Evaluation of the

Sustainable Agriculture Research for International Development (SARID) programme

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Key Findings

SARID (Sustainable Agriculture Research for International Development) was a successful programme. It produced high quality science; there was more movement towards developmental impact in some projects than expected; and participants themselves, both scientists and stakeholders, viewed it as successful and well-run. It provided a unique opportunity to link fundamental research through to its application in developing countries, enabling the same scientists who had understanding of the mechanisms underlying specified processes (such as the interactions between pests and plants) to transfer that knowledge to application to the field.

Review of the evidence suggests, however, that this success resulted not just from the SARID programme per se, but from that fact that SARID built on the results of previous funding initiatives such as DFID's Renewable Natural Resources Research Strategy and BBSRC's funding of Crop Science projects, both in terms of scientific outputs and the trust formed through previous partnerships.

With any programme, no matter how successful, room for improvement always exists. DFID is well-versed in working with developing countries and BBSRC has long experience in funding high quality science, but there is less experience in how best to support links between fundamental/strategic science and relevance to poor people in developing countries. In SARID, the combined efforts of DFID and BBSRC have made great strides while at the same time offering an experience base from which future joint programmes can benefit. SARID has helped to develop the capacity of young UK researchers to conduct research in the challenging conditions of developing countries and has provided opportunities for some developing country scientists to be trained in the most advanced technologies. Recommendations are offered here for consideration by the funding bodies considering further joint funding initiatives.

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EXECUTIVE SUMMARY

Key Findings

SARID (Sustainable Agriculture Research for International Development) was a successful programme. It produced high quality science; there was more movement towards developmental impact in some projects than expected; and participants themselves, both scientists and stakeholders, viewed it as successful and well-run. It provided a unique opportunity to link fundamental research through to its application in developing countries, enabling the same scientists who had understanding of the mechanisms underlying specified processes (such as the interactions between pests and plants) to transfer that knowledge to application to the field.

Review of the evidence suggests, however, that this success resulted not just from the SARID programme per se, but from that fact that SARID built on the results of previous funding initiatives such as DFID's Renewable Natural Resources Research Strategy and BBSRC's funding of Crop Science projects, both in terms of scientific outputs and the trust formed through previous partnerships.

With any programme, no matter how successful, room for improvement always exists. DFID is well-versed in working with developing countries and BBSRC has long experience in funding high quality science, but there is less experience in how best to support links between fundamental/strategic science and relevance to poor people in developing countries. In SARID, the combined efforts of DFID and BBSRC have made great strides while at the same time offering an experience base from which future joint programmes can benefit. SARID has helped to develop the capacity of young UK researchers to conduct research in the challenging conditions of developing countries and has provided opportunities for some developing country scientists to be trained in the most advanced technologies. Recommendations are offered here for consideration by the funding bodies considering further joint funding initiatives.

Key Recommendations

Selection Processes: The 2-stage project selection process adopted by SARID, which included separate evaluations of scientific quality and of developmental relevance, was generally thought to be an improvement on the process adopted by the Rural Economy and Land Use programme (RELU) where attempts to consider the comments of practitioners and academics in one panel was not entirely satisfactory. In future, to help both applicants and panel members understand more fully how to gauge the potential developmental relevance of a project, guidance is recommended on the likely relationship between choice of country, crop and partners and the likelihood of impact on the poor. Developing country scientists should continue to be included on panels, but they should be given appropriate induction training in the UK Research Council approach to project selection. The training should be aimed at giving them the confidence to contribute to panel discussions on all aspects, but in particular to raise awareness of any local constraints to any laboratory or field research proposed.

Project Implementation: Working on crop production in developing countries presents different challenges to research in the UK: it is recommended that mechanisms be considered for mentoring or 'inducting' individuals new to working abroad, to assist them in anticipating and resolving practical challenges that may arise when projects are implemented in

developing countries. (For example, experienced individuals could pass along lessons they have learned, in induction workshops and/or as matched mentors.) Consideration should be given to increasing applicants' awareness of the context in which their research will be applied, not least with respect to issues of gender. Specific types of actions might be suggested, e.g. putting higher expectations on developing country partners with respect to early stakeholder engagement, or including a liaison function at programme level so that key stakeholders are engaged or at least 'kept in the loop' throughout the project, not simply expected to respond at the end of the project. Similarly, if capacity-building is expected, guidelines should be provided as to incorporating that activity in with other activities, from the project's start. Planning for capacity-building should include matching capacity-building mechanisms (whether workshops, short courses or other activities) to the participants and objectives of the particular project.

Strategic context of individual programmes: While SARID funding was very much appreciated by participants, a widely-expressed concern is the lack of continuity posed by relatively short, non-extendable grants. Frequently, laboratory research was just beginning to bear fruit when the grant ended, prohibiting large-scale testing such as field trials and thus stopping short of impacts. We recommend to funders that they consider affording an opportunity for extension of grants to five years (or in exceptional cases, longer) based on review of both scientific quality and developmental relevance). These same funders could then continue to manage these extensions as they had the previous years, albeit with an increasing emphasis on steps being taken toward developmental relevance. In addition, funders need to consider the potential advantages and disadvantages of involvement of the private sector in developing countries. It is therefore recommended that where a research product appears to have potential but requires further input by UK scientists or involvement of the small-scale enterprises in developing countries, grantees are helped to reach out to alternative funders who would be interested in supporting that process, and/or other mechanisms of follow-on funding to help ensure uptake of the research by the private sector are considered.

Partnerships: For sound collaborations, individuals need opportunities to get to know each other and see if they are compatible in terms of delivering a project together. We recommend that funders consider enacting mechanisms which can help next-generation researchers to be included in such networking and, perhaps, pilot collaborations. Short-term experience in exploring ideas and perhaps even conducting very finite mini-projects together could act as "seeds" for future collaborations when the partnerships are found to be appropriate. Once full projects are awarded, one network-consolidation mechanism could be gathering all PIs and co-Is together early and mid-programme, so that practical insights can be shared by "old hands", individuals can network across projects, and mid-course reflection benefits final stages of projects.

Reporting: The current level of reporting was seen as a reasonable "half-way house" between the norms of DFID and BBSRC by researchers who are concerned that reporting not become more onerous, as they are kept extremely busy by the challenges of the international projects themselves. We would not recommend any heavier reporting requirements but rather simply continuing the current requirements of the annual reporting process, ensuring that recipients of funding do complete details of capacity-building activities such as workshops and numbers of male/female participants. It is also recommended that changes to report formats during the course of any future programmes are kept to a minimum.

Highlights on delivery of the programme

Project Selection Process: The call was welcomed by the research community, particularly due to its distinctive breadth in considering fundamental research with an eventual end-result of developmental impact. The 2-stage application process (184 outline proposals down to 12 grants) was seen as working well, albeit with some improvements possible. (Section 2.1)

Balance and Coverage of the Portfolio: With a particularly strong emphasis on plant-pathogen and-pest interactions, the portfolio demonstrates strength in the UK crop science community in applying fundamental science toward the growing of food crops, with a pleasing interest in a range of crops, including those of particular relevance to the poor.

Quality of the Scientific Research: As one quality metric, by the time of this review 43 papers had been published in 31 peer-reviewed journals for which impact factors were available; 19 had impact factors over 5. All but one project have recorded presentations made at conferences both in the UK and internationally. Projects also produced a range of insights, data sets, products and technologies. The quality of individuals involved was often noted as high, in both the UK and overseas. Since some projects finished relatively recently, it is likely that some more publications may appear in the next one to two years, particularly as more than three-quarters of the respondents expected that their particular SARID project would generate three or more papers. Seven of the projects had by the date of the surveys (July 2012) reported < three papers actually published in peer-reviewed journals.

Potential developmental impact and relevance to developing countries: Projects mostly used access to advanced genetic technologies in the UK to address a range of problems in crop production, including to: speed up the breeding process for disease resistance and drought tolerance; increase understanding of genes involved in yield characteristics and the impacts of specified soil contaminants; understand processes whereby inter-cropping or crop rotation could control *Striga* and nematodes, respectively; understand plant reactions to a specific virus; generate databases of cultivars, disease vectors and so on for those on the front-line of managing pests and diseases. Although the scheme emphasised underpinning science, five projects gave examples of impact on beneficiaries.

Capacity-building: Five of the twelve successful projects had included some capacity-building objective. In January 2010, 18 months after the start of more than half of the projects, an opportunity was offered for additional funding for capacity-building; nine grants were awarded. Mechanisms cited most frequently by survey respondents included: knowledge/skills-based short courses; exchange visits; and mentoring. This additional funding appears to have added value to projects and, overall, the SARID projects were seen as contributing successfully to non-UK countries. Furthermore, SARID projects engaged some British next-generation researchers in the research problems of developing countries. It would be more efficient, however, for requests for support for capacity-building to be included in the original proposal.

Partnerships: SARID participants felt that the grant had given them and their research partners an opportunity to work together that they would not otherwise have had. The experience appears to have been positive, as most are already working with these partners on a subsequent project. Many stressed the importance of having already known their main research partner before the SARID project, but in many cases there was more than one partner organisation in the developing country, which facilitated the formation of new partnerships.

Value added by the SARID Programme: Total expenditure on the main grants plus the additional Capacity Building grants is expected to be ~£7,011,350, with total expenditure on the latter expected to be ~£207,091 (figures taken from 3rd Annual Report of SARID initiative). Combined grants to individual projects ranged from £377,124 to £675,509. Numerous scientific outputs of good quality were generated as were even more impacts beyond research than might be expected given the nature of this programme, and there are indications of potential developmental relevance still to be delivered. Projects achieved a range of capacity-building outcomes. The SARID programme did deliver value for money.

1 INTRODUCTION

1.1 Evaluation Objectives

DFID and BBSRC commissioned this independent, ex post qualitative evaluation within the context of planning the future of their own collaborations, primarily to learn lessons in relation to the commissioning and implementation processes. The evaluation has considered multiple dimensions including "quality of the science, value for money, effectiveness, relevance and the potential for impact of scientific research funded under SARID". While providing accountability by securing evidence of achievements of SARID to date, a central goal of this evaluation is future-oriented … to make recommendations for future maximising of value for money and potential impact of research. The aims of this evaluation included:

- Analysis of firm evidence as to the quality of the science, the potential developmental impacts and the capacity-building achieved to date under the SARID programme
- Assessment of the SARID programme's achievements, effectiveness, relevance and performance in delivering against stated aims, objectives, outputs and outcomes
- Provision of lessons learned and recommendations to the BBSRC and DFID as they consider the scale of their investments in the programme and its potential impacts (and in relation to other BBSRC and DFID competitive grant schemes)
- Provision of an evaluation as a base to inform decisions on further collaboration under a more extensive programme for DFID and BBSRC.

1.2 Methods

This evaluation utilised multiple methods and gathered diverse perspectives in order to provide robust, triangulated evidence. In general, survey responses led to aggregation and pattern identification regarding outputs, impacts and views, while semi-structured interviews with individuals of varying perspectives, augmented by free-text responses to questionnaires, elicited detail and a deeper level of reflection upon processes and lessons learned. Document analysis grounded the evaluation. A Framework of Core Questions (**ANNEX A**), acted as a common "spine" across methods and perspectives, toward an integrated analysis.

Close analysis of relevant documents provided critical information regarding: 1) the programme (e.g., project and programme documentation and progress reports, reviews, guidance for commissioning panel meetings, and 2) academic quality and relevance (e.g. annual reports and other project-level documents, distribution of publications - updated by the survey).

A focused online survey was designed for award-holders and international partners from all the SARID projects. Invitations were sent to all twelve SARID project Principal Investigators, and to 21 co-Investigators whose contact information was provided by PIs. Twenty-one individuals responded, for a 63.6% response rate. These were split evenly, 11 primarily UK-based and 10 based outside of the UK. Five of the twenty-one were female. All but two projects were represented by at least one respondent; three projects were represented by three respondents each. (Throughout this report, "respondents" refers to survey respondents, as distinct from "interviewees").

A sample of fifteen interviewees (from UK and non-UK research collaborators or users of the research, as well as individuals involved in chairing commissioning panels) were chosen

purposively to elicit nuanced reflection from several different perspectives. Semi-structured interviews explored in particular evidence of realised or potential accomplishments/impacts and utility, relevance and impact of the programme. Interviewees were asked to conclude with lessons learned for future researchers in similar projects and with recommendations for BBSRC and DFID in future programmes.

Case studies were developed based on two SARID projects, to provide narratives illustrating both outputs and approaches toward their generation. (ANNEXES B and C). In addition, we drew on an analysis of SARID applications provided to us by Professor Jeff Waage and also on a report written by Professor Waage and Dr Andrée Carter, Understanding the UK Agricultural Research Contribution to International Development and Food Security (prepared for the UK Collaborative on Development Sciences & Food Research Partnership: International Sub-Group, 30/10/11). This evaluation's conclusions and recommendations are grounded in integrated analysis across these methods.

1.3 Background to SARID

During the 1990s, both BBSRC and DFID made significant investments in plant biosciences and crop research. BBSRC was investing in upstream research (e.g. on *Arabidopsis*), while DFID had a Plant Science research programme, which funded strategic and applied research. These funding streams contributed to the very strong standing of the UK in relation to agricultural sciences, where, based on publications in the decade from 1999 to 2009, Scotland led in terms of citations per paper (11.09) and England third in terms of total citations (Thomson Reuters: http://sciencewatch.com/dr/cou/2009/09augAGR/).

Funding for the DFID Renewable Natural Resources Research Strategy (RNRRS), of which the Plant Sciences programme was a part, ended in 2005, with subsequent funding being focused on the translation of research into use (RIU programme: http://www.researchintouse.com/). The focus of RIU was very much at the translation end of applied research, leaving a potential funding gap acting as a barrier to further movement of research results along the continuum from basic through strategic research to application. Discussions within BBSRC and a review of Crop Science research chaired by Professor Chris Gilligan on the potential for wider geographical impact of BBSRC-funded research, led to discussions with DFID and in 2006, agreement on joint funding for a programme, whose '***purpose*** *is to support basic and strategic biological and biotechnological research in sustainable agriculture that contributes to the achievement of the Millennium Development Goals and which will establish productive partnerships between scientists in the UK and developing countries'* (source: original call document). BBSRC contributed £2.5 and DFID £5 million to the joint funding initiative, which is administered by BBSRC. Maximum length of grants was specified as 4 years and guidance on budgets was in the range of £100-700K.

The original call document stated that the call:

'will focus on generic research that creates new opportunities for rural livelihoods, food security, sustainable agriculture and integrated natural resource management with specific relevance to problems of developing countries. The research will be crop orientated, but as well as food, will include fodder and dual-purpose crops in recognition of the central importance of livestock in farming communities and the burgeoning demand for livestock products by urban populations; non-food and cash crops, e.g. cocoa, coffee and cotton (but not tobacco), are also within the scope of the scheme. The soil environment will also be included, with a view to enhancing soil fertility, overcoming soil physical constraints and combating crop/soil safety issues.'

The call also made clear that the programme had the aim of '*extending the opportunity for existing collaborations as well as encouraging new partnerships*' and that the focus was '*on underpinning science'* and not on '*applied research*' expected to lead to '*immediate practical application*'.

2 COMMENTARY AND ANALYSIS: Science Quality, Potential Impact and Value for Money

2.1 The project selection process

From the start (and learning lessons from the Rural Economy and Land Use (RELU) initiative), a 2-stage application process was scheduled, with an initial call for outline proposals, selection amongst those proposals (based on the dual criteria of 'scientific excellence' and 'developmental relevance') by a Moderating Panel, using ranking by two separate (science and development) panels`. Parallel panels for assessment of science quality and developmental relevance of the outline proposals were used in SARID, motivated by experience in RELU, another programme supported by multiple funders, the Rural Economy and Land Use programme, which had also faced the challenge of reconciling two very different perspectives in the assessment of the same proposals – in the case of RELU, natural and social sciences, as well as practitioner and academic viewpoints. RELU had tried to deal with all viewpoints within one panel. The SARID Moderating Panel included the Chairs of the two separate panels but was chaired by someone who had not sat on either panel. The discussions of the Moderating Panel selected which of the outline proposals approved by the sub-Panels were to be invited to submit full proposals. A single panel was formed to consider the full proposals (chaired by the Chair of the earlier Moderating Panel), since all those invited to submit were deemed to have already met the criteria of quality and relevance.

The SARID call was open to researchers working in the UK or elsewhere, provided they were based in '*higher education institutes, research organisations or organisations with a credible research capacity*'. It was broadly welcomed by the research community (feedback from respondents and interviewees) in large part due to the opportunity for combining fundamental research with some move towards its application or as one PI put it:

> 'in allowing the participants to both pursue fundamental research to better understand a system and the mechanisms underpinning it (i.e. BBSRC-like research), as well as to push further the more applied aspects of the programme that perhaps will not lead directly to academic impact (i.e. DFID-like research). Having had separate funding from both DFID and BBSRC, I can testify that we would not have achieved the outputs we have during SARID if we had relied solely on one or other source of funding.'

This breadth, in reaching out beyond the usual community used to applying for Research Council funding, led to a large number of applications (250), of which 66 were ineligible. Prof Waage (Chair of the Moderating Panel) kindly shared with us an analysis he had conducted of 182 of the eligible applications, which provided some interesting data. In terms of applications from UK organizations, 54 separate organisations were involved in submissions, including 40 universities (31% of all UK universities). For developing countries, 145 institutions participated in bids (from 27 African and 13 Asian countries), with about 44% of them universities. CGIAR institutes have a very substantial level of participation, with 13 institutes involved in 86 submissions. This analysis confirms the strong interest of the UK research community in areas of research of relevance to crop production in developing countries.

Interviews with the Panel Chairs suggested that the selection process (184 down to 31applications invited for full proposals and then selection of the 29 actually submitted, down to 12 grants) had worked well, particularly for the 'science' panel, with which BBSRC is most familiar. There was a feeling though, that panel members from developing countries were at a disadvantage (and hence less able to make their opinions heard) through their lack of familiarity with the process. One suggestion that emerged from discussion was the possibility of providing such members with a brief induction process, immediately before the panel meetings. Analysis of the classification (**v**ery strongly, **s**trongly or **r**ecommended) of the applications at the first stage compared to those which were finally selected, showed, however, that of the 12 successful projects, 9 were originally classified as 'v' or 's' in terms of science and 8 in terms of developmental relevance, while 3 were only classified as 'r' in terms of science and 4 as 'r' in terms of developmental relevance at the first stage. This suggests that it was actually quite difficult to classify the proposals at the outline stage.

2.2 Balance and coverage of the programme portfolio

The call specifically noted the following research challenges, while pointing out that research challenges to be addressed were not limited to these:

- Plant-pathogen interactions
- Plant-pest interactions
- Plant and crop responses to resource availability (including water and nutrients)
- Plant and crop responses to natural or artificial soil contamination (including increasing salinity)
- Crop post-harvest physiology related to storage, value added and improved access to markets
- Development and improvement of crops for livestock production

Comparing the 184 eligible applications with the indicative topics, the greatest number of submissions were for topics outside those indicated (which gives confidence that provision of indicative topics is not constraining), followed by 'pathogens', 'pests' and 'resource availability', with the other three topics some way behind. It is interesting to note that of the twelve projects selected, all but one project focused on the first four bullet point suggestions, with the twelfth project targeting more fundamental genetics. Within the first four bullets, the focus was strongly on pest and pathogens. In terms of the focus crops, eight crops (plantain, wheat, coconuts, sweet potato, rice, brassicas, pearl millet and maize) were the direct focus of studies, with sorghum and tomatoes being crops chosen to demonstrate non crop-specific interventions. All but two of the projects had collaborators in Africa, with two operating only in Asia and two having collaborators in both India and West Africa.

This analysis reflects strength in the UK crop science community in applying fundamental science towards the growing of food crops, with a pleasing interest in a range of crops, including those of particular relevance to the poor. It also reflects less interest/expertise in the areas of crop post-harvest and fodder crops.

In relation to gender, the Final Report Form had a specific request for data on technologies which had been '*designed primarily for women*'. This elicited three generic responses about poor farmers being '*often women*', but one project noted they had collected data from 'mainly women farmers' and another took time to point out that bananas grown for subsistence in the region where they were working, were usually the responsibility of women. Three of the PIs were women, with a further four projects having female co-PIs. Gender was not specifically

mentioned in the original call: if consideration of gender is a priority, it is suggested that some guidance is given in the Call document.

2.3 Quality of the scientific research

The SARID programme was created to support basic and strategic research in biological and biotechnological science and science quality was an important part of the selection process.

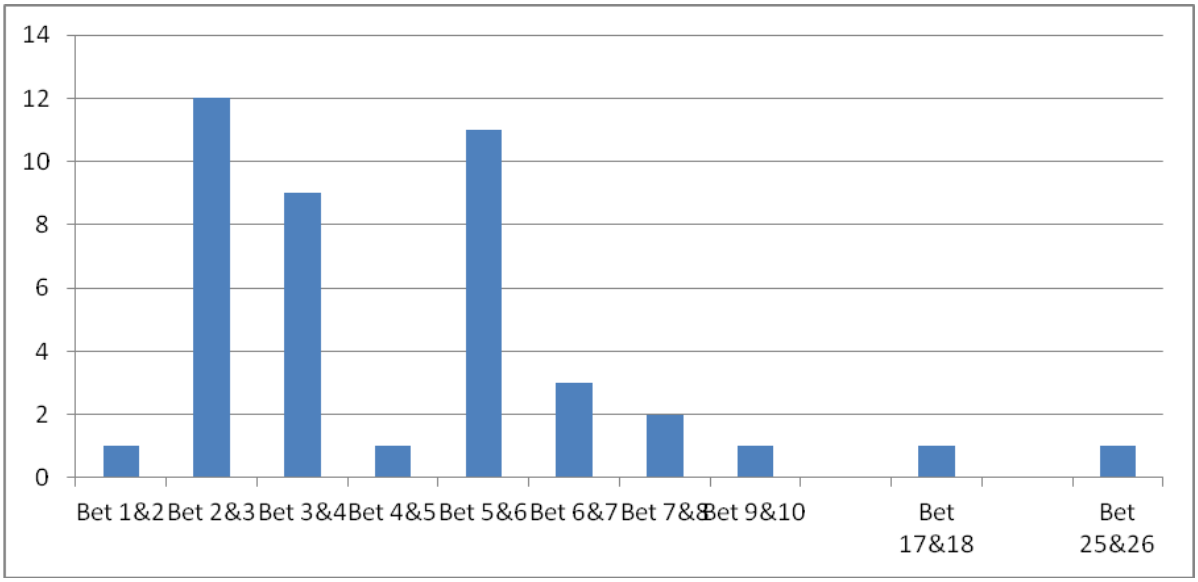
There are a number of ways in which science quality can be assessed. The most common metric used is the 'Impact Factor' of the journals in which papers are published. By the date of this review (July 2012) 43 papers had been published in 31 peer-reviewed journals for which impact factors were obtainable. Nineteen had impact factors over 5 (Fig. 1), although eleven of these were between five and six. Three projects had generated more than five papers each (6, 8 and 13) with four projects having generated < two peer-reviewed papers at this date. One project had not reported the publication of any papers in journals or conference proceedings by the date of the evaluation as evidenced either in the report, or the opportunity to update publications in the survey, although mention was made in the Final Report written in December 2011 of 'a draft manuscript to be submitted in the near future'. While accepting the upstream nature of the research with consequential high risks, experts in strategic crop science suggested that this lack of evidence of publications by four years after the start date should be challenged. Concern should also be raised about the other six projects with fewer than three papers in peer-reviewed journals by the date on which Project leaders were surveyed (July 2012). It is suggested that there is follow-up to these projects, to ensure that a complete picture of publications from each project is captured. Project Leaders could be given the opportunity to provide a reason for low publication output, but if the reason does not include extenuating circumstances, then follow-up action appropriate to Research Council standards should be taken.

In terms of the quality of the papers published, the usual criterion is to look at the Impact Factor of the journal in which the paper is published. There is pressure on individual scientists to publish in 'high' Impact Factor journals as acceptance by such a journal indicates high quality research. Figure 1 illustrates how many SARID-funded papers were published in each range of impact factors. The definition of 'high' varies between disciplines, but it is good to see 20 papers published in journals with Impact factors higher than 4. Citations of individual papers were also explored and there were a number of examples of relatively high citations (> 20 with a high of 45), with these numbers still rising, since the majority of papers were only published in the last two years.

Five of the 20 papers published in higher Impact factor journals were read, which confirmed that they were of high quality equivalent to a score of 3* (internationally excellent) or 4* (world leading) according to the criteria used in the UK-wide Research Excellence Framework process conducted under the auspices of the Higher Education Funding Council of England to assess comparative levels of research excellence.

All but one project have recorded presentations made at conferences both in the UK and internationally. Two projects recorded over 15 conference presentations each, with a high proportion being given in conferences held overseas, including Japan, the US and a number of developing countries. These two projects also reported high media coverage (one of the projects reported 7 items in the media and the other reported 1 radio interview, 2 TV interviews in Bangladesh and 1 for regional TV in UK plus 'extremely numerous' reports in newspapers, magazines and websites), indicating that the topics were of wide interest.

Fig. 1 Histogram of the numbers of peer-reviewed journal papers produced by the SARID programme which fall into different ranges of impact factor



In addition to papers, the projects have also produced a range of insights, data, products and technologies. When asked about "research products" delivered by their projects , most respondents identified a range (Table 1):

Table 1 Research Products claimed by % Respondents

Research publications	95.2%
Data sets	81.0%
Methods	71.4%
Techniques	66.7%
Tools	57.1%

These are listed in the BBSRC/DFID Annual Reports and their potential impacts outlined in the section on 'developmental relevance' so they are not listed here. For some of the projects the PIs or co-PIs reported (in interviews) that the scientific progress made was greater than they had expected when writing the original proposal and the percentage of projects contributing data-sets and new methods is impressive. It is likely that these would not have been produced without SARID funding.

Another indicator of the quality of the science is the quality of the individual scientists, both in UK and overseas. Some of the interviewees drew attention to both the quality of the local scientists and to the respect in which the UK scientists were held. In two of the projects selected for more detailed study, the local partners referred to the world-leading status of their UK partners.

2.4 Potential developmental impact and its relevance to developing countries

All of the projects were assessed for their 'developmental relevance' as part of the selection process. The successful projects mostly used access to advanced genetic technologies in the UK, to address a range of problems in crop production, including to:

- speed up the breeding process for disease resistance and drought tolerance;
- increase understanding of the genes involved in yield characteristics and the impacts of specified soil contaminants;
- understand the processes whereby inter-cropping or crop rotation could control *Striga* and nematodes, respectively;
- understand plant reaction to a specific virus;
- generate databases of cultivars, disease vectors and disease outbreaks for use by those on the front-line of managing pests and diseases

The Assessment Panel Guidance made it clear that the '*emphasis of the scheme is on underpinning science; it is* ***not*** *intended to support applied research directly oriented towards the development of specific products, processes or systems, and undertaken with a focus on its immediate practical application';* yet in survey responses to a non-confidential question on impacts, five of the twelve projects gave examples of impact on beneficiaries beyond scientists in developing countries (see Table 2). (Other evidence suggests that even more of the projects could have given examples, e.g. the impact of the project on arsenic in rice.) In addition, it is worth noting that interviews (which included UK researchers, non-UK research collaborators and independent users of the research) deepened understanding of impacts and impacts-in-progress, and how they occurred. For example, interviews revealed that many of these products could only reach this stage, by building on progress made in earlier projects funded by DFID (Plant Sciences programme) and BBSRC (grants in the area of crop science). At least one project also benefitted (in terms of speed of application) from DFID funding through the Research into Use programme.

Table 2 Examples of beneficiaries beyond research scientists which have already been realized (evidence provided by PIs)

Direct beneficiary	**Research output**
Potential being promoted to 250k new farmers in Uganda	Evidence of potential benefits of inter-cropping systems for growing food crops to decrease the risk of *Striga* infestations
Tanzanian government policy	Evidence of the positive influence of the SpexNPV baculovirus in controlling armyworm infestations has led to this being the preferred method of control for this crop pest in Tanzania
Extension organizations like AATF	Evidence from field trial of impact of technology for nematode control on leaf area index of bananas
Wheat breeders in South Africa	Wheat disease resistance already being used in marker assisted breeding programmes.
Pearl millet breeders in India	Tools to help breeders improve drought tolerance in HHB 67 improved variety of pearly millet.

The potential impact of such technologies can be estimated from evidence given in the original proposals. For example the new virulent race of stripe rust in wheat which emerged in the 1980s is estimated to have caused losses in wheat production of US$1 billion over 4

years (Boyd et al). For subsistence farmers, armyworm infestations frequently result in damage to the crops of 70% of food producers in Tanzania and often the total loss of crops Wilson et al), while control of *Striga* infestation has been shown to increase yield of maize from <1 tonne/ha to 5 tonnes/ha (Hooper et al). The benefits of these new technologies generated by the SARID programme will be the earlier control of pests and diseases, leading to a reduction in the scale of such losses in the future.

2.5 Potential for scaling up and scaling out the findings

Routes to enhancing and broadening the potential impact of the research findings are dependent on a range of factors beyond the control of the research projects. The assumption given in the logframe for moving from outputs to purpose is: '*Research generated effectively and is utilised by donor agencies, government, private sector and civil society institutions'* and the assumption for moving from purpose to goal is: '*Governments and other key stakeholders have resources and infrastructure to implement policies, programmes and practices'*.

Attempts were made to take this into account during selection, through including a section on beneficiaries in the application form and taking as one of the assessment criteria: '*The engagement strategy to be deployed for academic and non-academic stakeholders to maximize potential for impact on poverty'.*

The challenge is that scientists based in the UK have little opportunity to either understand or influence these processes and hence the text in the *Beneficiaries* sections tended to be generic rather than specific to the focus of the project. Despite that, project PIs and co-Is did take deliberate steps to facilitate the emergence of impacts beyond their research itself, as seen in respondents' replies. Most (80%) respondents disseminated results to users or stakeholders through targeted visits, presentations or workshops. More than half (60%) involved potential users or stakeholders during the project itself (which is widely considered to be a constructive step toward impacts) and the same number made use of the media, press releases and so on. Fewer (30%) provided language in layman's terms for stakeholder publications. One interview also revealed, however, that opportunities may have been missed for engaging with key stakeholders enough in the projects.

As it is becoming more widely recognised that engagement of stakeholders during a project can help to facilitate uptake of research results, DFID/BBSRC could consider including in each grant some funding targeted to *early* stages of projects for "Knowledge Exchange" mechanisms that would: engage some stakeholders, develop champions and/or work with "knowledge intermediaries" (individuals comfortable with both research and application) from relevant beneficiary organisations. In addition, induction workshops for awardholders could include some practical coverage of lessons learned about knowledge exchange and generation of various types of impacts benefitting stakeholders.

2.6 Impacts on Stakeholders

Despite the challenges, SARID research has already led to different types of impact, on various stakeholders. In the survey, respondents were asked to indicate any of five different types of non-academic impacts they saw as having arisen from their project. Fittingly for the

aims of the SARID programme in particular, more than 85% of the survey respondents saw Conceptual Impacts, Capacity-building Impacts and Enduring Connectivity.

Table 3 Types of Impacts arising from SARID research projects

Conceptual Impacts (e.g. broad new understanding/awareness-raising)	95.3%
Capacity-building Impacts (e.g. training of students or professionals)	90.5%
Enduring Connectivity (e.g. longer-term collaboration in follow-on interactions)	85.7%
Attitude/Culture Impacts (e.g. increased willingness in general to engage in new collaborations)	57.1%
Instrumental Impacts (e.g. actual changes in policy or practice)	52.3%

In terms of the domains in which impacts were made, by far most (84.2%) of the respondents feel that their projects have had non-academic impacts in agriculture. A quarter (26.3%) see other impacts on society (such as public education in science) and a fifth (21.1%) feel their projects have contributed to policymaking, regulation or government legislation. Fewer, just a tenth each, saw economic/business impacts or public health/well-being impacts.

Several respondents provided their own examples of **impacts** on the economy, policy or society from SARID research, including:

- "The SARID project has demonstrated the scientific basis for the use of baculovirus for the biological control of a major sub-Saharan crop pest, African armyworm, and paved the way for its strategic control across the region. It is now Tanzanian government policy that the SpexNPV baculovirus we have been working on is the preferred method of control for this crop pest in Tanzania, based partly on results from the SARID (and RIU) projects. Once baculovirus production is secured (via RIU outputs) this should impact on the economy of the country via reduced crop damage and sales of the product to neighbouring countries."
- "The genetics of useful wheat disease resistance genes/QTL were unravelled and better characterised. The resistant wheat lines were given to three South African wheat breeding programs. A RSA company CenGen, through the support of the South African Winter Cereal Trust, have already started in 2011 to transfer these genes into their germplasm using marker-assisted selection (MAS). The PhD student that was trained in this project has been employed in 2012 at CenGen and is working in this MAS project. Another outcome of this project was the identification of potential new sources of resistance which will be studied in a follow-up project, but the breeders already started making crosses with these as well."
- "Among the field trials approved by the Ugandan government is one for nematode-resistance in bananas, developed by the SARID research. In addition, a non-transgenic banana field trial in the SARID grant has demonstrated a Leaf Area Index measurement method for rapidly measuring benefits of nematode control on improved banana plant growth (this method will have other uses as well). Once efficacy of BXW resistance is established in a contained field trial, an experienced African technology transfer group will ensure that farmers benefit."

- "Through the workshop on ARSSENIC, the scientists and the government people are now aware regarding the mitigation of arsenic problem in Bangladesh."
- "Crop rotation was identified as a powerful tool in the management of root-knot nematodes in the small scale sector which is dominated by resource-challenged farmers. A crop rotation system incorporating maize as a poor host of root-knot nematodes, which also stimulates build-up of *Pochonia chlamydosporia*, to be grown in alternation with tomato was developed. Maize was rated as the most appropriate crop given its high ranking as a staple in Kenya. A cost effective strategy of delivering *P. chlamydosporia* was developed. The strategy entails application of the fungus into the nurseries where tomato seedlings are produced. The soil adhering onto the roots of the seedlings carry the fungus into the field thus providing early protection of the crop against plant parasitic nematodes. The two technologies are appropriate to the poor who are dominated by women farmers. Maize serves as a food crop while tomato is mainly grown as a cash crop."

2.7 Capacity-building

Five of the twelve successful projects included in the original application, an objective with some form of capacity building, either funding for a PhD student or training for developing country scientists. In January 2010 an opportunity was offered to all SARID grantholders to apply for additional funding specifically for capacity building, although more than half of the projects had started more than 18 months earlier. Eleven took the opportunity to apply. An internal process was used to assess the proposals and nine grants were awarded.

The survey responses indicated that one to three mechanisms of capacity building were supported by these grants. The three most frequently cited (each by just under a half of the respondents, 45.5%) were:

- Knowledge/skills-based short courses
- Exchange visits
- Mentoring

Other mechanisms cited by more than one person were:

- On-the-job training
- Research fellowships.

This additional funding was cited in free text and interviews as leading to various capacity-building outputs. For example, one project interviewee noted three outputs:

One Project's Capacity-building Accomplishments

1) A lecturer from Kenyatta Africa spent 6 months at PI Julie Scholes' UK university (Sheffield), combining his transformation technology with resistance gene work; this was very successful, leading to a scientific publication in Plant Methods. He is now a co-investigator with the PI and others on a new but related project.
2) A student from Niger came to the UK university with millet cultivars, learning how to use the UK university's special growth system for quantified monitoring of parasite resistance; he produced a poster presentation and is now doing a PhD in France, still in contact with the UK PI.
3) The PI and an African student funded by the SARID project joined up with African colleagues to run a very well-received week-long course on use of molecular markers in plant breeding for over 20 African students.

Overall the additional funding appears to have added value to the projects, although some survey respondents also commented on the possible benefits of being more directive about including capacity building as part of the main project application. There was no consistent difference between the grants that had initially included funding for capacity building and those that had not, with respect to the sum of additional funds which were bid for.

The SARID projects were clearly viewed as contributing successfully to capacity-building in non-UK countries; all but one respondent agreed. Respondents saw multiple forms of capacity-building as having been generated; in fact seven forms were seen by more than half:

Table 4 Types of Capacity-building by SARID

Additional skills/methods developed by a non-UK co-Investigator	71.4%
Increased research experience for a non-UK co-Investigator	71.4%
Research experience for non-UK postgraduates	71.4%
Development of international network	61.9%
Advancement in career of non-UK postgraduates	61.9%
Development of a reputation for addressing relevant problems	57.1%
Advancement in career of non-UK co-Investigator	52.4%
Advancement in career of UK postgraduates	28.6%

SARID projects exerted influence even beyond those formally participating; 60% of respondents report that there was a positive impact on early career researchers not officially part of the project and 65% report a positive impact on additional established researchers. This "ripple effect" also spread to host organisations; by far, most respondents (85.7%) felt that the project had a positive impact on their own institutions. Examples given by respondents of ***effective capacity-building*** included:

- Many times, individuals were trained and are continuing their careers, for example by pursuing and/or securing higher degrees. Trained individuals have contributed to peer-reviewed journals.
- Some trained individuals are also transferring technologies, for example through a training session for farmers and extension officers on methods for managing nematodes.
- After training in the UK, a course in next generation sequencing was provided by an overseas university to a range of overseas collaborators.
- An international training course was provided to students from five overseas countries, demonstrating technical analytical approaches that are cheap, quantitative and use reagents that can be obtained and stored.

An additional type of capacity-building should also be considered as an accomplishment of the SARID programme: the engagement of British next-generation researchers in research problems of developing countries. For example, one reflective postdoctoral fellow in the UK made the following comments:

> "The SARID scheme really opened my eyes as to what is possible, and also what opportunities there are for research projects within developing countries. … I matured greatly over the course of the project and am now fully prepared to participate in international research whereas before I may have been somewhat unsure or reluctant, or, frankly, just

> unaware of the opportunities. … Being involved with this project….has given me a useful skill-set that will be useful for my future science career."

Developing a positive mindset, enthusiasm and skills in younger UK researchers may be especially important in the face of what has been identified as a generational loss of well-networked researchers experienced in working with developing countries.

2.8 Partnerships

Over half the projects involved individuals who knew each other prior to the project or, at the least, had worked with other individuals in the same institutions. Many times, respondents offered "lessons learned" stressing the importance of getting to know a partner prior to undertaking a full-scale project together.

A key goal for the SARID programme was to foster genuine international partnerships. Respondents were unanimous that their SARID grant had given them and their research partners a new opportunity to work together that they would not otherwise have had (with three quarters Strongly Agreeing and a quarter Agreeing). Most (85.7%) felt that they and their international research partners have worked together effectively on the grant. The effectiveness of the partnerships is further indicated by the fact that they seem to act as a basis for future collaboration: nearly as many (81%) think that it is likely that their international research partners and their institution will work together on a different research project in the future. Indeed, three quarters (76.2%) are already working with their international research partners on another research project.

Six of the twelve projects involved partnerships with research centers of the Consultative Group on International Agricultural Research (CGIAR). Two involved the International Rice Research Institute while the other Centers involved were: the Africa Rice Center, International Potato Center (CIP), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and the International Institute of Tropical Agriculture (IITA). Another two projects involved international research organisations which are not part of the CG system namely: the International Centre of Insect Physiology and Ecology (ICIPE) and CABI. The remaining four projects were partnered with national organisations within their country locations. Partnering with an international organisation undoubtedly provides more opportunities for wider dissemination, while partnering with national organisations (universities and government organisations) helps to strengthen those organisations through providing them with international contacts.

The survey explored the types of interactions that have taken place between individuals and their international research partners. All had used email communication, and nearly all (90%) met up at conferences or workshops. Two thirds (66.7%) shared training activity conducted in another country (more than the 42.9% shared training activity conducted in the UK). Well over half (57.1%) held conversations by telephone or SKYPE.

Table 5 Types of Interactions (Respondents ticked all that applied)

Email Communication	100.0%
Meeting up at a conference/workshop	90.5%
Shared training activity conducted in another country	66.7%
Telephone/SKYPE conversations	57.1%
Shared training activity conducted in UK	42.9%
One or more visits from the UK to other country (Total days = 2-6 months)	38.1%
One or more visits from another country to UK (Total days = 2-6	38.1%

months)	
One or more visits from another country to UK (Total days = 1-14)	38.1%
One or more visits from the UK to other country (Total days = 15-30/1 month)	23.8%
One or more visits from the UK to other country (Total days = 1-14)	19%
One or more visits from another country to UK (Total days = 15-30/1 month)	4.8%

Quite a few survey respondents offered ***examples of good collaborative working*** in their SARID grants. A few examples follow.

- After working for a year in a UK laboratory, an overseas collaborator has set up biochemistry facilities to pursue new aspects of the work, while still using UK substrates.
- Joint work included making constructs in the UK, developing transgenic plants overseas, with joint testing and training overseas and joint publication resulting.
- In one project, UK infrastructure supported extensive genotyping, while the overseas facilities supported phenotyping
- An overseas SME partner in one project helped to develop a key dataset, resulting in a publication, paving the way for a novel approach, and securing Research into Use funds for a related, highly applied project.
- Expertise was increased in multiple fields, new materials were identified and follow-on projects are underway.
- Joint supervision of a non-UK student stimulated collaboration between the researchers, who had to think beyond their own disciplines.
- Complementarity of individuals' strengths, addressing different tasks, was key to one project: "I just think that we were the right collection of people".

2.9 Value added by the SARID programme

The total expenditure on the main grants plus the additional Capacity Building grants is expected to be ~£7,011,350, with total expenditure on the latter expected to be ~£207,091. The size of the combined grants to individual projects ranged from £377,124 to £675,509, with the average being £584,279. This compares well with a call specification which gave a budget guideline of £100,000 to £700,000.

Total expenditure on administering the programme provided to us by BBSRC was £84,915, which equates to 1.2%. Since the MOU between DFID and BBSRC allowed for 5% of programme costs on administration, this represents very good value for money.

As discussed above, numerous scientific outputs of good quality were generated by the programme. Furthermore, perhaps even more than might be reasonably expected given the nature of this programme, impacts were generated beyond research and there are indications of potential developmental relevance yet to be delivered, and a range of capacity-building accomplishments were achieved. By these criteria, the SARID programme did deliver value for money.

The survey made it possible to explore views of participants as to whether or not the SARID Programme itself added value, and if so, in what way. Indeed, most (85.7%) of the respondents felt that the Programme added value, that "being part of this DFID/BBSRC

Programme has made the collaboration more effective than if the collaborative project had been conducted separately from the programme". Two individuals were neutral and one strongly disagreed.

When asked *why* they felt the programme added value, respondents offered a range of points, including:

- Training, increased capacity and confidence
- Funding and equipment, samples, etc.
- International image/credibility, participation in international conferences
- Exchanges and linkages between laboratories
- Interaction between younger scientists
- Integration across disciplines (e.g. "biomolecular lab work with agronomic field work"), across basic and applied work
- Linkage of "science and development aspects"
- New collaborations
- Follow-on projects

The integration between BBSRC-style fundamental research and DFID's application orientation, directly enabled by the dual-funder nature of the programme, was praised by respondents and interviewees. The programme is seen as distinctive in the research it makes possible; a respondent commented: "Outside of defined initiatives such as SARID, it is difficult to identify sources of funding for these collaborations. The BBSRC/DFID programme strongly facilitates the latter". An interviewee noted that "You need a scheme like SARID if you want to bring in some of the best scientists to tackle some of these problems".

Furthermore, this sort of combination of science with application has the potential to open subsequent funding doors, as one interviewee commented: "What the SARID scheme has done in particular in the last three years --- (with a) science impact that underpins the applied side, is to put in place answers to the questions any future donor might want answered about how you might go about applying what we've done on a small scale to a full region-wide effort, …for example, regarding environmental impact or non-target organisms… we've answered those; these are key steps that could block scale-up."

Several respondents took the opportunity to make additional comments praising the SARID programme:

> "The initiative as a whole was extremely successfully in terms of academic and applied outputs. It was also very enjoyable and led to many new contacts and collaborations with African scientists."
>
> "For me, SARID provides the template by which we can both increase our fundamental scientific knowledge in key areas, and sustainably provide real-world solutions to major issues in developing countries. This approach allows researchers to understand the mechanisms underpinning the solutions, so allowing them to effectively implement or short-cut them, as well as the potential for developing other, novel solutions."
>
> "Thanks for your support!"

2.10 Administration Challenges and Issues

At project level*:* Any collaboration faces challenges; survey respondents reflected upon whether or not the difficulty of a range of challenges was increased by the international nature of SARID collaborations. Nearly half (47.1%) cited Administrative issues such as visas, and just over a third each cited Communication during the research project, and Timeframe/meeting deadlines. An interviewee mentioned delays that can be caused when each country's phyto-sanitary regulations differ. In terms of the bigger picture of capacity-building, a PI interviewee observed that, whereas there are whole areas (such as transformation, tissue culture, biosafety) in which it would optimal to keep training going, the cost of PhD training in the UK causes real difficulties; for example, three in that person's project had wanted to do their PhD in the UK but found the cost prohibitive. Injecting training periods within a larger grant is one mechanism to address this in part, but cannot be done as an ad hoc activity. Another big-picture issue raised was the funding gap that arose after the SARID grant, in the face of a need for continuity of research, especially if research is to be taken closer to application or impact; perhaps evaluation of progress could be used to underpin such continuity.

At programme level*:* BBSRC's vision is to fund '*World-class bioscience, curiosity-led research and priority areas*'. It has a budget (2011-12) of around £445 million, which is used to support ~ 1600 scientists and 2000 research students. DFID leads '*Britain's fight against global poverty, delivering UK aid around the world*' with a budget of over £6 billion, within which the Research and Evidence Division (RED) has a budget of ~ £250 million in total. RED's vision is '*to support DFID to become world-class in using evidence to drive value for money and development impact, to influence other donors to be the same and provide better evidence to all decision makers in development*.'

It is a tribute to the staff of the two organizations that, given the different foci of the two organizations, they managed to find a compromise position which proved successful as viewed from the perspective of the PIs. BBSRC provided annual reports to DFID and quarterly meetings between DFID and BBSRC managers were also held, which contributed to better mutual understanding of each others' reporting requirements. Financial reporting remained a challenge throughout, but a new Memorandum of Understanding between the two organizations should ensure that these issues are addressed from the start, in future collaborations. By giving timely alerts, the reports should act as suitable risk management for possible risks such as: falling seriously behind schedule, lack of delivery by any of the partners (due to illness or other reasons), external problems (e.g. drought, regulatory approval), or technical difficulties in the lab or field. With timely alerts, project officers can discuss issues with principal investigators at an early stage and help them develop tactics accordingly.

The perception of programme management by PIs was that it had worked well: not a single respondent felt that interactions with the programme personnel/bureaucracy were a problem. One respondent (also interviewed) did note a problem with currency fluctuations and getting funding to Indian partners. Interviewees too were primarily positive, with, for example, none feeling "pulled in two directions" by the two funders. The management approach of BBSRC was generally appreciated, even commended as "superb" by one interviewee. Reporting requirements were seen by interviewees as "a halfway house", more frequent than BBSRC's usual reporting, but less "onerous" than DFID's level (their words not those of the reviewers). For future programmes, "Providing DFID doesn't impose any more reporting requirements than SARID, I think it's fine. If it moves to more, that would be a problem."

3 LESSONS LEARNED & SUGGESTIONS FROM SARID PARTICIPANTS

One element of capacity-building has been the development of tacit knowledge regarding effective approaches to international collaborations and capacity-building, among SARID participants. Drawing from this reservoir of tacit knowledge, we captured key "lessons learned" and suggestions from survey respondents and from interviewees, who were generous in sharing their insights. These are provided in ANNEX D, with some highlights here.

Key "general" recommendations to funders:

- stressed the importance of continuity of funding in relation to actual delivery of impact
- noted a potential role for funder-supported networking across projects
- thanked DFID and BBSRC for their support.

As requested, respondents and interviewees also offered suggestions *for funding bodies*:

1) hoping to stimulate international collaborations with developing countries

- Support, with flexibility, integration across academic and applied work
- Contribute to prospective partners' opportunities to get to know each other
- Manage commitments and expectations regarding developing country contexts
- Afford projects flexibility to manage dynamics of collaborations
- Provide time, resources and flexibility, even mentoring, for project leaders

2) hoping to stimulate capacity-building in developing countries

- Train (and build confidence of) young scientists
- Ensure shared support, engagement and ownership of capacity-building activity
- Recognise challenges; be flexible with follow-on funding, short periods of follow-on funding and/or recommendations to other donors.

Respondents and interviewees shared practical lessons learned with *future researchers*:

1) trying to build effective collaborations with developing countries

- Select collaborators very carefully, ideally individuals you know will work well with you.
- Seek complementarity and an equal footing for collaborations
- Create transparency from the very start as to who will do what.
- Keep collaborations alive.

2) trying to stimulate capacity-building in developing countries

- Engage directly with overseas collaborators
- Ensure that developing country partners guide development and implementation of capacity-building programmes.
- Include training but also encourage follow-up
- Encourage networking among UK and overseas "next-generation researchers", to the benefit of all.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Key Conclusion: Success in relation to objectives

SARID supported high quality science (as evidenced from reports and analysis of publications); there was further movement towards development impact in some projects than

expected and project scientists and stakeholders themselves viewed it as very successful and well-run (as evidenced from survey responses and interviews)' it. In short, SARID was indeed a successful programme.

Review of the evidence suggests, however, that this success resulted not just from the SARID programme per se, but from the fact that SARID built on the results of previous funding initiatives, both in terms of scientific outputs and the trust formed through previous partnerships. This wider context should be borne in mind throughout upcoming discussion and recommendations.

With any programme, no matter how successful, room for improvement always exists. DFID is well-versed in working with developing countries and BBSRC has long experience in funding high quality science, but there is less experience in how best to support links between fundamental/strategic science and relevance to poor people in developing countries. In SARID, the combined efforts of DFID and BBSRC have made great strides while at the same time offering an experience base from which future joint programmes can benefit. Most of this report's recommendations, therefore, suggest ways in which links might be strengthened between science and relevance, based on the evidence collected in this review. Recommendations for consideration by future joint programmes fall into five categories: 1) selecting projects, 2) implementing projects, 3) contributing to a more strategic approach, 4) partnership working and 5) reporting.

4.2 Selection processes: Recommendations

The process adopted was generally thought to be an improvement on earlier attempts to select jointly on the basis of science quality and developmental relevance. Analysis of the initial scoring versus the final listing of projects selected, however, highlighted some of the challenges. The topics covered broad geographic regions and a range of crops and it is unlikely that even the panel as a whole had sufficient expertise and experience to be grounding their decisions in evidence. In addition, many of the applications and reports had some very generic statements regarding beneficiaries. In future, to help both applicants and panel members understand more fully how to gauge the potential developmental relevance of a project, guidance is recommended on the likely relationship between choice of country, crop and partners and the likelihood of impact on the poor. With respect to choice of panel members, Developing country scientists should continue to be included on panels, but they should be given appropriate induction training in the UK Research Council approach to project selection. The training should be aimed at giving them the confidence to contribute to panel discussions on all aspects, but in particular to raise awareness of any local constraints to any laboratory or field research proposed.

4.3 Project implementation: Recommendations

There are serious challenges in conducting crop research in developing countries and the evidence reviewed contains excellent examples of researchers being adaptable in ensuring barriers did not get in the way of the science. This was easier where PIs had previous experience of working in developing countries. Given the demographics that many UK scientists with such experience are close to retirement, it is recommended that mechanisms for mentoring or 'inducting' individuals new to working abroad be considered. Another challenge in working in developing countries is the varied contexts in which research results will be applied. There was a good effort to involve potential users or stakeholders during the projects (60% of respondents), which would have helped in this respect, but to help to ensure

sustained developmental impact, more specific action may be required. It is recommended, therefore, that consideration is given to increasing applicants' awareness of the context in which their research results will be applied, not least with respect to issues of gender. A workshop was held for SARID and CIDLID PIs, with one of the aims being to raise such awareness, but perhaps the expectation of more specific action needs to be clarified, e.g. through putting higher expectations on developing country partners with respect to stakeholder engagement, or by including a liaison function at programme level. Similarly, if capacity-building is expected, guidance should be provided as to weaving that activity in with others, from the start of a project onwards.

4.4 Strategic context of individual programmes: Recommendations

While SARID funding was very much appreciated, a widely-expressed concern by participants in SARID is the lack of continuity posed by relatively short, non-extendable grants. Frequently, researchers felt that their laboratory research, for example molecular research, was just beginning to bear fruit when the grant ended, prohibiting large-scale testing such as field trials and thus stopping short of impacts. Affording the opportunity for review (with criteria relating to both scientific quality and to developmental relevance) such that grants could be extended to 5 years (or in exceptional cases, longer) would enable projects to span basic to strategic to applied research more effectively. Following on from the recommendation in section 4.3 on enhancing awareness of the context in which research results will be applied, the evaluation also highlighted a need to consider the involvement of the private sector with publicly funded research. The time of a co-investigator who worked only in the private sector could not be funded, whereas there was evidence from a Case Study of benefits accruing as a result of a company being associated with a co-investigator. Dissemination of the knowledge gained in the research (e.g. pest or disease resistant cultivars or biological control methods) needs the involvement of the private sector. Some of the research outputs are not yet at a stage where they can be taken forwards to application without continued involvement of the UK scientists, but small enterprises in developing countries cannot afford to pay for that input. It is therefore recommended that where a research product appears to have potential but requires further input by UK scientists or involvement of the small-scale enterprises in developing countries, grantees are helped to reach out to alternative funders who would be interested in supporting that process, and/or other mechanisms of follow-on funding to strengthen the probability of uptake of the research by the private sector are considered.

4.5 Partnerships: Recommendations

Collaborations benefit when individuals know each other beforehand. If partnerships are to continue to be initiated and to grow, individuals need opportunities to get to know each other, and see if they are compatible in terms of delivering a project together. Next-generation researchers in both the UK and developing countries need to be included in such networking and, perhaps, pilot collaborations. One energising mechanism would be to gather together all the PIs and all the co-Is early and mid-programme. This would allow new networking to take place while also affording "old hands" the opportunity to share practical insights with individuals newer to this sort of work. Such gatherings could also be facilitated in ways that encourage shared reflection on issues and opportunities, a mid-course "retreat" for programme participants that would help them adapt their plans as they move ahead.

4.6 Reporting: Recommendations

There is a real concern among researchers that reporting not become more heavy-handed, as most feel they are kept extremely busy by the projects themselves, accentuated by unpredictable features of working in different countries (e.g. facing unsettled regulatory contexts, vagaries of weather, and so on). The current level of reporting was seen as a reasonable "half-way house" between the norms of BBSRC and DFID. One very slight addition to reporting might be a simple request to, perhaps on an annual basis, capture capacity-building activities (e.g. number of workshops provided, where and to what sorts of audiences). It is also recommended that changes to report formats during the course of any future programmes are kept to a minimum and if evaluations are to be conducted on future programmes, PIs are helped to understand the benefits in terms of future funding, of fully recording research outputs!

5 ANNEXES

ANNEX A: Framework of Core Questions (based on Terms of Reference)

I. Quality of the scientific research and evidence, and extent to which the programme has met its aims and objectives

I.1How did the application, review and assessment processes work?

I.2 What lessons can be learned, e.g. about framing questions or reviewer remits?

1.3 What has been the relevance, sufficiency and scientific rigour of the outputs and achievements to date? What lessons have been learned and what recommendations could maximise relevance, sufficiency and scientific rigour of future programmes?

I.4 To what degree were gender dimensions considered, either implicitly or explicitly in the programme? What lessons have been learned; what recommendations would help future programmes?

I.5To what extent has the programme met its development objectives elaborated in programme documentation or reflected in the logframe?

I.6 To what extent/how have effective partnerships been built?

I.7 To what extent was additional capacity development secured through incremental funding? How did the selection process work? What mechanisms were supported and can lessons be drawn from those efforts? Were there differences in outcomes between those who did or did not receive these additional funds?

I.8 Has the collaboration between DFID and BBSRC met the aims and objectives of both funding organisations? What lessons can be learned for future collaborative programmes?

II. Potential Development Impact of the scientific research and its relevance to developing countries

II.1 What indications exist as to the comparative international reputation and quality of the science?

II.2 What is the balance and coverage of the SARID programme portfolio, including: research and thematic areas; country and geographic spread and relevance to developing country policies?

II.3 What is the potential for economic and social impacts, including potential to scale up or scale out the research investments?

II.4 What have been the comparative role and relative strengths of scientific partnerships established between UK and developing country scientists working on SARID projects? What lessons learned and recommendations might help to enhance future programmes?

II.5 What has been the effectiveness of scientific capacity building activities undertaken through the programme? Has collaborative potential been enhanced?

II.6 Given that the research funded is at the more strategic/basic end of the spectrum, the immediate users are likely to be scientists. What has been the degree of interaction between scientists involved in the programme and potential users of the scientific research emerging from the SARID programme? In what ways might the outputs of the research be effectively used or applied by policymakers and practitioners? What steps have the project scientists taken to ensure that the likelihood of such use is enhanced?

II.7 What types of research, approaches and mechanisms seem to have the greatest potential for

impact? Can lessons be learned from this assessment?

III. Value for Money and Effectiveness

III.1 What, overall, have been the successes and weaknesses of the programme, both relevant to the original goals and any unanticipated benefits?

III.2 What is the role of the SARID programme within the wider context of BBSRC and DFID investments in the area?

III.3 What value has been added by programme organisation and/or delivery mechanisms? How effective have been the roles of the Secretariat and programme management in adding value? What lessons have been learned?

III.4 How effective were (what value has been added by) the programme's design and implementation, management and commissioning processes? What lessons can be learned from call specification, application submission, assessment and decision-making processes, feedback to applicants and progress monitoring?

IV. What lessons for the future, for research collaborators and for funders, can be learned from SARID? What recommendations might be considered by DFID and BBSRC?

IV.1 What issues or constraints have arisen?

IV.2 What lessons have been learned through SARID that would be helpful for research collaborators in the future?

IV.3 What learning can DFID and BBSRC take from SARID into future collaborative ventures? -

ANNEX B: Case Study, Atkinson Project

Project

Nematode resistant plantain for African subsistence growers

Principal investigator and Co-Investigators/Institutions

PI: Prof. Howard J. Atkinson, University of Leeds

Co-Is: Dr**.** Leena Tripathi, IITA (International Institute of Tropical Agriculture)-Uganda

Prof. P.E. Urwin, University of Leeds

Research summary

Banana and plantain *(Musa* spp.) are major staple foods and a source of income for millions in subtropical and tropical regions, where they are mostly grown by small-scale farmers. *Musa* is among the top four crops produced in Africa by weight where it also has cultural and social significance. Nematodes cause perhaps 20% of crop loss worldwide, and up to 40% locally. Yet, *Musa i*s in some sense "an orphan crop". Nematicide use is usually not affordable for subsistence farmers and there are limited sources of nematode resistance or tolerance in the *Musa* gene pool: therefore, genetically modified plantain with resistance to all nematodes would make a vast difference in Africa and beyond. Natural sterility of the crop allows for rapid improvements by biotechnology, while simultaneously addressing concerns as to transgene flow. Following development of successful constructs and transformation, transgenic lines were generated; two anti-nematode genes were shown to be effective and dual lines expressing both defences were obtained. The work proceeded to glasshouse trials, but did not receive regulatory approval in time to conduct field trials during the SARID project. The SARID project did demonstrate clear potential to control nematodes in plantains and by implication, cooking bananas.

Key types of scientific impact/outputs

- Building on previous BBSRC and DFID funding, the SARID work demonstrated that nematode resistance can be achieved in plantain.
- Unfortunately, lack of continued funding has meant that an emerging opportunity has not been pursued: combining bacterial wilt resistance developed by Tripathi with the SARID nematode resistance. Atkinson and Tripathi hope to find support for further work, including field trials (essential for commercialisation) and combinatorial resistance, as this two trait approach --developing bananas resistant to their two major biotic stresses in East Africa --could provide an extensive benefit for both poor producers and consumers in Uganda. (One estimate for nematode control in Uganda would be a benefit of more than US$250M over 30 years and 4X this figure for nematode combined with bacterial wilt resistance.)
- Non-transgenic banana field trial in the SARID project demonstrated that Leaf Area Index (LAI) measured by digital hemispherical photography is an effective, rapid way to measure benefits of nematode control on improved banana plant growth. (This non-destructive approach to assessment would take a few minutes rather than a day measuring leaf dimensions while on a stepladder!)
- The research showed how two different defences work against nematodes; ideally these two could be combined.
- An RNA interference target was identified for broadly based banana nematode control. (this would lessen regulatory hurdles as no novel protein is made by the plant).
- Joint outputs include a co-authored 2012 paper in Molecular Plant Pathology.

Collaborations

- The complementary interaction developed well between Atkinson and Tripathi such that they hope to find support to continue joint work.

- Another colleague, Dr Wilberforce Tushemereirwe, plant pathologist at NARO, the national banana research programme in Uganda, had visited Leeds University before the project; he is a Visiting Scientist there.

Capacity-building impact

- 12 Africa-based scientists were provided with a range of different capacity building activities. Many were trained by Tripathi, e.g. in tissue culture; some went to Leeds for training in some aspects of the work.
- Three of these early career African scientists progressed to PhD study (in Africa, due to the prohibitive costs of study in the UK)
- A Kenyan student now at IITA is finishing his Masters thesis.

Highlighted non-academic impact

- The high profile SARID award was welcomed by the then Deputy Director of IITA and contributed to a University of Leeds/IITA commitment to co-found Africa College, "an international research partnership working to improve the lives of millions of people in sub-Saharan Africa by the sustainable enhancement of their food and nutritional security". In a sense, this was a step toward an institutional culture change at the University of Leeds. www.africacollege.leeds.ac.uk
- The SARID project featured in a presentation to the UK Parliamentary & Scientific Committee (Atkinson, 2010), an exhibition at the Science Museum, a TV Debate (Ch 4: What the Green Movement Got Wrong, 04/11/2010 and an article in the Financial Times (3/2/12), and the work is covered on the BBSRC website and that of the Global food security programme: www.foodsecurity.ac.uk .
- Atkinson advised NARO staff while they were building a comprehensive biosafety submission to the Ugandan national biosafety committee and responding to their questions. This culminated in consent for a controlled field trial of nematode resistant plantains and bananas.

Routes toward Impacts

Key roles

- Atkinson and Tripathi had met at several scientific meetings, and realised that their interests matched, so they were ready to prepare a bid for SARID, and work together.

Processes

- Complementarity of expertise translated into complementary roles in the research. Constructs were developed in Leeds, and transformation was carried out in Uganda. Characterisation to identify lines of interest, including nematode challenge, was carried out in Uganda by an African scientist following training in Uganda provided by the UK-based postdoctoral fellow.

Institutions/environments

- Uganda has a political commitment (from the President on down) to developing GM bananas, with a dedicated government lab. Leaders of farming organisations are also supportive of the SARID research.

Potential for further impact and need for follow-on funding

- The next steps on the impact pathway are for this material to be field tested in one location (3-4 years) and then tested in different parts of the country (a further 3-4 years).
- National funding of NARO staff comes from the Ugandan Government for a range of projects, but would not cover further involvement of IITA or University of Leeds staff. Consequently SARID outputs will not be developed further without additional funding.

Key lessons learned

For Researchers

- Seek partners that have the appropriate research environment for the work that needs to be done; it is important that the developing country partner has access to collaborators that can ensure an uptake pathway to prevent outputs remaining on the shelf.
- Ideally, researchers will complement each other's expertise.
- Exchange visits, especially for the young, are very important.
- Ensure that staff from the Ministry (with regulatory responsibility) are engaged with the project from the start.

For Funders

- Consider mechanisms to engage young UK researchers in interactions, as this not only builds networks between the UK and developing countries, but also broadens their knowledge and commitment to key global issues such as food security, which can have a long-term benefit on their research interests.
- Long-term training like PhD fellowships for developing country researchers should be built into projects.

ANNEX C: Case Study, Boyd Project

Project
Assessment of genetic biodiversity of durable disease resistance in African wheat genotypes, leading to the development of novel marker systems for wheat breeding
Principal investigator and Co-Investigators/Institutions
PI: Dr. Lesley A. Boyd, John Innes Centre UK Co-Is: Dr. Renée Prins, CenGen Pty Ltd and University of the Free State; Prof Zakkie Pretorius, University of the Free State, Bloemfontein, South Africa
Research summary
Virulent rusts are endangering wheat crops in Africa; rust-resistant wheat strains are critical to the ability of commercial and small-scale farmers (producers) in Africa to achieve a return on their wheat crop. The goal of the SARID project was to identify and develop molecular markers for new sources of APR (Adult Plant Resistance) for stripe rust and for stem rust, and thus to be able to combine genes conferring complementary resistance mechanisms. In the ongoing race against rust evolution, the hope is to develop wheat varieties whose resistance will remain effective for longer than the typical 2-4 years. The team used genetic mapping techniques to identify DNA markers linked to new sources of rust resistance, and also conducted QTL analyses to determine the impact of each gene in different environments and different stages of wheat plant development, complemented by fluorescent microscopy studies of different modes of function. New gene-based SNP markers for 2 stripe rust APR genes in the cv. Kariega have been developed, which has introduced a new marker technology in wheat into South Africa as a resource for current wheat breeding programmes there. Genetic mapping and gene identification analysis of stripe rust resistance in the old French cv Cappelle-Desprez enabled identification of APR genes active against stripe rust in South Africa. In addition, after extensive screening, followed by crossing, populations have been developed for further work in genetically mapping and characterising new sources of stem rust resistance. As the work has been conducted, capacity has been built in African nationals for work in wheat rust pathology and cereal marker technologies. Particularly through CenGen in South Africa, along with key wheat breeding companies, the process has begun of translating these scientific advances (the first use of markers in wheat breeding in South Africa) into application in breeding and farming practices in Africa, and beyond.
Key types of scientific impact/outputs
• Characterised additional sources of resistance for two very important global wheat diseases • Defined and identified a number of genes and developed markers to identify genes for use in breeding
Collaborations
• A new collaboration was established between the South African partners and Susanne Dreisigacker at CIMMYT, Mexico, which will support future work of the South African partners. • A new collaboration has been established between the UK and South Africa partners, and partners at the Kenyan Agricultural Research Institute at Njoro. • This latter collaboration was successful in securing a SCPRID award.

Capacity-building impact

- Students trained in wheat-rust pathology, molecular marker technologies for cereals, statistical and genetic analysis
- Made it possible for PhD student (Gloudi Agenbag) to attend two international meetings and four local conferences, a significant opportunity
- The key individual trained at PhD level is now a postdoc for the co-I in Africa, active in translation of research to users in CenGen, a company providing services for breeders

Highlighted non-academic impact

- This project has helped to give credibility and stature to the co-I and her business, CenGen, providing research and services for crop breeders first in South Africa and potentially elsewhere in Africa. "By raising our profile as a group, our industry is looking differently at us and funding from local funders has improved when we want to support stakeholders."
- This project has helped strengthen positive stakeholder attitudes toward the usefulness of technology such as genetic markers within the *South African Winter Cereal Trust*, which has provided funds for Dr Prins to establish a routine DNA markers service for the three wheat breeding companies, public and private, in South Africa.

Routes toward Impacts

Key roles

- The PI articulated a set of research objectives; everyone took responsibility for a certain aspect and everyone made sure they delivered what they promised to deliver.

Processes

- When the unpredictable happened, such as vagaries of weather affecting field trials, team members found alternative ways to still deliver on objectives.
- Interaction between breeders and scientists was sufficient to ensure that scientists understood what was needed, and the project delivered—in the eyes of a wheat breeder at a South African breeding company

Institutions/environments

Factors/Determinants

- A key element was the real commitment shared by the members of the team.
- Individuals knew each other before the project: PI Professor Lesley Boyd and co-I Professor Zakkie Pretorius are both active members of the Borlaug Global Rust Initiative; the PI had worked in South Africa and the co-I Prins had in the past done doctoral work at Boyd's institution, the John Innes Institute.

Potential for further impact and need for follow-on funding

- The SARID project has established Renee Prins and CenGen as a provider of crop marker technologies for the wheat breeding industry in South Africa. CenGen is now a hub from which these technologies can be transferred into surrounding Southern African countries. Within the new SCPRID project we will transfer marker technologies in to the wheat breeding programme at KARI-Njoro in Kenya, but the plan is to bring other Southern African nations into the programme, initially through a workshop that will be held at CenGen as part of the new SCPRID programme. To make this a reality would of course require follow-on funding.

Key lessons learned

For Researchers

- It is important to make links with people working in developing countries anyway, not just when you see a call for proposals. Even if you are only working together in a small way, like a student visiting for a few weeks, it is important to start building trust and to find people with similar

mindsets and approaches to problems.

- It helps collaborative projects if participants know each other.
- Try to support people who are passionate about their work but restricted by lack of physical infrastructure and lack of financial support.

For Funders

- It would be very good if another round of funding possibilities (peer-reviewed) became available to follow up a current project about a year before completion. This will ensure that if a project performs very well, momentum is not lost.
- Research and technologies in crop breeding are moving forward at an ever increasing rate. If African countries do not have access to and training in these technologies this will only increase the marginalisation of Africa from the developed world.

ANNEX D: Lessons Learned & Suggestions from SARID Participants

For *funding* bodies, generally

Interviewees and respondents frequently encouraged funders to think about continuity: "Funding needs to be for longer, and with more thought on how to extend it if successful"; "always consider a second phase of a project", depending on a) progress and b) potential impact on end-users. Royal Society Fellowships that can last for 3, 5 or 10 years, with assessment at each point, were suggested as a useful model for developing country projects. For much of the sort of biological research funded by SARID, longer term funding can make a difference to impact generation. "Otherwise, there is frustration; you can just publish and that's it; you can't get to the farmers". As an example of how opportunities for impact can be lost, in one project the funding ended before it was possible to conduct a field trial, and also it was not possible to take advantage of an opportunity to combine two desirable traits that would have made a real difference to producers and consumers overseas. A correlated issue is that some prospective subsequent funders might see proposed work as developmental, rather than innovative, so that it can be all the more difficult to find funding for taking the work through to completion. There is also the issue of momentum being lost in a research effort, with the possible moving on of key individuals. "It can't be overestimated, the momentum you can get for long-term projects." Funders were encouraged to play broader roles important to longevity, such as investing in centres of excellence in various countries, with longer-term relationships with universities, or establishing commitment of UK bodies to continuing overseas collaborations in these research areas and encouraging strong public-private partnerships to spread the use of research findings.

Other general suggestions were that funding bodies could also consider doing a bit more to consolidate networks across UK and overseas researchers in the various projects, perhaps, for example, bringing them all together in a workshop halfway through a programme to help individuals from different projects share early results and spot potential synergies across collaborators, capacity-building efforts, crops, diseases, or techniques.

And, generally, positive comments were made about SARID's role: "I'm a big fan of SARID; it's the way forward". Another placed the importance of SARID's role in a global context:

> "Absolutely, I would recommend continuing this sort of programme. Science is progressing at such a pace; technologies are advancing so much; we are learning so much – the rest of the world is getting left behind and marginalisation is increasing. It will be even more difficult for people in developing countries to keep up with technologies being developed, to implement them and for people to be trained. We can't afford for half the world to be good at food production and the others not."

For *funding bodies* stimulating international *collaborations with developing countries*

Joint funding schemes involving UK and developing world collaborations were seen as necessary for the development of 'low-tech solutions underpinned by high-tech science', a type of accomplishment associated with SARID. "The unique nature of the SARID scheme is that it pushed an applied agenda whilst promoting a better understanding of the fundamental science underpinning the approach." Funders were encouraged to fund "excellent integration of UK and non-UK partners focused on real world issues". Similarly, another respondent commented: "Delivering academic and applied impact in a single project is tricky, but can be achieved if projects are long enough and sufficiently well resourced; there must also be the flexibility to allow projects the freedom to explore new areas and new collaborations. SARID

was an excellent start in this direction. I hope it will be extended and/or spawn similar programmes that allow low-tech solutions to be developed that are underpinned by high-tech/high-quality science".

Practical advice was offered regarding the early stages of project-framing and selection, for example, that it is best if the researchers already have at least some collaboration track record, so that they know they can work together. Yet, another suggests that "routes by which new contacts between researchers in the UK and developing countries are required", particularly since research into many crops important in developing countries tends not to be supported by UK funders. One suggestion was for SARID to hold a series of workshops in each country, with various UK researchers visiting to stimulate network-building (even a variant of 'speed-dating') toward subsequent collaboration. Another suggestion is that there should be a clear focus, with the number of project co-investigators not so large as to be ineffective. "Often small collaborations between a few people work better than large groupings, since they are easier to manage." One observation was that "research on tangible issues is of more value than research on intangible issues such as strengthening linkages; intangible issues benefit best through research on the tangible ones".

Regarding implementation of projects, advice included ensuring "a clear will of participation from the developing country so that the bureaucracy doesn't come in the way while implementing the programme". An issue to be aware of is that of visas: "UK visa requirements can be a major thorn in the eye for longer term scientific exchange". Another pragmatic point raised was that funders should enhance their flexibility "with regards to helping the international partner adapt to fluctuations in currency exchange rates between the time that the budget of the project is developed and that actually experienced during the implementation of the project". Funders may need to send a clear message as to limits on funds, to manage expectations.

The point was made that flexibility and longevity in funding are needed to match the nature of the collaborative process: "building appropriate collaborations is tricky and can be a little hit-and-miss, so the scheme must include the flexibility to allow non-functional collaborations to fade whilst allowing new collaborations prosper. The funding also needs to be sufficiently long (5 years plus) to allow for this organic process to develop and to account for the logistical and cultural challenges associated with these collaborations". In a more technical dimension, one interviewee noted that, thanks to flexibility shown by SARID, his project was able to take an additional direction that "paid dividends in a high profile paper and potentially a new way of controlling pests." This (successful) researcher noted that, as frequently happens in projects in developing countries, practical challenges can require adaption and change in specific goals, so "the more flexibility the funders give the better, as long as the core aim is the same".

Thinking about the international element in particular, another respondent recommended 5 year projects (with opportunity to be extended after 3 years), observing that issues exist: "many of the UK-based researchers were new to working in developing countries, or were exploring new collaborations in these areas. The logistical, cultural and administrative hurdles associated with scientific research in the developing world should not be under-estimated and future projects should be provided with the time, resources and flexibility needed to successfully navigate these issues". Given that, for UK researchers new to working with developing country collaborators, there are likely to be different "pinch-points" that could lead to mis-understanding or frustration, another suggestion was that funders might offer a workshop prior to the start of a programme, or perhaps mentoring, to complement

"learning by doing". Putting new project leaders in touch with experienced researchers would be another helpful role for funders: "It would be very useful to have access to people who could give you practical advice, like on how universities work in another country. I would really have wanted a mentoring programme if I hadn't had experienced people to talk with." An issue to consider is maintenance of a cohort of experienced people, when many who were young in the early days of large international programmes are now retiring.

A specific point put forward was that "adequate capacity, in terms of 'technical know how' and equipment" should stay in the co-investigator's lab, to ensure that benefits "will not be short lived, but long lasting". Funder flexibility was urged regarding allowing any leftover funds to be used for purchase of items such as pipettes or paying for publications.

For *researchers* building effective *collaborations with developing countries*

Good relationships are critical if collaborations are to be effective: "Partnership is very important; the trust between the partners is the main key." As another individual reflected, "I benefited from excellent working relationships with my overseas collaborators and this was central to the success (and enjoyment) of the project." One element is to "Ensure collaboration is on an EQUAL footing. Links between Institutes strongly relying on one side for intellectual input will not be long term, both must provide their own irreplaceable contribution". "It is important to include local partners and stakeholders in the project as they will provide you with the necessary network and feed back to achieve impact and to improve." "Exchange visits especially for young scientists are very important."

The importance of careful selection of collaborators was emphasised repeatedly, for example:

> "Take time to establish who is likely to make a good collaborator to establish that you have the same working ethos and same goals from the study. Marriages of convenience do not often work out long term."
>
> "Get to know the people you intend to work with first."

Perhaps even try to work with people you already know.

> "Rely most on colleagues with whom you have had good past experiences".
>
> "We had the best successes with those parts of the project where we could build on past research which was a good platform to add a novel bit with which we struggled more. A balance in the application will thus be good to ensure some success. It also helped that most members of the team had met before and interacted before and it was therefore easy to bring in a new member to this already established group."

Complementarity should be sought, as part of a mutually respecting relationship:

> " It is important that the developing world partner has access to collaborators that can ensure an uptake pathway to prevent outputs remaining on the shelf. It is preferable if overseas partners offer complementary expertise to that of the UK partners."

Transparent understanding as to who does what is highly recommended, both for practicality and for building shared commitment:

> "Having a really good working relationship between members of the team is essential in getting maximum value out of international collaborations. … Have a project meeting fairly soon into the grant and really work out (a plan) at an early level so that

> everyone knows their responsibilities, how they will communicate, and how they will handle publications…. And have a social element, for example meals together…. Face to face contact really makes a difference at the beginning of a project. … Follow up with another meeting midway through, reviewing where you are, what is left to do, results compared to objectives….and plan."
>
> "Establish clear guidelines for working together and what both parties hope to get out of the collaboration."
>
> "It is critical that everything is well organised and that everyone's role in the project is clearly defined."
>
> "Define a clear boundary of the work to be conducted under the funding as some partners (may) tend to conduct and report work outputs to more than one funder simultaneously."

Collaborators' context is important, too:

> "Seek a clear commitment at the outset that participating developing country bureaucracy will support implementing the programme enthusiastically".
>
> "Seek partners that have the appropriate research environment for the work needed to be done in the developing world. It is of value for the UK scientist to visit and assess capabilities before the work begins."
>
> ""Researchers need also to work with private institutions that have potential of technology uptake, which in future will make use of research findings."

A quite specific piece of financial advice offered was:

> "Do not seek funding from donors in countries that have exchange rate that are currently at relatively high levels compared to recent historical trends unless you can convince the developed country partner and donor to permit the developing country partner to budget using the 15-year average exchange rate rather than the current exchange rate."

Finally, keep collaborations alive:

> "The rapport and cordial working relationship between UK and local scientists must never be allowed to die out. A lasting communication link ought to be established between the UK and local partners for sharing of ideas, and assistance where necessary."

For *funding bodies* hoping to stimulate *capacity-building in developing countries*

The most frequently voiced recommendation to funders by respondents was to train young scientists, including capacity-building in the main proposal. Rather than automatically funding older scientists who may have "no track record and little knowledge but who are highly revered", funders were urged to be sure to support younger researchers who will be able to "gain new knowledge and come up with ideas for themselves". The SARID funding, for example, was praised for developing not only the skills but also the confidence of some early career scientists, three of whom have now entered PhD programmes. One respondent recommended that any project support both an experienced post-doc or similar person as

required to meet the challenges of collaboration, and also a 4-year developing country PhD student, observing:

> "The best form of capacity building is probably via on-the-job experience of working on a given project as part of a PhD programme. Most academics (both in the UK and in developing countries) are too busy with teaching and admin commitments to devote much time to learning new skills and approaches, whereas the next generation of researchers (PhD and similar levels) have a golden opportunity to immerse themselves in a project and learn new skills without distractions."

Yet, an issue raised is that of the high cost of PhD training in the UK, with an interviewee suggesting for example that "it would be in the UK's best interests in terms of diplomacy if it were possible for PhD students to train in the UK at a lower cost".

Shared support, engagement and ownership of capacity-building were seen as critical. For instance, respondents commented:

> "Training of any PhD or MSc students should be fully joint between the UK and developing country partners, i.e. the student should not spend more than 50% of their time at the UK partner/s."

> "Require involvement of (and financial support for) the developing country institutional partners in the capacity-building activities -- do not permit the UK-based partner to develop the proposal for this in isolation from the project partners (or if this is done, do not fund the capacity-building programme)."

> "Funding bodies need to recognise the role of the private sector in the research, encourage their involvement and make available resources for the private partnership."

One overseas co-Investigator appreciated the credibility conferred by this funding, when speaking to industry; the grant also enhanced understanding as to levels of funding needed: "I now realise what sort of scale people are operating on, on an international level. The grant opened up the eyes of our funding agencies and stakeholders as to what is really needed to make a difference."

Challenges exist. One respondent observed, for example:

> "Capacity-building is extremely difficult, given current constraints on the time and resources of senior academics in most developing countries. Establishing properly-resourced Doctoral Training Centres in a number of key universities in developing countries may prove a fruitful capacity-building strategy".

Integration of capacity-building with other activity such as research or development projects was recommended, with care to achieve an appropriate balance. Funders might think of spreading the influence of activity more widely, for instance by enabling those running projects with support to invite workshop participants from additional countries. Towards or at the end of a project, one suggestion was that even those projects not qualifying for another full phase of funding, should be considered for support for short periods of time to conclude activities. An interviewee's suggestion was that, if funders cannot provide follow-on funding to individuals in developing countries whose capacity is being developed, they might "at least recommend us to other donors and increase our chance of funding".

One respondent suggested that future researchers could benefit from other's past experiences; "It may also be helpful to have some examples of successful activities from other projects".

For *researchers* hoping to stimulate *capacity-building in developing countries*

The main thrust among respondents' lessons on capacity-building for other researchers was the importance of direct engagement with overseas collaborators:

> "Make sure all links are personal with intimate knowledge of the people and Institutes."
>
> "Working through local universities works best."
>
> "I enjoyed and learned a great deal from the capacity building activities on this SARID project particularly from running a short course/workshop in collaboration with colleagues … . I think it is essential for UK researchers who have not undertaken capacity building activities before to consult widely with their overseas collaborators on the most appropriate activities."
>
> "The developing country partners in the project must guide the development and implementation of the capacity-building programmes, if these capacity-building programmes are to be effective in enhancing in-country capacity in the developing country itself. Otherwise they will simply contribute to the brain-drain and will not directly benefit the targeted developing country."

Again, the importance of training –along with ensuring potential for follow-up – was emphasised, as summarised by one respondent:

> "1. It is important to ensure that any training received can be implemented at the home lab. This needs the UK partners to have a good knowledge of the home institute's research environment and infrastructure. 2. Trainees often need more time to complete their training and maximise benefits than they or their home institutions appreciate before arrival. 3. UK PGs and PDs should engage with the training process partly to speed technical transfer but also to ensure the younger visiting worker enjoys the experience and build links to the UK. Such involvements benefits for the UK-based scientist as summarised earlier."

Not only postgraduate training, but also workshops and equipment to ensure continuation of the work should be budgeted, as one respondent recommended; another said, realistically, "It usually costs more than you first imagine". Yet, as another respondent exhorted, "Make sure you deliver". Another caution offered was that, however rewarding such a collaborative effort might be, its continuation within the UK partner's institution may be vulnerable.