ICRISAT Research Program on Markets, Institutions and Policies

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Background

The management of international agricultural research faces many challenges especially with regard to priority setting. Research managers have to provide clear direction in pursuing long-term strategic goals, and at the same time be responsive to change and demonstrate accomplishment of short-term objectives. They also need to address international development concerns and respond sensitively to wishes of a broad array of beneficiary and stakeholder groups.

Research for development is expected to follow a functioning pathway from inputs, outputs, outcomes to impacts with different "partners" charged with different parts of knowledge-action chain (Figure 1). International agricultural research centers (IARCs) have faced a long-standing dilemma regarding their position along the research-impact pathway.

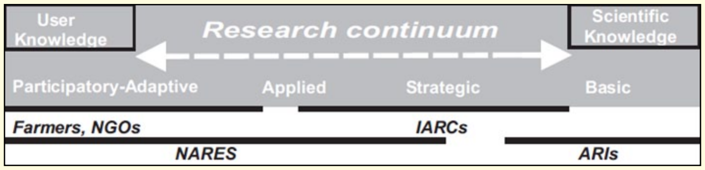

Figure 1. Primary Domains across the research continuum of INRM (Source: CGIAR Science Council 2009.).

There is a general consensus that centers of the Consultative Group on International Agricultural Research (CGIAR) should focus on production of international public goods (IPGs) that have wide applicability across regions/countries (CGIAR Science Council 2009). Even so, their mandates are much broader with increasing focus on impacts such as reduction of poverty and hunger, enhancement of ecosystem resilience, and most recently increased focus on improvement of human health and nutrition.

Until the 2007-2008 world food crises, most centers experienced huge declines in core funding and had to increasingly depend on bilateral projects that include substantial capacity building and technology dissemination activities. Considering the weakening capacity of national agricultural research systems (NARS) in most developing countries, these international institutions have had to engage in applied research for development and have been pulled downstream to address the wide range of issues facing the poor. This kind of participatory downstream research continues to be criticized for placing emphasis on local development agendas at the expense of IPG delivery.

The key question is where the comparative advantage of the CGIAR lies, or what the centers should actually do along the research chain. There is concern that involvement in downstream activities may directly compete with or crowd out the other actors in the knowledge-action chain and undermine incentives for building national systems.

1. IPGs in the CGIAR strategy

The concept of CGIAR as a provider of IPGs began to be clearly voiced in the late 1990s (Sagasti and Timmer 2008). Public goods are defined as being non-rivalrous and non-excludable (Samuelson 1954). Non-rivalry means one person's consumption of the good has no effect on the amount of it available for others. Non-excludability, on the other hand, implies that the benefits accrue to everyone and it is impossible or very costly to exclude those who do not pay for the good, from utilizing it.

Public goods can be defined at the local, national, international or global level. Local public goods are available only within a district, municipality or state; National public goods are available only within the borders of a country; Regional public goods are available to two or more contiguous countries within

Internationality and public good nature of downstream research: Lessons from ICRISAT's experiences with natural resource management technologies

a geographic or political environment; International public goods are available to two or more countries across geographic, political or continental divides; Global public goods are available to all countries.

Ryan (2006) defines IPGs in the CGIAR as "*Research outputs of knowledge and technology generated through strategic and applied research that are applicable and readily accessible internationally to address generic issues and challenges consistent with* CGIAR *goals*".

According to this definition, IPG is not just a characteristic of the good itself but also the range over which the benefits apply. The critical debate here is whether the CGIAR is focused only on producing IPGs, and not on their application. IPG concepts have relevance for the underlying knowledge that research is hoped to generate, but not necessarily in terms of the pursuit of the ultimate goals of the international agricultural research community. For instance, if seed markets are the limiting factor, is producing improved lines a 'relevant' IPG?

Ultimately, innovation involves not just development of new technologies but also their application to derive economic and social value. New technologies have to be put to use within a socioeconomic, institutional and policy environment. The IPG stance however rests on the premise that benefits are inherently international in range and applicable to members of the public within that range, without necessarily implying that all people derive a measurable benefit.

Taking into account the persistent and heterogeneous nature of poverty, degraded natural resources and existing institutional weaknesses, a concerted research and development effort is required under an innovation systems framework (World Bank 2006) to achieve agricultural growth. As international public goods have a spillover range across borders and continents, the CGIAR is indirectly held responsible for exerting influence and building capacity of the network of institutions along the pathway to ensure that the expected benefits actually materialize (Sagasti and Timmer 2008; Spielman 2005).

IARCs such as ICRISAT have often acted as a bridge-broker-catalyst providing backstop support in critical areas. This component is believed to fall under development research, conducted by local partners with minimal involvement of an international organization. The Sixth External Program and Management Review (EPMR) of ICRISAT suggested that downstream work should generate IPGs (CGIAR Science Council 2009). The pragmatic view, that research into the "process of scaling up" is a legitimate research activity that will generate IPGs, was taken.

In its strategic plan to 2020, ICRISAT recognizes the need to be engaged along the R&D continuum to the extent appropriate to assist (but not to replace) those local partners. It illustrates how its roles diminish while those of partners increase along the impact pathway. The aim is to provide knowledge and expertise needed to maximize intended outcomes and impacts, including learning-by-doing with partners and capacity strengthening strategies that improve knowledge flows.

2. Process Lessons as IPGs

The key question is thus whether an IARC like ICRISAT can use location-specific, impact-oriented, applied research to meet its mandate of producing IPGs by identifying research problems and testing proof-of-concept hypotheses. Bearing in mind that downstream work involves not just technical but also institutional innovations of different actors, synthesis and sharing of both technical and institutional lessons is required.

Activities along the R&D continuum offer opportunities for generating IPGs associated with the process and dynamics of technology and policy uptake by partners at all levels (CGIAR Science Council 2009). Scientists and managers will thus have to ensure that research is hypothesis-based and strategic, testing improvements in key processes or technologies across locations and time (Figure 2). Biggs (2008a) cites the importance of learning from actor-oriented studies of situations where positive socio-economic and welfare benefits have been realized.

Proof of concept hypotheses result from documentation of past experience within the organization as well as of external knowledge from other organizations working on similar issues. Testing of these hypotheses across locations with varying biophysical and socio-economic characteristics provides evidences for scientists, policy makers and other stakeholders. A critical analysis of the technology development and deployment process has the potential for generating IPGs on the conditions and pathways by which international agricultural research can be effective in achieving intended impact. Advances can thus be made in both upstream (basic and strategic) research, and downstream work that involves some adaptation, dissemination, policy advocacy, capacity building components.

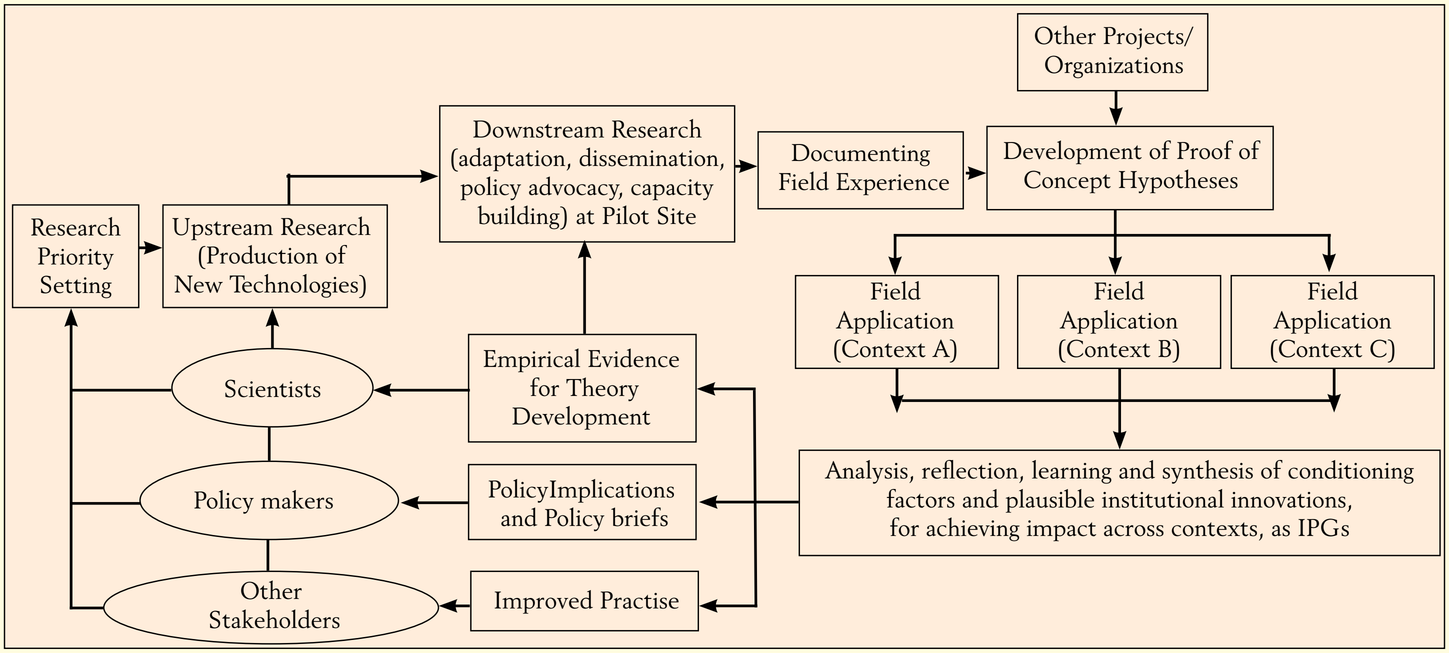

Figure 2. Process Lessons as IPGs. Source: Authors, Adapted from Learning Alliance Concept (Lundy et al. 2005).

Understanding of "what works" in diverse circumstances and the processes driving outcomes is still far from complete. There is a wide array of literature on the dynamics of adoption, but more is yet to be learned on the broader policy and institutional context that shapes agricultural technology uptake. Research should therefore go beyond studies of farmer adoption decisions to include institutional innovations in order to address the wider environmental context and patterns of interaction and learning. A major role of IARCs should be to identify major institutional constraints to achievement of development goals, and seek alternative solutions. However, technical innovations are often highlighted while institutional innovations are rarely reported. One way of capturing the whole range of activities as an experiential learning process is by process documentation and synthesis of case studies across contexts.

3. Link with concept of research spillovers

If a new technology has applicability beyond the location or commodity for which it was generated, such an effect is referred to as a spillover effect (Figure 3). This effect is related to the internationality, "I element", of IPGs that depends on both the research domain and potential for spillovers. This international range has to be consciously defined by the scientist beforehand.

As Ryan (2006) points out, the location where research activities are carried out is of little significance as far as IPG requirements are concerned as long as the expected outputs are intended to be relevant to many agro-climatic conditions and achievable through spillovers. If the spillover potential of research outputs is high, research programs and the associated infrastructure can be located centrally with an assurance that the results can be transferred and applied in similar environments elsewhere.

The gap between actual and potential spillover benefits can only be closed through working with partners to identify and alleviate the binding socio-economic and institutional constraints to agricultural development. Past analyses of research impacts and spillovers across locations have, however, taken into account agro-biological characteristics and yield potential without much attention to the prevailing context that shapes the actual benefits.

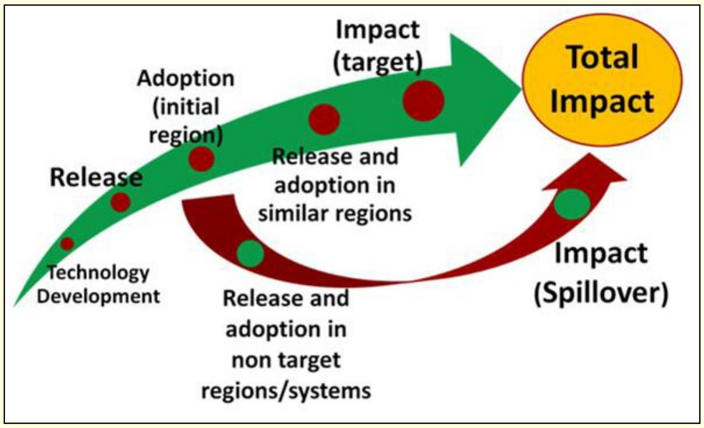

Figure 3. The concept of research spillovers impacts (Mausch and Bantilan 2011).

4. Complementary advantage in IPG delivery

The overall goal of CGIAR research is to improve the welfare of smallholder farmers in developing countries through elimination of poverty, food insecurity, malnutrition, gender inequality and child mortality, and to foster better institutions, policies and sustainable management of natural resources of particular importance to agriculture. Since the obstacles to achieving impact are usually greatest where the need is greatest, adopting only the IPG stance could make the CGIAR look dishonest as this is where institutional bottlenecks need to be addressed. International research institutes should be the nodal agencies playing a catalytic role to induce the other actors in the innovation system to commit to common objectives and the required resources.

Interest for participatory research approaches have risen over the years because of doubts about scale and nature of visible impact from international agricultural research and because of donor demand for more farmer integration into research in order to produce more relevant results.

A number of complementary approaches to understanding participatory research have evolved including adaptive management and adaptive learning; Participatory technology development and participatory learning and action research (Stroud 2003; Kristjanson et al. 2008); Learning alliances (Lundy et al. 2005); Learning selection (Douthwaite et al. 2002); Local innovation/community innovation (Van Oost et al. 2008; Fetien et al. 2009); Institutional learning and change (Watts et al. 2003); Innovation histories/institutional histories (Douthwaite and Ashby 2005; Shambu Prasad et al. 2006); Learning from the positive (Biggs 2008b); Action and reflection (McAllister and Vernooy 1999). The agricultural knowledge and information systems (AKIS) and innovation systems (IS) perspectives consolidate these attempts by encouraging systems thinking in agriculture (World Bank 2006). Consultations of the global conference on agricultural research for development (GCARD 2010) also demonstrated a growing view to shift from a pure focus on upstream research to research for development (AR4D).

Despite the advances, many lessons have yet to be learned and top-down approaches to innovation development dominate in many circles. Even though the innovation systems approach might be a valuable framework for understanding the innovation context, it still needs to be transformed into an operational concept with policy options and targeted interventions to improve everyday innovation capacity (Spielman 2006).

5. Reconciling the need for location specificity and delivery of IPGs

INRM research findings may only be site specific unless the identical intervention is tested across multiple environments and results verified within probabilities. The research should thus be planned and coordinated across benchmark sites offering a range of variation (eg, soil types, water, climate, demographics eg, education level of farmer, market infrastructure etc.) that forms the basis for testing alternative process-based hypotheses about interventions. Since the level of complexity in INRM research may inhibit synthesis across sites, high standards of co-ordination, teamwork time commitment and research design that enables synthesis is required, ie, common objectives, questions, hypotheses and methods (eg, diagnostic methods, treatment of problems, or indicators of impact).

Findings of hypotheses tested can then be extrapolated across research sites within matrices of resources. The intent for spillovers should be made explicit from the outset by developing research domains and utilizing benchmark sites representing a range of possible settings. The process by which the 'best bet' innovations (products or processes) can be adapted to work in other areas should be defined, eg, building the knowledge networks among key stakeholders that are necessary for scaling-up. Focus on research portfolios maximizing international impact will be a reflection of the IPG nature of the research.

Involvement in some complementary activities like adaptation, dissemination, extension, technical assistance, policy advice, and training is necessary to ensure flow of IPGs from the international to the national and local levels. However, since it may be ineffective to be involved in several location-specific work, potential projects need to be carefully reviewed to ensure that they enhance capacity to produce IPGs.

Although natural resources management research is often very location-specific, modern methods and tools, implemented through partnerships of institutions, can apply databases and models for extrapolation across ecosystems. International integrated natural resource management (INRM) research should be process oriented to ensure maximum contribution to producing IPGs. Lessons learned from one area can also greatly speed the research process in regions with similar conditions. Harwood et al. (2006) suggests that appropriately designed research with development components generate at least five types of IPGs:

1. Tools and methods for research and/or development that have applicability beyond the localized borders,
2. Global and regional approaches for INRM research co-ordination and facilitation services that involve more than one country,
3. Development at both field and landscape levels of management and institution building principles that have applicability in more than one country,
4. Contributions to technology development for INRM-based production systems that can be effectively used, with modest adjustments for site-specific conditions, in more than one country, and
5. Scientific understanding of ecosystem problems, driving factors and consequences/interactions with poverty and productivity.

At the end of the research process, improved technologies, institutions, and/or policies, set within their contextual matrix and extrapolated across gradients of change, will be in place for widespread impact.

6. Lessons from past studies

a) Adoption and impact studies

A comprehensive analysis of lessons learned featuring ICRISAT innovations along the impact pathway point to a number of conditioning factors for technology uptake and diffusion: (i) the role of the informal farmer-to farmer seed exchange and community level seed system linkages; (ii) role of a champion on technology delivery; (iii) quality of new technologies matching user's preferences and quality assurance systems; (iv) information reaching farmers early in the technology development process, eg, participation in early stages of plant varietal selection; (v) innovations in social capital build-up, collective action and input-output trade contracts for facilitating information, credit and input access; (vi) flexibility for technology adaptation according to users' needs and resource endowments; and (vii) institutional arrangements easing access to selling points and linking producer marketing groups (Kamanda and Bantilan 2010).

The concerns raised in the studies reviewed above helped identify important areas for further research. For instance, the recognition that seed availability was a major setback to adoption of new varieties triggered a series of in-depth seed systems studies. Lessons on the importance of participation and collective action influenced ICRISAT to develop the consortium approach to watershed development projects, which has been cited as one of the seven best INRM cases in the CGIAR. The approach has been replicated in others countries in Asia and sub-Saharan Africa. The need for focus on soil fertility management, soil and water management amid resource constraints of most smallholder farmers are being addressed by work on fertilizer micro-dosing and African Market Garden (AMG), which is based on low-pressure drip irrigation systems. The fertilizer micro-dosing and AMG and warrantage approaches, initially tested on-station and around Niamey, has been successfully replicated in many African countries.

b) ICRISAT research on watersheds

During the 1970s and 80s, the resource management agenda at ICRISAT was agronomy-based to optimize on-farm performance of new crop varieties developed by ICRISAT breeders. The scope later expanded to include crop-livestock interactions and watersheds.

It was, however, only after more than 25 years that the work went on-farm through new partners. Participatory approach to watershed development through coalition approach and farmer integration was promoted, and processes and institutional arrangements evolved to address sustainability. The model was developed by establishing watersheds covering various agro-ecological, socioeconomic and technological contexts in India, Thailand, China, Vietnam, and several African countries through partnership with ASARECA with technical backstopping by ICRISAT. Explaining differences in success between India, other Asian regions and SSA would be a good entry point for strategic formulation.

Some of the conditioning factors for successful watershed implementation identified include: (i) Demand driven watershed approach, eg, acute water stress; (ii) Pre-disposition to work collectively; (iii) Equal partnership, trust and shared vision among the consortium partners and high confidence of the farmers; (iv) Transparency and social vigilance in financial dealings; (v) Decentralized decision-making process; (vi) Involvement of all stakeholders in program implementation with clear responsibilities including elected representatives (eg, Panchayat), women and landless laborers; (vii) Tangible economic benefits to individuals and commensurate sharing of benefits; (viii) Targeted activities for women and vulnerable groups; (ix) Knowledge-based entry point activity rather than subsidy based; (x) Proper targeting, eg, agro-ecoregion specific technologies, targeting poor regions; (xi) Role of leadership or champion (researchers/policy makers) and good local leadership; and (xii) Sustainability of the watershed project through use of low cost structures that can be maintained by the communities themselves, capacity building, watershed institutions/self-help groups and adoption of a business model linking with other institutions, eg, credit, input delivery and technology transfer mechanism.

c) India-Africa Knowledge Exchange

A key area of collaboration has been research on Vertisol technologies in Ethiopia. This built upon earlier research in India since 1974 where it was noted that the Broad-bed and Furrow maker (BBF) was mainly used by farmers with drainage problems. Subsequent ICRISAT research on Vertisols was then designed to target eco-regions with waterlogging problems. ICRISAT, ILCA (now International Livestock Research Institute - ILRI), Ethiopian Agricultural Research Institute (EARI) and Alemaya University collaborated in the Joint Vertisol Project. The study was initially funded by the Swiss Development Co-operation (SDC) with additional support from Oxfam, CARITAS Switzerland and the Norwegian government and later by the Dutch government. The BBF, also called broad-bed maker (BBM) earlier developed by ICRISAT was found to be heavy and could not be managed by the local Zebu. It was then modified (Figure 4) based on farmer recommendations and incorporation of design elements from a traditional local Ethiopian plough (*Maresha*). With sustained interest of the Ethiopian government and other stakeholders like Sasakawa Global, BBF has been widely adopted in Vertisol areas. By 2005, up to 100,000 farmers were using the BBF on 63,000 ha across the country (Rutherford 2008).

Some of the lessons learned from the evolution of Vertisol technologies include (i) Problem orientation and identification of entry point; (ii) Applicability of readily available inputs and systems and affordability of the technology by farmers; (iii) Risk aversion and selective adoption of components based on individual or institutional capacity to manage the risk; (iv) Consideration of attitudes and cultural practices, eg, religion; (v) The role of leadership or champions among the stakeholders; (vi) Client orientation and ownership; (vii) Important role of government and involvement of policy makers; (viii) Governance and co-ordination of multi stakeholder partnerships and for common interest; (ix) Stable financial support and accountability; (x) Sustained commitment since the time dimension for transfer and adoption of NRM technologies is longer than adoption of crops; and (xi) Scaling up and exit strategy for sustainability.

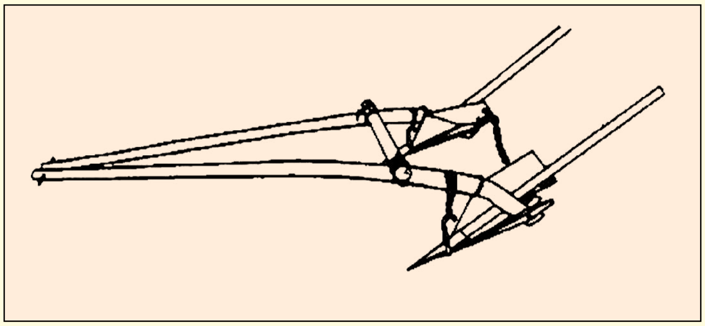

Figure 4. BBM made out of two mareshas connected in a triangle structure (Jutzi et al. 1986).

7. IPGs from ICRISAT INRM research

The lessons in the above section represent type i, ii and iii of IPGs as categorized by Harwood et al. (2006. See section 5). Broadly, all 5 types of IPGs have been developed from ICRISAT location-specific agro-ecosystems research including: the consortium approach to watershed management, identification and amelioration of micronutrient deficiency across agro-ecosystems, information and understanding of the SAT environment (parameters like weather data, changes in cropping systems with productivity and incomes, water level in geo-referenced open-dug wells, water quality, runoff and soil loss using automatic water level recorders and sediment samplers, vegetation cover estimation by satellite imagery; all collected in the benchmark watersheds), identification of biophysical and socioeconomic constraints for sustainable production, innovative soil and water conservation practices, integrated pest management (IPM) protocols for major crops and delivery mechanisms at village level, methods for representative soil sampling in micro-watersheds, detailed datasets of pedons for carbon sequestration in benchmark sites, simulation models for water balance, cropping systems and soil management, remote sensing application technology and meteorological forecasts and analysis of its acceptance by farmers, methods for assessing economic and environmental effects of NRM, consequences of upstream use on downstream availability, and how actions taken at one scale affect uses and users at other scales, among others.

The contextual setting and the 'fit' of specific technologies across locations is enriched through an iterative process of technology refinement and analysis of its adaptation and extension across locations, eg, testing of Vertisol management technologies in India and Ethiopia.

Summary and conclusion

ICRISAT can embrace location specific research within an IPG framework in all stages of the research for development cycle. Specific problems at the local level present opportunities for testing of hypotheses to confirm proof of concepts and presenting the results as IPG knowledge that is applicable, accessible and relevant elsewhere. Scientists need to define the process by which their research outputs can be implemented across regions, and what human, physical and institutional infrastructure, and financial resources are required for scaling up.

Analysis undertaken in this study addresses the critical concerns regarding downstream work and corresponding approaches for an effective and flexible structure. Development of hypotheses, based on a synthesis of location-specific experiences provides a basis for understanding the factors that influence the probability of success in agricultural research for development.

It is not uncommon for researchers to claim that national systems (NARES/ extension) are not doing their job. The latter, on the other hand, claim that researchers are in an ivory tower and not in touch with reality. Both blame the institutional context and especially the failure of government to provide the enabling conditions. The CGIAR does recognize though that institutional strengthening should be part and parcel of its activity in its endeavor to act as catalyst, integrator, organizer and disseminator of knowledge. Capacity building helps ensure a continuing global reach and relevance and closes the gap between actual and potential impacts.

A strategic analysis of case studies of research programs, considered as development activities, will provide guiding principles for engagement and partnerships in the future. The types of interventions identified in different locations that have achieved the best results, as well as those that have experienced limiting political, cultural and institutional constraints to adoption, are worthy of analysis.

According to its strategic plan, ICRISAT strives to employ a systems perspective in setting priorities to ensure that all important issues along the pathway are addressed holistically, explicitly recognizing constraints and opportunities, and playing a catalytic role in overcoming obstacles by bringing together researchers, farmers, processors and other stakeholders to find solutions. Part of this is documentation and publication of outputs, outcomes and impacts to learn what works, what does not, and why. Whether the learning element, even from failures, and appropriate mid-course corrections are properly integrated into project monitoring and evaluation is a critical measure of success in generating process types of IPGs that are essential for impact and providing knowledge to others working on similar problems.

It is also essential that research outputs are communicated and put to use, in the village, on the ground, in the laboratory, or across the negotiating table under an availability, accessibility and applicability (AAA) framework as advocated by the ICT-KM of the CGIAR as a tool for turning outputs into IPGs.

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