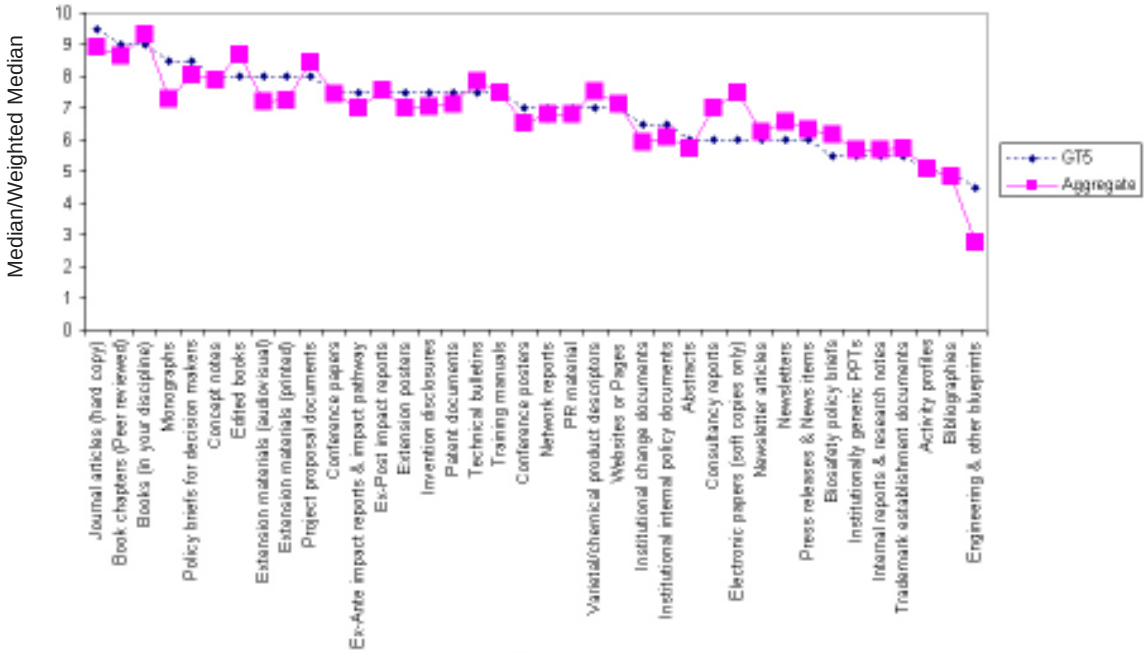
Appendix 5. Distribution of responses (Boxplots) and relative ranking of outputs in Global Theme 5.



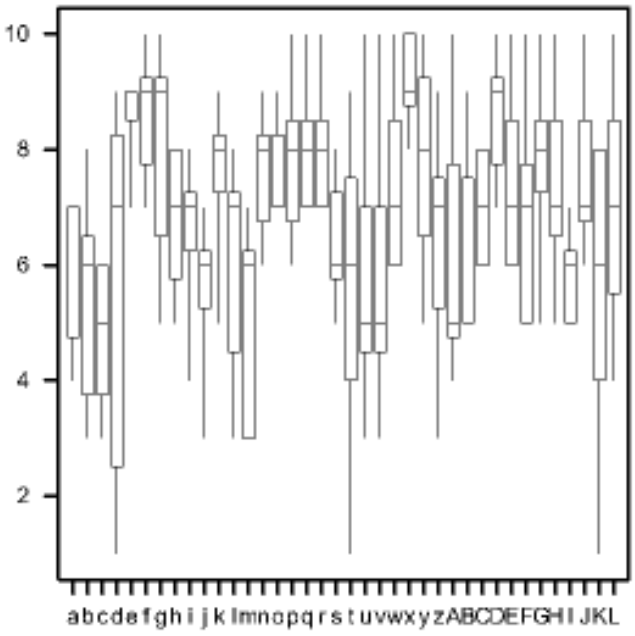


a – Books (your discipline, you are one of the principal editors)
b – Conference proceedings (your discipline, you are one of the principal editors)
c – Global Theme reports (For ICRISAT)
d – Institutional public awareness material
e – IPR and patent documents
f – Journal special issue editions (your discipline, you are one of the principal editors)
g – Newsletters
h – Paper for external journals (assume you are doing 5 per year)
i – Papers peer reviewed internally for colleagues (assume you are doing 5 per year)
j – Project reports (for donors)

Writing

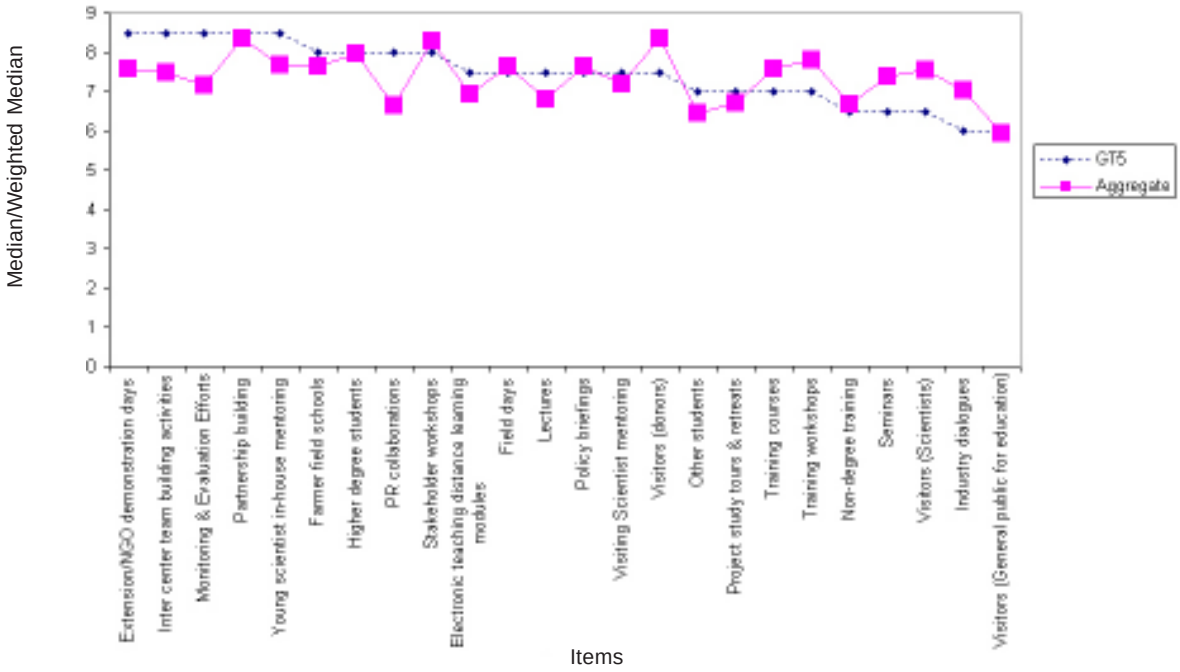


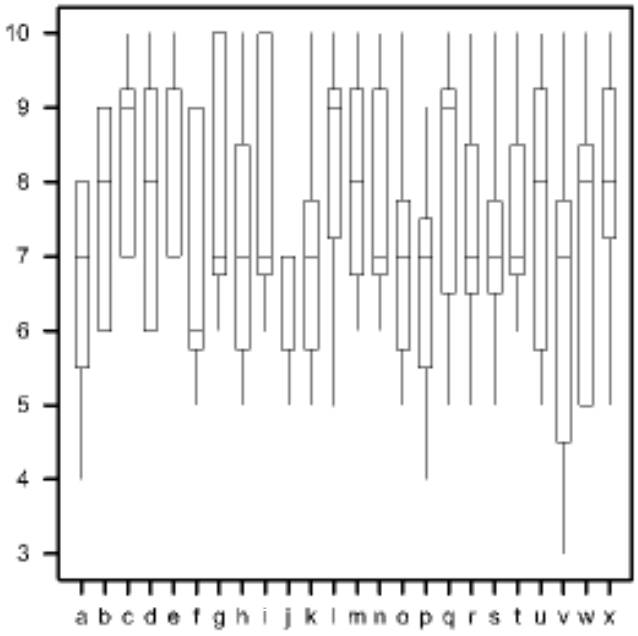
Items



a – Abstracts
b – Activity profiles
c – Bibliographies
d – Biosafety policy briefs
e – Book chapters (peer reviewed in your area of specialization)
f – Books (in your discipline)
g – Concept notes
h – Conference papers
i – Conference posters
j – Consultancy reports
k – Edited books (peer reviewed conference proceedings etc)
l – Electronic papers (soft copy only)
m – Engineering and other blue prints
n – Ex-ante impact reports and impact pathway studies
o – Ex-post impact reports
p – Extension materials (audiovisuals)
q – Extension materials (printed)
r – Extension posters
s – Institutional change documents
t – Institutional internal policy documents
u – Institutionally generic power point presentations
v – Internal reports and research notes
w – Invention disclosures
x – Journal articles (hard copy)
y – Monographs
z – Network reports
A – Newsletter articles
B – Newsletters
C – Patent documents
D – Policy briefs for decision-makers
E – PR material
F – Press releases and new items
G – Project proposal documents
H – Technical bulletins
I – Trademark establishment documents
J – Training manuals
K – Varietal or chemical product descriptors or germplasm registration notes
L – Websites or pages

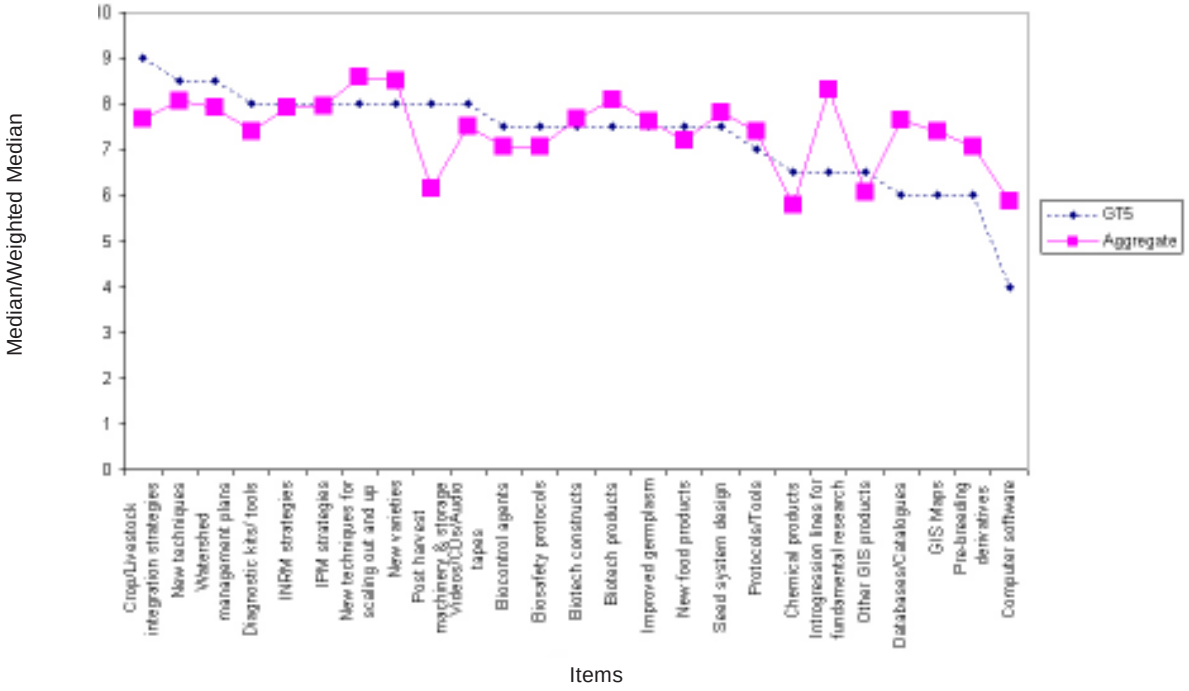
Training

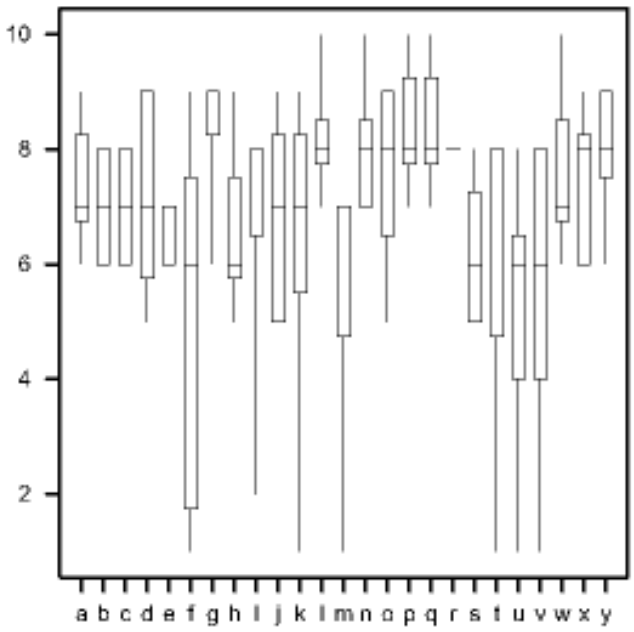




a – Electronic teaching distance learning modules
b – Extension /NGO demonstration days
c – Farmer field schools
d – Field days
e – Higher degree students
f – Industry dialogues
g – Intercenter team building activities
h – Lectures
i – Monitoring and evaluation efforts
j – Non-degree training
k – Other students
l – Partnership building
m – Policy briefings
n – PR collaborations
o – Project study tours and retreats
p – Seminars
q – Stake holder workshops
r – Training courses
s – Training workshops
t – Visiting scientist mentoring
u – Visitors (donors)
v – Visitors (general public for education)
w – Visitors (scientists)
x – Young scientist in-house mentoring

Products





a – Biocontrol agents
b – Biosafety protocols
c – Biotech constructs
d – Biotech products
e – Chemical products
f – Computer software
g – Crop/Livestock integration strategies
h – Databases/Catalogues
i – Diagnostic kit/tools
j – GIS maps
k – Improved germplasm
l – INRM Strategies
m – Introgression lines for fundamental research
n – IPM strategies
o – New food products
p – New techniques
q – New techniques for scaling out and up
r – New varieties
s – Other GIS products
t – Post harvest machinery and storage design
u – Pre-breeding derivatives
v – Protocols/Tools
w – Seed system design
x – Videos/CDs/Audio tapes
y – Watershed management

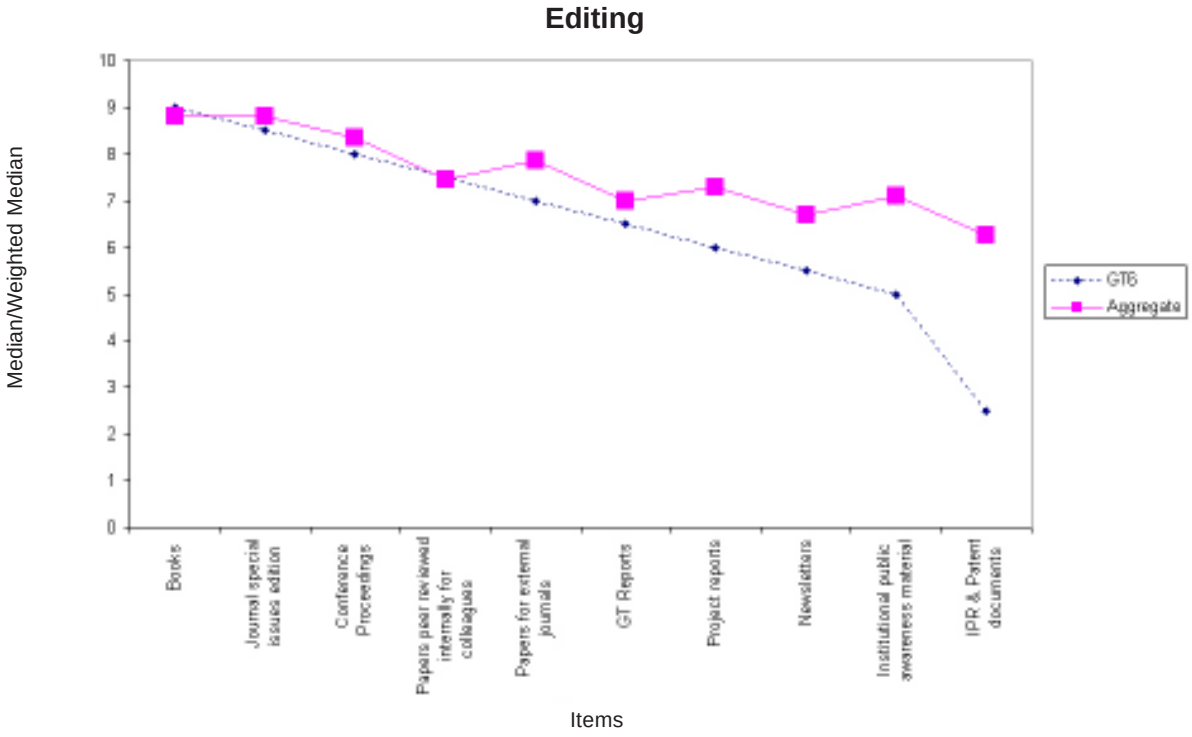
For GT5 scientists, in the case of *editing*, journal special issue editions, conference proceedings and books are all rated highly. External peer reviewing of papers is seen to be a more important job than doing the same job internally.

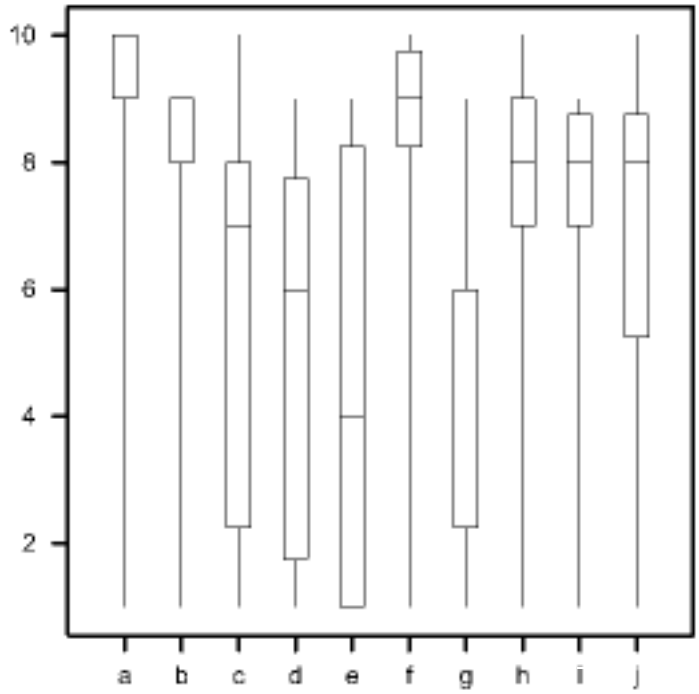
For *writing*, again the hard copy of the journal articles is rated highest, substantially higher than the soft copy. Very high importance is also ascribed to books, book chapters, monographs, extension materials (audiovisual and printed), edited books, policy briefs for decision makers, concept notes and project proposal documents. Extension posters, ex-ante and ex-post impact reports and PR material, received middle level support whereas biosafety policy briefs, engineering blueprints, trademark establishment documents and bibliographies are rated of comparatively low value.

For *training*, partnership building, extension/NGO demonstration days, monitoring and evaluation efforts, young scientist in-house mentoring, higher degree students, farmer field schools, inter-center team building activities and stakeholder workshops are rated substantially high. Training courses and workshops, other students, industry dialogues and visitors (general public for education) are low priority for these scientists.

In the *products* category, crop/livestock integration strategies are rated the top priority followed by watershed management strategies, diagnostic kits and tools, INRM and IPM strategies. Other items such as introgression lines for fundamental research, other GIS products, database/catalogues, computer software, biotech products and pre-breeding derivatives are rated low.

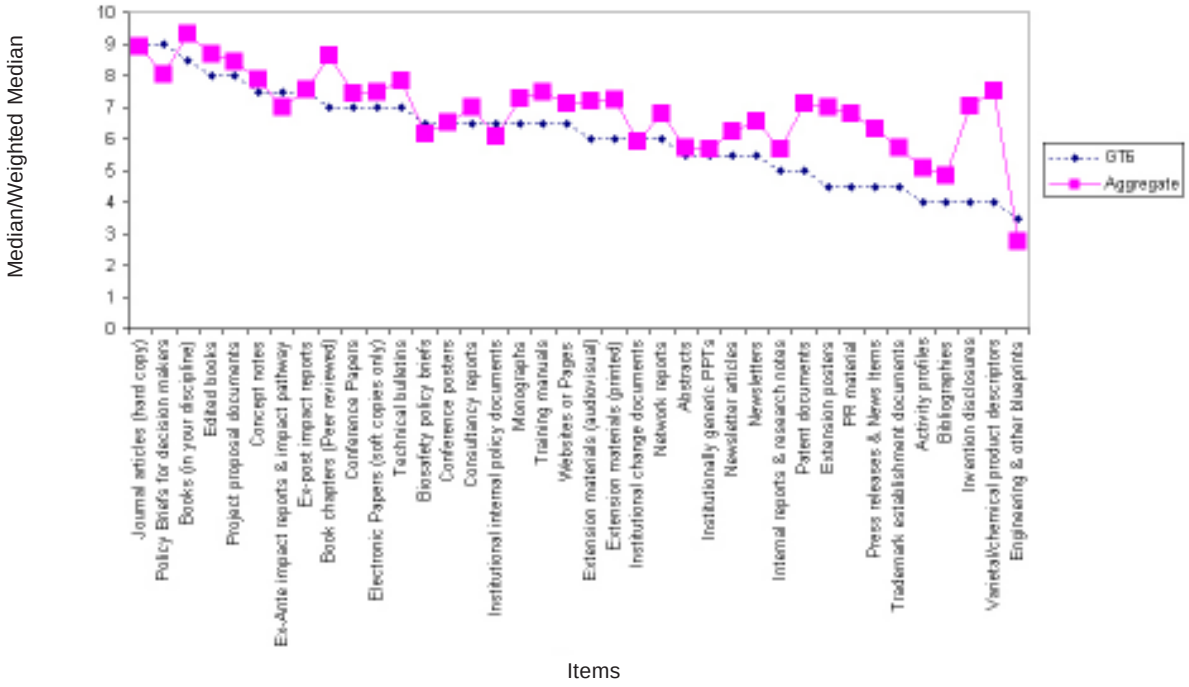
Appendix 6. Distribution of responses (Boxplots) and relative ranking of outputs in Global Theme 6.

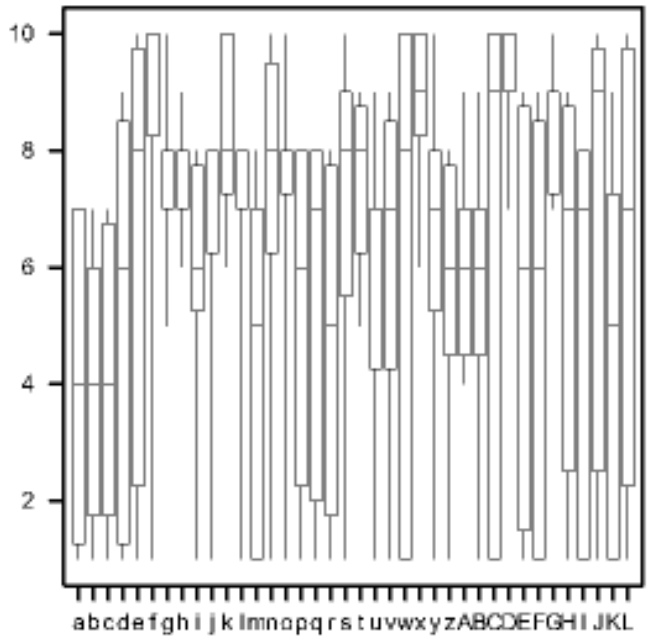




a – Books (your discipline, you are one of the principal editors)
b – Conference proceedings (your discipline, you are one of the principal editors)
c – Global Theme reports (for ICRISAT)
d – Institutional public awareness material
e – IPR and patent documents
f – Journal special issue editions (your discipline, you are one of the principal editors)
g – Newsletters
h – Paper for external journals (assume you are doing 5 per year)
i – Papers peer reviewed internally for colleagues (assume you are doing 5 per year)
j – Project reports (for donors)

Writing





a – Abstracts
b – Activity profiles
c – Bibliographies
d – Biosafety policy briefs
e – Book chapters (peer reviewed in your area of specialization)
f – Books (in your discipline)
g – Concept notes
h – Conference papers
i – Conference posters
j – Consultancy reports
k – Edited books (peer reviewed conference proceedings etc)
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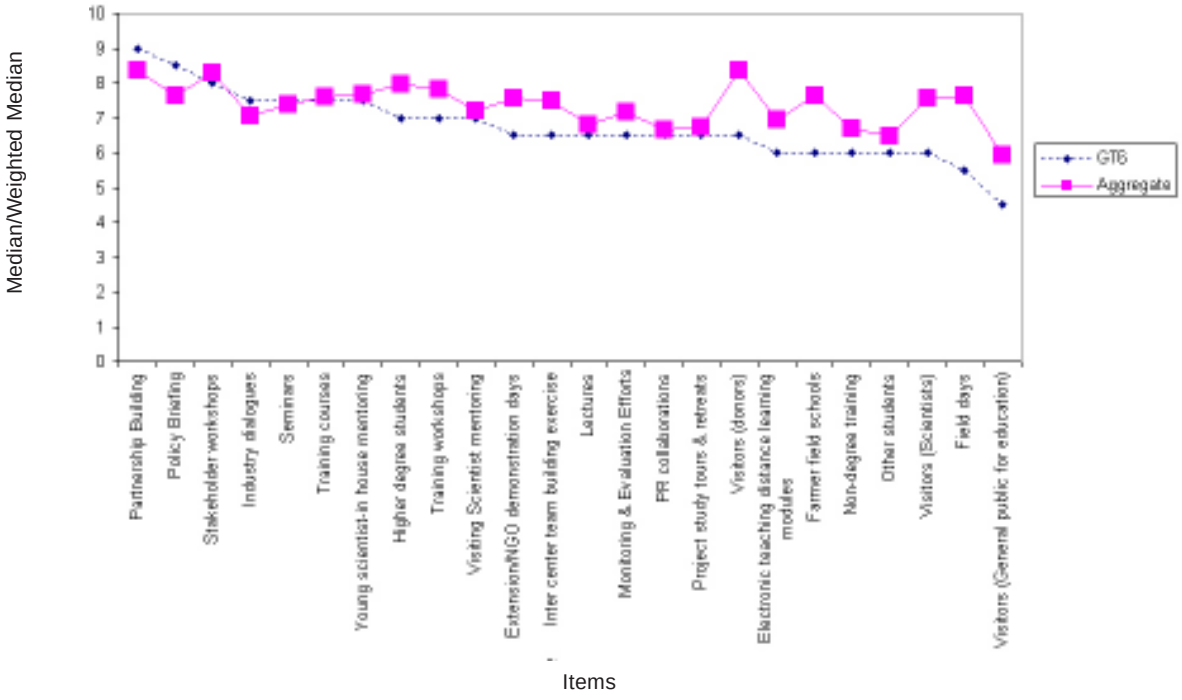
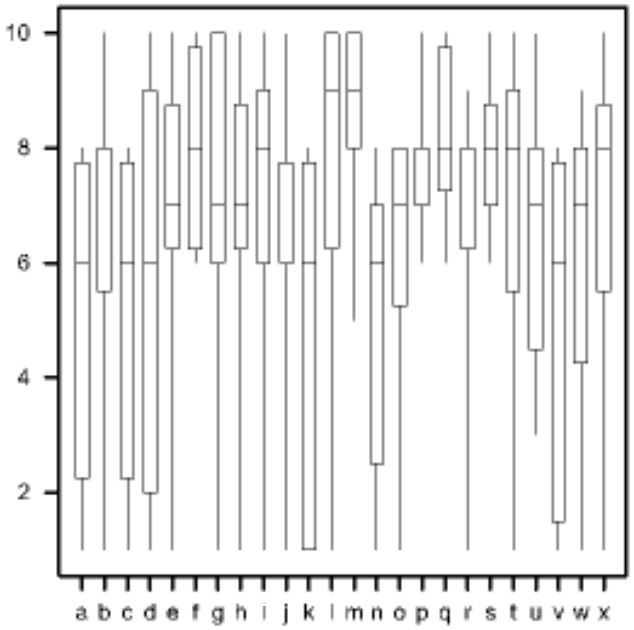
m – Engineering and other blue prints
n – Ex-ante impact reports and impact pathway studies
o – Ex-post impact reports
p – Extension materials (audio visuals)
q – Extension materials (printed)
r – Extension posters
s – Institutional change documents
t – Institutional internal policy documents
u – Institutionally generic power point presentations
v – Internal reports and research notes
w – Invention disclosures
x – Journal articles (hard copy)
y – Monographs
z – Network reports
A – Newsletter articles
B – Newsletters
C – Patent documents
D – Policy briefs for decision-makers
E – PR material
F – Press releases and new items
G – Project proposal documents
H – Technical bulletins
I – Trademark establishment documents
J – Training manuals
K – Varietal or chemical product descriptors or germplasm registration notes
L – Websites or pages

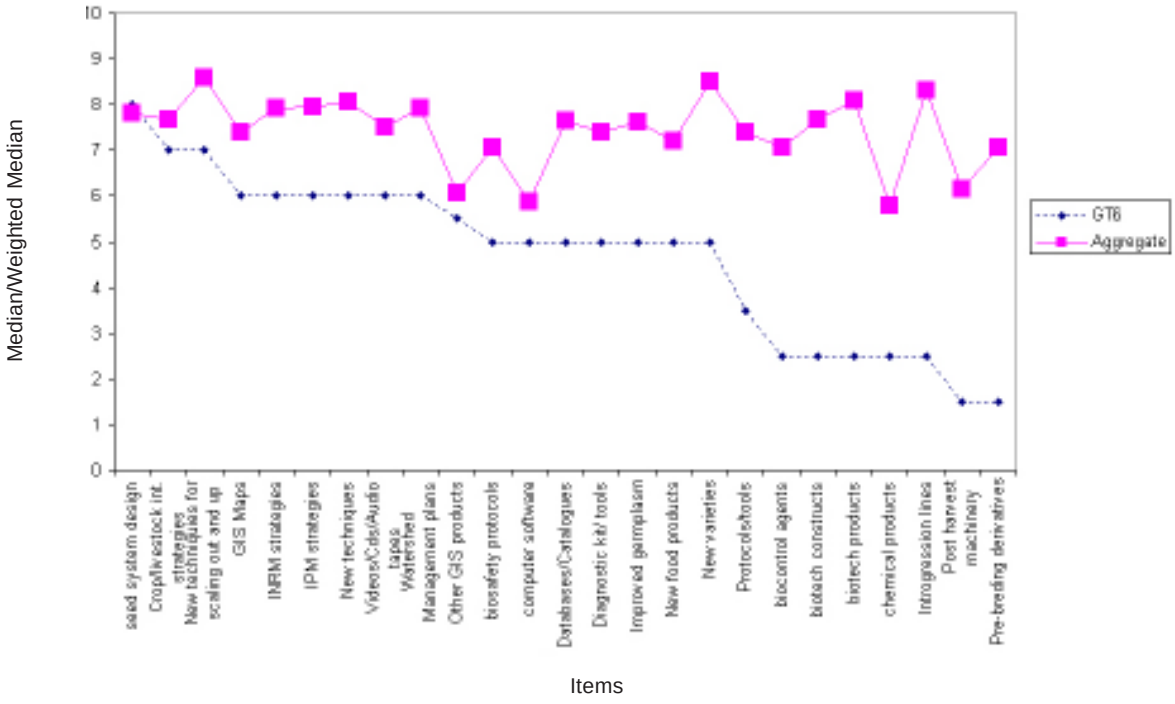
Training

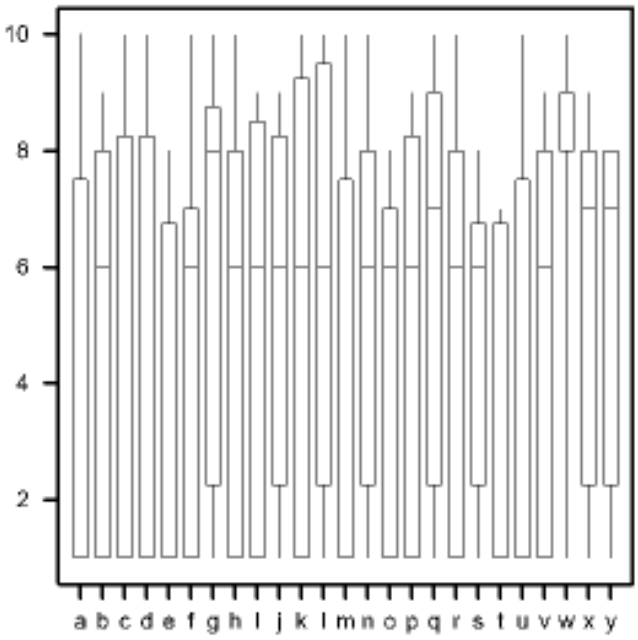




a – Electronic teaching distance learning modules
b – Extension /NGO demonstration days
c – Farmer field schools
d – Field days
e – Higher degree students
f – Industry dialogues
g – Inter center team building activities
h – Lectures
i – Monitoring and evaluation efforts
j – Non-degree training
k – 0ther students
l – Partnership building
m – Policy briefings
n – PR collaborations
o – Project study tours and retreats
p – Seminars
q – Stake holder workshops
r – Training courses
s – Training workshops
t – Visiting scientist mentoring
u – Visitors (donors)
v – Visitors (general public for education)
w – Visitors (scientists)
x – Young scientist in-house mentoring

Products





a – Biocontrol agents
b – Biosafety protocols
c – Biotech constructs
d – Biotech products
e – Chemical products
f – Computer software
g – Crop/Livestock integration strategies
h – Databases/Catalogues
i – Diagnostic kit/ tools
j – GIS maps
k – Improved germplasm
l – INRM strategies
m – Introgression lines for fundamental research
n – IPM strategies
o – New food products
p – New techniques
q – New techniques for scaling out and up
r – New varieties
s – Other GIS products
t – Postharvest machinery and storage design
u – Pre-breeding derivatives
v – Protocols/Tools
w – Seed system design
x – Videos/CDs/Audio tapes
y – Watershed management

For GT6 scientists, in the case of *editing*, books, journal special issue editions and conference proceedings are all rated highly. In contrast to all other GTs internal peer reviewing of papers is seen to be a more important job than doing the same job externally.

For *writing*, again the hard copy of the journal articles is rated highest, substantially higher than the soft copy. Very high importance is also ascribed to books, book chapters and edited books, policy briefs for decision makers and ex-ante and ex-post impact reports, concept notes and project proposal documents. Extension materials (audiovisual and printed), institutional change documents, and conference papers received middle level support whereas varietal or chemical product descriptors of germplasm registration notes, invention disclosures and engineering blueprints are rated of comparatively low value.

For *training*, partnership building, policy briefing, higher degree students, seminars and stakeholder workshops are rated substantially high. Farmer field schools, field days, other students and visitors (general public for education and scientists) are low priority for these scientists.

In the *products* category, seed system design is rated the top priority followed by crop/livestock integration strategies, new techniques for scaling out and up, GIS maps, INRM and IPM strategies and watershed management plans. Other items such as improved germplasm, introgression lines for fundamental research, biotech products, post harvest machinery and pre-breeding derivatives are rated low.