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Evaluating the Impact of North-South Research Fellowships: The Case of the Vavilov-Frankel Fellowship Program on Fostering Conservation and Use of Agro-Biodiversity

Elisabetta Gotor
Elizabeth Doupé Goldberg

Abstract In this study, we combine Kirkpatrick's learning and training evaluation theory with a logical impact assessment pathway to evaluate a North-South fellowship program which supports young scientists from developing countries to carry out innovative research on plant genetic resources conservation and use. The program's inputs and outputs are evaluated at the reaction and learning level of the fellows while the program's identified outcomes and expected impacts are evaluated at the behavior and result level. Conclusions are drawn on methodological lessons learnt and improvements that can be applied to evaluate similar capacity building activities.

Key Words: Evaluation of Training, Kirkpatrick's Model of Evaluation of Training, Logical Impact Assessment Pathway

INTRODUCTION

Bioversity International, Bioversity for short, is part of the Consultative Group on International Agricultural Research which works to reduce hunger, poverty and environmental degradation in developing countries by generating and sharing relevant agricultural knowledge, technologies and policies. Bioversity undertakes, encourages and supports research and other activities on the use and conservation of agricultural biodiversity to create more productive, resilient and sustainable harvests. The North-South fellowship program which supports young scientists from developing countries to carry out innovative research on plant genetic resources (PGR) conservation and use was established in 1989, to commemorate the unique and pioneering contributions to plant science made by academicians Nikolai Ivanovich Vavilov of Russia and Sir Otto Frankel of Australia. The rationale of the Vavilov-Frankel Fellowship (VFF) is to encourage the conservation and use of PGR by enabling outstanding young scientists from developing countries to carry out relevant, innovative research outside their own countries for a period of between three months to one year. The expected

impact of the program in the long term is to have Plant Genetic Resources for Food and Agriculture (PGRFA) more equitably, productively and sustainably managed.

Two major outcomes are expected as a result of the program: the strengthening of knowledge and expertise of research fellows and the application of the knowledge gained within national institutions. Applicants in fact must demonstrate the importance and benefit of their proposed research to their home country and indicate how it will be applied upon their return. In this way, the VFF helps countries build the scientific capacity they need to address urgent issues relating to the management of PGR and to promote the contribution of those resources to development.

Only the first two fellowships in 1993 were granted to scientists from developed countries who examined the historical background of the PGR movement. Their work resulted in two books: *Scientists, Plants and Politics* by Robin Pistorius of The Netherlands and *Vavilov and his Institute* by Igor G. Loskutov of Russia. Since 1994, fellowships have been awarded to scientists from developing countries. The rationale of the choice was that the experience gained by the fellows at an advanced research institute outside of their home country would enable them to contribute more effectively to PGR activities once they returned to their home countries. In doing so not only would the fellowship develop in-country capacity to research urgent problems identified by the fellows' home countries, but it would also stimulate scientific exchange between researchers in developed and developing countries and would build lasting linkages between the home and the host institutes and countries.

Research conducted by the fellows has covered a wide range of topics related to the conservation and use of plant genetic resources, such as new conservation technologies and strategies, socioeconomic, human and policy aspects of conservation and use, germplasm management, forest genetic resources conservation and use strategies, genetic erosion assessment and mitigation and conservation and use of specific crops.

The nomination and selection process of the Vavilov-Frankel Fellows is a competitive process that considers the originality of the research, the quality of the proposal and the likelihood that the fellowship will result in positive and tangible benefits for the home country. Potential fellows are made aware of the fellowship program through notices placed in journals and newsletters and sent to Bioversity collaborators such as donors, board members, former host institutes and Bioversity regional offices. More recently, electronic sources such as web sites and electronic bulletin boards have increasingly been used to notify target audiences of the fellowship opportunity. The

fellows are responsible for developing a research proposal, arranging collaboration with a host institute, and presenting the proposal to Bioversity for a decision. Proposals are peer-reviewed and ranked by a selection committee of thematic experts.

This evaluation is based upon evidence derived from the perspective of past fellows, the fellows' home institute supervisors, the host institute supervisors and the Bioversity scientific advisors. Data gathered are then cross-checked or triangulated to assess consistency or lack of consistency in addressing the following key questions:

- To what extent are the fellows able to apply the knowledge gained through the fellowship program?
- To what extent has the fellowship contributed to the professional development of the fellow?
- What is the impact of the fellowship research on PGR at the national, regional and international level?
- What are the strengths and weaknesses of the fellowship program?

The scope of this paper is to evaluate the effectiveness of Bioversity International's VFF capacity building program by testing the workability of merging Kirkpatrick's learning and training evaluation theory (2002) to the logical impact assessment pathway.

CONCEPTUAL FRAMEWORK AND DATA COLLECTED

In this study we combine Kirkpatrick's learning and training evaluation theory (2002) to the logical impact assessment pathway. Kirkpatrick's learning and training evaluation theory is based upon four levels of analysis:

1) Reaction
2) Learning
3) Behaviour
4) Results

Evaluation at the reaction level measures how those who participate in a training program react to it and should ideally be assessed during or immediately after a training program ends. At the most basic level, training should be well received by trainees. A positive reaction (to the content and or delivery of training) may not ensure learning, but negative reaction almost certainly reduces the possibility. Learning is defined as the extent to which participants change attitudes, improve knowledge, and/or increase skills. Behavior is the extent to which change has occurred as a result of attending the training program. This implies that the training participant will apply what they have learned back on the job.

In order for behavior to change four conditions are necessary:
1. The trainee must have a desire to change
2. The trainee must know what to do and how to do it
3. The trainee must work in the right climate
4. The trainee must be rewarded for training

The third and fourth conditions are beyond the scope of the training itself but relate to the working environment of the trainee. It is important to consider these two conditions when evaluating training, as lack of change in behaviour does not necessarily mean that no learning has taken place.

The result level is defined as the final results that occurred because the participants attended the program.

The impact assessment logical pathway provides a good and commonly used tool for identifying the goals of a program, and much of the information around which the evaluation is constructed. It helps the evaluator to determine whether the program-expected outputs, outcomes and impacts were met.

Our analysis is conducted following the logical framework depicted in Figure 1. The VFF outputs, generated thanks to several activities conducted both by the fellows, but also by other actors will be evaluated at Reaction and the Learning level, while the VFF outcomes and expected impact will be evaluated at the behavior and results level.

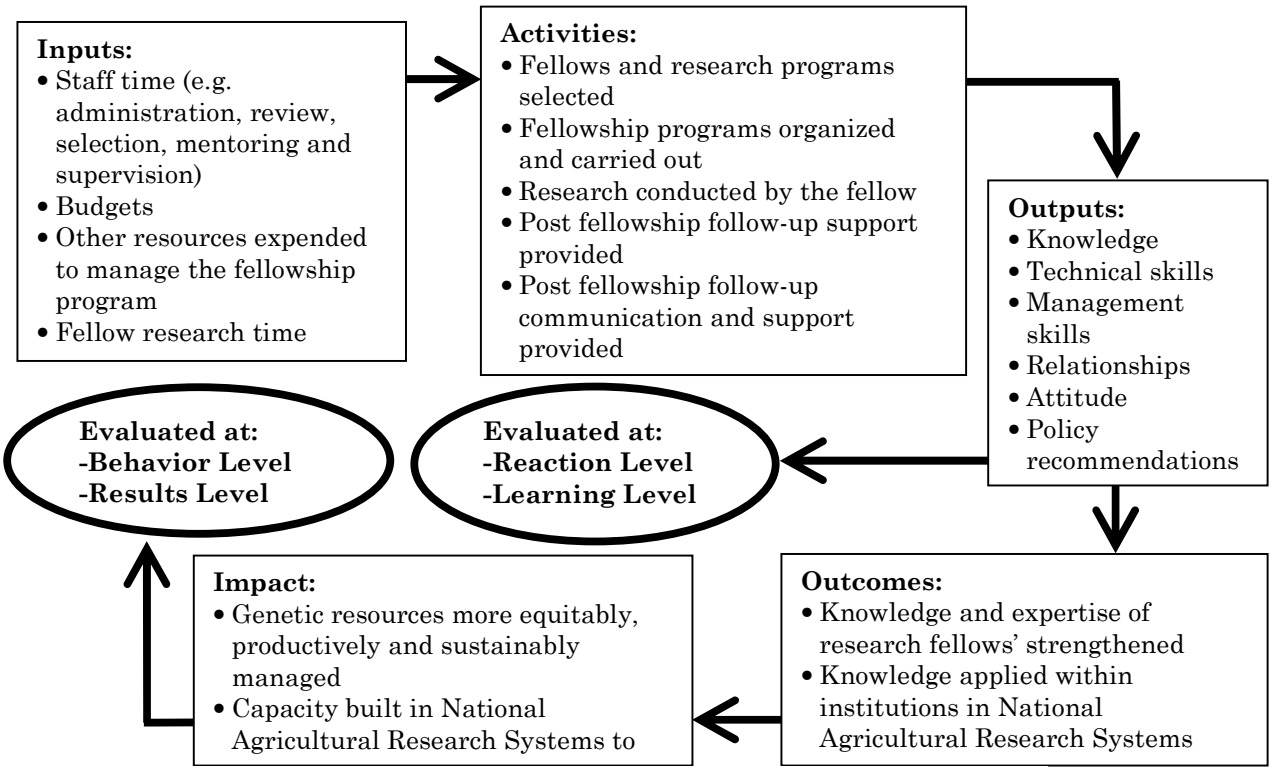

Figure 1: Logical Framework of the VFF Program

The major inputs are provided by the fellows (at the activities level of Figure 1) who are granted the fellowship in order to generate a set of scientific outputs. However, fellows are not the only actors. Fellows' host and home institute supervisors and Bioversity scientific advisors also perform an important role in the achievement of the program through the provision of supervision and mentoring. Given the multitude of actors involved in this evaluation, due attention is given to data collection. We wanted to depict opinions from all sources involved in the process and we wanted to validate the responses obtained with desk reviewed studies.

Therefore, this evaluation was conducted with a mixed methods approach using multiple data sources. A participatory approach was used by conducting interviews and gathering data directly from individuals involved in the project. Survey tools were designed for online data gathering and telephone interviews. A desk review and bibliometric surveys were carried out with the scope of assessing the solidity of the research outputs generated. Table 1 summarizes the four levels by evaluation type and includes also the research questions this evaluation attempts to answer and the data collected to support our findings.

TABLE 1
EVALUATION TYPES, RESEARCH QUESTIONS AND DATA COLLECTED

Logical Framework	Level	Evaluation Type (What is measured)	Evaluation Description	Questions we want to answer	Data Collected
Inputs ↓ Outputs	1	Reaction	*Reaction Evaluation* is how the fellows felt about the learning experience	To what extent are the fellows able to apply the knowledge gained through the fellowship program?	Personal assessment: Data gathered through questionnaire sent to past fellows
	2	Learning	*Learning Evaluation* is the measurement of the increased knowledge		Objective assessment: Data collected to evaluate the Reaction Level are cross checked and triangulated with information obtained by home and host institute supervisors
	3	Behavior	*Behavior Evaluation* is	To what extent has	Information obtained from

Outcomes ↓ Impact			the extent of applied learning	the fellowship contributed to the professional development of the fellow?	the perspective of the individual fellows, home and host institute supervisors and Bioversity scientific advisors, bibliometric survey of publishing outputs of the fellows
	4	Results	*Results Evaluation* is the effect on the business or environment by the trainee	What is the impact of the fellowship research on PGR at national, regional and international level?	Official documents such as selection criteria and procedures for awarding VFF, the Global Plan of Action for the Conservation and Sustainable Utilization for Plant Genetic Resources for Food and Agriculture, Bioversity web-site and other CGIAR sites

Questionnaires and interviews were applied to obtain information about the fellowship program from the perspective of the individual fellows, host and home institute supervisors, and Bioversity scientific advisors. The survey instruments were made available to respondents by use of an online survey service provider (www.surveymonkey.com). The survey instrument contained some questions that were mandatory for all respondents, other questions that were optional and others that were conditional with respect to certain responses. The surveys required the respondents to rate or rank the importance of various factors. Opportunities for respondents to make additional comments were provided for in many questions. The respondents also had the option to fully or partially answer optional questions and, as a result, the number of complete responses varied for several questions. Separate survey instruments were prepared and tailored to the role and

interests of the four key stakeholder groups: the fellows, the host institute supervisors, the home institute supervisors and Bioversity scientific advisors. Invitations to complete the surveys were sent to twenty-five fellows, twenty-two host supervisors, five home supervisors and twenty-two Bioversity scientific advisors. We received sixteen responses to the survey of the fellows, nine responses to the host institute survey, two responses to the home institute survey and eleven responses to the scientific advisors' survey. A total of sixteen fellows responded.

TABLE 2
DATASET COMPOSITIONS

	Number of survey sent	Responses	%
Fellows	25	16	64
Host Supervisors	22	9	41
Home Supervisors	5	2	40
Bioversity Scientific Advisors	22	11	73

The survey instruments were complemented with follow-up interviews. Specifically four fellows (two female and two male) were interviewed from four different continents namely — Africa, Latin America, South-East Asia and Eastern Europe. Additionally, two host institute supervisors, one home institute supervisor and one Bioversity scientific advisor were interviewed. This enabled us to deepen our understanding of certain issues and to further examine the questionnaires.

In addition, a bibliometric survey was carried out to assess the publishing outputs of the fellows. Each fellow was, through the survey instrument, asked to provide a list of publications that resulted from the fellowship program. Searches on Thomson Scientific (formerly ISI) Web of Knowledge for impact factors were carried out by the Bioversity librarian on selected journal articles. Thomson is a large USA based publisher with worldwide coverage and it calculates impact factors each year for those journals which it indexes and the indices are published in *Journal Citation Reports*. In addition, searches on citations of selected articles by fellows were carried out in, Scopus and Google Scholar.

The data gathered were then cross-checked and validated with official documents such as procedures for awarding VFF, selection criteria, sample evaluations of fellowship programs conducted within the CGIAR, the Global Plan of Action (GPA) for the Conservation and Sustainable Utilization for Plant Genetic Resources for Food and Agriculture. Where possible, different sources of information were used to verify and substantiate the assessment. In doing so we sought to overcome the bias that comes from single informants, single methods or single observer studies

EVALUATION RESULTS AND DISCUSSION

Following the model depicted in Figure 1, inputs and activities conducted and outputs generated are evaluated at the fellow's Reaction and Learning levels. Specifically how the fellows feel about the learning experience and how their knowledge has increased is evaluated answering questions posed in Table 1. The fellowship's outcomes and impact are instead evaluated at the Behavior and Results levels. The extent to which the fellowship has contributed to the professional development of the fellow and the impact of the fellowship research on PGR at national, regional and international level are thus analyzed.

1. To what extent are the fellows able to apply the knowledge gained through the fellowship program?

Although the individual capacities of the fellows differed and their success rate varied all fellows felt that their knowledge and skills had increased as a result of the fellowship program. This was supported by both host institute supervisors 100% reporting a high to medium degree of capacity strengthened and Bioversity scientific advisors 100% reporting an increase in the skills, knowledge and ability of the fellow to carry out innovative research on conservation and use of PGR.

Thirteen out of the sixteen fellow respondents affirmed that they have or will apply the knowledge and skills obtained during the fellowship program. For example, thanks to one fellow's training and capacity building in tree genotype characterization and in the field of tree domestication at Ghent University, the Faculty of Agronomic Sciences in Benin could increase expertise in the field of molecular genetics techniques. Also in Turkey, as reported by a fellow, all methods and protocols learnt during the fellowship have been applied in the laboratory and taught to new under-graduate and post-graduate students. Most commonly faced obstacles in applying knowledge and skills were related to the availability of funding and equipment.

Moreover host institute supervisors and Bioversity scientific advisors/advisor were asked to rank how effectively the research of the fellows had increased the scientific knowledge in an area of importance to PGR conservation. This was done by using a four-point scale from completely achieved to not achieved. Twenty-three out of twenty-five Bioversity scientific advisors and host institute supervisors respondents rated the extent to which the fellowship research increased scientific knowledge in an area of importance to PGR as completely or mostly achieved.

The host institute supervisors were asked to rate (high, medium, low) the degree to which the capacity of the fellows was strengthened during the fellowship. Six out of nine (two-third) reported that capacity was strengthened to a high degree and the remaining three that capacity was strengthened to a medium degree.

> *"The fellow came with well developed skills in biological field research and in community motivation, gained from his undergraduate training and experience of managing a land reclamation project in Ethiopia for a non-government organization (NGO). The fellowship support allowed strengthening of his skills in research design, data management and analysis (particularly in the area of statistical analysis), report organization and in scientific writing. While skills would have been enhanced even if the Vavilov Fellowship had not been received, the fellowship allowed a significantly higher skill level to be attained*" (Response of a host institute supervisor to the questionnaire).

The relationship between the host institute and the fellow is crucial to the success of the fellowship program. The questionnaires revealed that many of the fellows are still in contact with the host institute or colleagues whom they met in the place and developing new research projects together.

> *"We are in contact by mail and discuss our results and new collaboration"* (Edited response to questionnaire from a former fellow).

The collaboration between the host institute and the home institute of the fellows can influence the degree to which the strengthening capacity for research is embedded in the national structure of the home country. Seven out of nine host supervisors found that the program had either completely or mostly been successful in creating a partnership between the host institute and the home institute.

> *"We are still in contact with the fellow. And because my institute has established good links with the fellow's former supervisor, it has received students from* [Fellow's country of origin] *almost every year since then. They come for six months training in plant breeding"* (Response to the questionnaire of a supervisor from the host institute).

However, other comments revealed that it could sometimes prove difficult to work with institutes who differ radically in the approach and manner of working.

> *"After the fellow returned to his home country I have lost contact with him. The difference in culture between his home lab and our lab is also very big. I find it difficult to collaborate with an organization, which I discovered to be very strongly hierarchical"* (Response of a host institute supervisor to the questionnaire).

2. To what extent has the fellowship contributed to the professional development of the fellow?

The fellowship program seeks to contribute towards positive changes in the fellows' professional lives. The fellows were asked to rate nine selected parameters of changes in terms of attitudes and skills by using a six point scale, from "great change observed" to "not sure/not applicable."

Fourteen out of the sixteen respondents felt that being part of the fellowship program resulted in "*an increase in academic outputs*." This was followed by twelve of them that felt *"exposed to useful methods and technologies."*

In addition, the fellows highlighted a number of other factors that benefitted their careers. Some of these issues are listed below:

> *"It significantly improved my self-esteem by allowing me to learn new methods and apply them in my study"* (Fellow's response to the questionnaire).

> *"The fellowship helped improve my capacity to negotiate with other scientists for collaboration and develop joint research programs. This is important for my future career"* (Another fellow's response to the questionnaire).

Several of the fellows also mentioned that the VFF had exposed them to a wide network of people, which has played and will continue to play an important part in their career development.

> *"The fellowship was recognition of the importance of the project, and the activities sponsored by it. Working with one of the best researchers and his team on the subject of population genetics in plants improved my knowledge and helped me to develop professional relationships that I keep to this day"* (A fellow's response to the questionnaire).

There is no doubt that the access to professional networks and resources combined with the prestige the VFF carries with it were considered some of the most beneficial elements of the fellowship program.

> *"The fellowship has had a greater impact on my career than even my doctoral studies and it has brought me more recognition and contacts that continue to yield positive dividends to date"* (A fellow's response to the questionnaire).

The majority of the respondents continued to work in universities upon completion of the fellowship program (see Table 3 below). This was followed by work in Government departments and work in public research organizations/institutes. Only one former fellow was working in the private sector. Only one of the respondents has not continued to work in the field of plant genetic resources. The reason given was to pursue long-term goals and interests.

TABLE 3
SECTORS IN WHICH THE FELLOWS ARE PRESENTLY EMPLOYED

Sectors	Number of Fellows (n=16)
Government department/ministry	2
Private sector organization	1
Public research organization/institute	4
University	9

3. What is the impact of the fellowship research on PGR at national, regional and international level?

The results level evaluation is related to the potential impact of the fellowship research at national, regional and international level.

The main goal of the fellowship program is to build capacity in National Agricultural Research Systems to conserve and use plant genetic resources, particularly in developing countries. In terms of benefits to the home institute derived from the fellowship program fifteen out of sixteen fellows felt that their participation in the program had indeed benefitted the home institute. In this regard, an interesting example is provided by the established scientific co-operation between Ghent University, Belgium (host institute) and University of Abomey-Calavi, Benin (home institute) which has led to other partnerships in the field of natural resources management. Indeed, a new agroforestry project on Baobab (*Adansonia digitata*) and Tamarind (*Tamarindus indica*) in West Africa (2007-2011) is being developed between the two institutions. The new partnership, as reported by one of the respondents, was facilitated thanks to the already established link throughout the VFF project.

> *"With this project, the scientific co-operation between my host institute and my home institute has been increased and has led to other partnerships in the field of natural resources management"* (A fellow's response to the questionnaire).

Testimony from host institute supervisors also indicates that the research results obtained by the fellows in some cases have made a contribution to the knowledge base on PGR.

> *"The research was on traditional farmers and their management of Sorghum landraces on their farms with particular accent on agrobiodiversity. The research produced a baseline data set on the range, location and relative abundance of the various landraces on individual farms and across five communities. This was followed for nine years later to produce some of the first time-series data in this nature. The results directly relate to the viability and importance of in situ landrace conservation to the maintenance of genetic resources. The fellow continues to work in this area."*

Twelve out of the sixteen fellows interviewed returned to their home country to live and work upon completion of the fellowship program. Returning to the country of origin is considered a necessary precondition for the knowledge gained through the fellowships to be applied to advancing the science of PGR and PGR related programs of research and management in the home countries of the fellows.

The most common reasons for not returning to the home country upon completion of the fellowship program were to either complete or continue their PhD studies. This leaves the possibility open that some of the fellows might return to their home countries later on in their career (e.g. one respondent made it clear that he intended to return to his home country within the next five years). Further professional qualifications derived from capacity development obtained through the fellowship, however, might make it easier and more attractive for the former fellows to find jobs in their host countries. One respondent mentioned that she was not able to find suitable work where she could apply her new skills in her home country. Two of the respondents, who did not return to their country of origin, did however, continue to work on research projects focused on their countries (e.g. with coffee farmers) whilst based abroad.

Fourteen out of sixteen fellows responded that their participation in the fellowship program had benefited their home country. Examples provided by the fellows show that the fellowship in fact allowed them not only to inform

policy-makers about how genetic biodiversity erosion can effect loss of biodiversity; but also to pass on knowledge and new methods to students; to provide comprehensive inventories of shade tree biodiversity in coffee plantations and disseminating it widely to professionals and graduate students; to apply knowledge on gene flow and artificial selection between cultivated and wild populations to national decisions on environmental risk assessment of genetically modified organisms; and in introducing new research on Baobab in the context of sustainable utilization of plant genetic resources in agriculture and forestry. Furthermore, one fellow was appointed as a consultant for the country's State of the World report on PGRFA commissioned by the Food and Agriculture Organization of the United Nations (FAO). Only one fellow responded that the country had not benefitted from the participation in the fellowship program.

In order to determine the relevance of the research to the global PGR research agenda each fellow's research topic was compared with the GPA for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture (www.globalplanofaction.org). The GPA is an important international yardstick adopted by 150 countries in 1996 as a framework for action at community, national, regional and international levels, by which to measure their progress towards sustainable PGR conservation and use. The GPA also provides the priority basis for the funding strategy of the International Treaty for Plant Genetic Resources for Food and Agriculture. It can be used as a relevance factor to correlate fellows' choice of research topic with importance of the topic to developing countries in agricultural research for development. Two areas dominated the research undertaken by the fellows, namely "Supporting on-farm management and improvement of PGRFA" (three fellows working on this) and "Expanding the characterization, evaluation and number of core collections to facilitate use" (three fellows working on this). This was followed by "Promoting in situ conservation of wild crop relatives and wild plants for food production" (two fellows working on this), "Surveying and inventorying PGRFA" (two fellows working on this), and "Increasing genetic enhancement and base broadening efforts" (two fellows working on this). Other research fellowship topics contributed to GPA thematic areas are-"Sustaining existing ex situ collections" (one fellow working on this), "Building strong national programs" (one fellow working on this), "Supporting seed production and distribution" (one fellow working on this) and "Developing and monitoring early warning systems" (one fellow working on this).

TABLE 4
GLOBAL PLAN OF ACTION THEMATIC AREAS

GPA Thematic Areas	Respondents 2008 (n=16)
Surveying and inventorying PGRF	2
Supporting on-farm management and improvement PGRFA	3
Assisting farmers in disaster situations to restore agricultural systems	
Promoting in situ conservation of wild crop relatives and wild plants for food production	2
Sustaining existing ex situ collections	1
Regenerating threatened ex situ accessions	
Supporting planned and targeted collecting of PGRFA	
Expanding ex situ conservation activities	
Expanding the characterization, evaluation and number of core collections to facilitate use	3
Increasing genetic enhancement and base broadening efforts	2
Promoting sustainable agriculture through diversification of crop production and broader diversity in crops	
Promoting development and commercialization of underutilized crops and species	
Supporting seed production and distribution	1
Developing new markets for local varieties and diversity rich products	
Building strong national programs	1
Promoting networks for plant genetic resources for food and agriculture	
Constructing comprehensive information systems for plant genetic resources for food and agriculture	
Developing monitoring and early warning systems for loss of PGRFA	1
Expanding and improving education and training	
Promoting public awareness of the value of PGRFA conservation and use	

In total, research has been carried out in nine different action areas covering therefore a good half of the GPA global research themes. If we consider that areas such as "Building strong national programs," "Promoting networks," "Expanding and improving education and training" or "Promoting public awareness" are not research activities *stricto sensu* but rather process activities we have a good balance of VFF research topics addressing most action areas considered to be relevant to developing countries' PGR needs.

Interestingly, all the respondents felt that the research had benefitted international efforts in plant genetic resources conservation and use. This was substantiated through evidence of contribution to the scientific literature (as noted below) and the respondents expressed a sense that the research undertaken was of relevance to many countries.

Many of the fellows published more than one publication or made more than one presentation at international conferences based upon their fellowship research. On average they published or presented 2.8 papers (this figure does not include articles or presentations currently in preparation). This

evaluation has looked at some citation based statistics which can, if used properly and interpreted with caution, play a role in assessing the impact of the fellows' research on the scientific community.

The impact factor is a bibliometric parameter based on the number of times that papers in a particular journal are cited by all journals (Opthof 1997). The impact factor is considered a parameter of scientific quality of a journal, the assumption being that frequency of citation reflects quality. It is calculated by dividing the number of citations a journal receives to articles published in the two previous years by the number of articles published in those same years (Amin et al 2003).

Based on the questionnaires filled in by the fellow respondents, a total number of eleven articles were analyzed in Thomson Scientific database. Of these articles eight publications by seven authors were identified in the database. The majority of these articles were refereed. Table 5 shows the journals in which the fellowship research was published and the impact factor (2007).

TABLE 5
JOURNALS IN WHICH FELLOWSHIP RESEARCH WAS PUBLISHED

Journal	Impact Factor
Agroforestry Systems	1.67
American Journal of Botany	2.51
South African Journal of Botany	0.44
Silvae Genetica	0.54
BiomedCentral Genomics	4.18
Agriculture, Ecosystems and Environment	2.308
Chromosome Research	3.469
Economic Botany	1.776

In principle, it is better to publish in journals with a high impact factor in terms of a proxy measure to influence science, or gain scientific credibility for the published work. However, many factors influence the calculation of the impact factor. Some journals command more respect than others in a given field but might have a lower impact factor. This is due to the different rate with which articles are cited within different disciplines. For example, some disciplines such as biomedical sciences receive most of their citations soon after publication. In other disciplines many citations occur outside the two year period of the impact factor (Joint Committee of Quantitative Assessment of Research 2008). Angelsen et al. (2004) notes that it takes time to get cited and that for forestry related publications the leveling off of citations is surprisingly quite slow. Since the coverage of the articles is spread over several disciplines conclusions in terms of comparison of the results based on the impact figures above are limited.

While it is natural that the majority of the fellows' research appears in botanical and forestry journals, the impact could possibly be increased by publishing in more general journals within the ecological/biological/conservation and economics/development fields.

Ten articles were analyzed in Web of Science, Scopus and Google Scholar for citations. Citations made by the authors themselves were then subtracted from the list. A number of the publications were too recent to be cited but on average the fellows' research was cited 2.1 times. One article, however, was cited twelve times while the rest were cited between 0-3 times. Table 6 below shows in which journals the researches of the fellows were cited.

TABLE 6
JOURNALS CITING FELLOWSHIP PUBLICATIONS

Journal	Number of times Fellows' work cited	Impact Factor
American Journal of Botany	2	2.512
Annals of Botany	4	2.939
Bioscience	1	4.083
Botanical Journal of the Linnean Society	1	1.075
Economic Botany	1	0.525
Functional Plant Biology	1	2.375
Genetic Resources and Crop Evolution	2	0.731
Interciencia	1	0.271
Journal of Arid Environments	3	1.349
Journal of the Professional Association for Cactus Development	1	0.357
Plant and Cell Physiology	1	3.654
Plant Biosystems	1	0.649
Southwestern Naturalist	1	0.37

The research analyzed was cited in thirteen different journals. Of these, nine cited only one fellow's work, whilst four journals have cited two or more. Not surprisingly, most citations are in botanical journals.

CONCLUSION

In this study we combine Kirkpatrick's learning and training evaluation theory to the logical impact assessment pathway to evaluate Bioversity International's Vavilov-Frankel Fellowship, a North-South program which supports young scientists from developing countries to carry out innovative research on PGR conservation and use. Specifically inputs and outputs of the program are evaluated at the Reaction and Learning level of the fellows while the program's identified outcomes and expected impact are evaluated at the Behavior and Results level.

This methodology allowed the evaluator to assess different stages of the learning process against the fellowship impact pathway (Figure 1). Results highlighted the need to address three aspects of the program:

1. The need for a more thematically targeted approach to increase the relevance of the proposals received
2. The need to increase engagement with fellows post-fellowship
3. The need to increase monitoring of results for future assessments

In this regard, some measures were taken up by Bioversity to address the identified needs. A more thematically targeted approach was implemented to increase the relevance of the proposals received. The fellowship announcement included a call for proposals on eight priority topics on themes of interest to Bioversity. As a result more relevant proposals have been received. Also this is contributing to strengthening the quality of the networking and professional linkages between the fellow and the Bioversity and host institute supervisors. Moreover a Fellows Gallery web portal is being developed to raise the profile of the fellows, showcase their research results and provide a more dynamic means to put them in contact with other fellows who have worked on Bioversity projects. The Fellows Gallery features short videos that allow the fellows to tell their own story in the context of the research they have carried out. It also features fellows' publications or other outputs associated with the fellowship. Social media links provide a mechanism for the fellows to connect with each other or stay in touch with news and opportunities in the field. This addresses a need expressed by fellows in the study to maintain closer linkages with Bioversity. Finally, informal communication by e-mail was initiated with the fellows to obtain more information on the fellows' employment status and publication record post-fellowship. A recent survey indicated that several of the fellows have used the VFF to leverage additional support for their PhD studies, to obtain positions of greater responsibility within their institutes or to develop follow-on collaborative research projects between their home institutes and their host institute.

However, the budget and time frame of the evaluation did not allow the evaluator to assess impact at greater depth (e.g. what difference has the VFF made to PGR conservation and management in each of the countries and to what extent have the fellows increased their skills?). Since such analysis would have required proper baselines of the fellows' capacity before they embarked on the fellowship program and further studies would have had to be carried out to establish the fellows post-program capacity (before and after testing). Such baselines were not available and would be difficult to create given the flexible nature of the fellowship program (the fellowship is competitive and is open to all middle or low income countries and application

changes annually). The evaluation was therefore designed to determine what role the VFF had played in the lives of the participants without speculating about what would have happened in the absence of the fellowship program (counterfactual). This evaluation is therefore limited to the perceptions of the fellows, their supervisors and their Bioversity scientific advisors and these perceptions are regarded as important evidence.

The use of the proposed theoretical framework as an *ex post* evaluation tool should therefore be combined with a careful *ex-ante* analysis, where data and qualitative information of the individual fellows, host and home institute supervisors, and Bioversity scientific advisors are collected before the start of a program and subsequently monitored for a final assessment after a given number of years.

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Dr. Elisabetta Gotor is Scientist Impact Assessment Specialist at the Bioversity International, Via dei Tre Denari Maccarese (Fiumicino) Rome, Italy. Dr. Gotor has ten years of research experience in the area of economic analysis of agricultural development problems, policies and impact assessment. She holds a PhD in Agricultural Economics from the University of Reading, UK and has authored several academic and practitioner publications in the area of global trade analysis and impact assessment.
Email: e.gotor@cgiar.org

Ms. Elizabeth Doupé Goldberg is Head of the Capacity Development Research and Support Unit, Bioversity International, Rome, Italy. Ms. Goldberg has thirty-six years of work experience in information and knowledge management and

capacity development acquired in public, private and international organizations in the United States, Colombia and Italy. She has a Master's degree in Information Science from the University of Illinois (USA).
Email: e.goldberg@cgiar.org