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The when and where of research in agricultural innovation trajectories: Evidence and implications from RIU's South Asia projects

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THE WHEN AND WHERE OF RESEARCH IN AGRICULTURAL INNOVATION TRAJECTORIES: EVIDENCE AND IMPLICATIONS FROM RIU'S SOUTH ASIA PROJECTS

Vamsidhar Reddy T.S.[1], Andy Hall[2] and Rasheed Sulaiman[3]

Abstract

The question of how agricultural research can best be used for developmental purposes is a topic of some debate in developmental circles. The idea that this is simply a question of better transfer of ideas from research to farmers has been largely discredited. Agricultural innovation is a process that takes a multitude of different forms, and, within this process, agricultural research and expertise are mobilised at different points in time for different purposes. This paper uses two key analytical principles in order to find how research is actually put into use. The first, which concerns the configurations of organisations and their relationships associated with innovation, reveals the additional set of resources and expertise that research needs to be married up to and sheds light on the sorts of arrangements that allow this marriage to take place. The second — which concerns understanding innovation as a path-dependent, contextually shaped trajectory unfolding over time — reveals the changing role of research during the course of events associated with the development and diffusion of products, services and institutional innovations. Using these analytical principles, this paper examines the efforts of the DFID-funded Research Into Use (RIU) programme that sought to explore the agricultural research-into-use question empirically. The paper then uses this analysis to derive implications for public policy and its ongoing efforts to add value to research investments.

Key words: Agricultural Innovation, Value Chain Innovation, Research Into Use, South Asia, Innovation Trajectories, Research for Development, Policy

JEL Codes: N5, N55, O13, O19, O22, O31, O32, O33, O53, Q13, Q16

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LIST OF ACRONYMS

ADB	-	Asian Development Bank
AFP	-	Adivasi Fisheries Project
AIT	-	Asian Institute of Technology
ARD	-	Agriculture and Rural Development Department, World Bank
BFRI	-	Bangladesh Fisheries Research Institute
CABI	-	Centre for Agricultural Bioscience International
CGIAR	-	Consultative Group on International Agricultural Research
CIP	-	International Potato Center (in its Spanish acronym)
CoDI	-	Coalition to Diversify Incomes through Underutilised Crops
CRT	-	Central Research Team, RIU
DASP	-	Decentralization of Sustainable Aquaculture Project
DFID	-	Department for International Development, UK
DoF	-	Department of Fisheries, Bangladesh
DSP	-	Decentralised (Fish) Seed Production
FAO	-	The United Nations Food and Agriculture Organization
GIFT	-	Genetically Improved Farmed Tilapia
ICLARM	-	International Center for Living Aquatic Resources Management, now renamed WorldFish Centre
ICRISAT	-	International Crops Research Institute for the Semi-Arid Tropics
ICUC	-	International Centre for Underutilised Crops
IDE	-	International Development Enterprises

IDS	-	Institute of Development Studies, University of Sussex
IFPRI	-	International Food Policy Research Institute
INCOPA	-	Project for Potato Innovation and Competitiveness in Peru
LINK	-	Learning INnovation Knowledge
KIT	-	Royal Tropical Institute, Amsterdam
MSU	-	Michigan State University
NFEP	-	Northwest Fisheries Extension Project
NGOs	-	Non-Governmental Organisations
ODA	-	Overseas Development Administration (DFID's predecessor)
PMCA	-	Participatory Market Chain Approach
R&D	-	Research and Development
RAAKS	-	Rapid Appraisal of Agriculture Knowledge Systems
RDRS	-	Rangpur-Dinajpur Rural Services
RIU	-	Research Into Use
RNRRS	-	Renewable Natural Resources Research Strategy
S&T	-	Science and Technology
UK	-	United Kingdom
UN	-	United Nations
USA	-	United States of America
VAPCOL	-	Vasundhara Agri-Horti Producers Company Limited

1. INTRODUCTION

The context of this paper is the ongoing discussion about how agricultural research can best be used for developmental purposes. The idea that this is simply a question of better transfer of ideas from research to farmers has been largely discredited. There certainly are circumstances where this sort of technology delivery pipeline arrangement works well, but these circumstances are exceptions rather than the rule. The contemporary understanding of agricultural innovation is that it is a process that takes a multitude of different forms, depending on local circumstances and histories, and different challenges and opportunities. And, within this process, agricultural research and expertise are mobilised at different points in time for different purposes. This paper boils these sorts of issues down to two key analytical principles in order to find how research is actually put into use. The paper then seeks to use this analysis to derive implications for public policy and its ongoing efforts to add value to research investments.

The first analytical principle used in the paper concerns the configurations of organisations and their relationships associated with innovation, as well as the location and role of research in these configurations. This is useful as it reveals the additional set of resources and expertise that research needs to be married up to and sheds light on the sorts of arrangements that allow this marriage to take place.

The second analytical principle concerns understanding innovation as a path-dependent, contextually-shaped trajectory unfolding over time. We argue that this analytical perspective is important, partially because it reveals the changing role of research during the course of events associated with the development and diffusion of products, services and institutional innovations. However, it is also important because this idea suggests that the task of putting research into use is not a post-research task, but is a long-term capacity development task concerned with marshalling resources and expertise to deal with an unpredictable and highly dynamic world in which innovation trajectories play out.

The paper uses these two perspectives to explore the recent efforts of a donor-funded programme that has been established to explore the agricultural research-into-use question empirically — the

Research Into Use (RIU) programme funded by the UK's Department for International Development (DFID).

The paper concludes by suggesting new modes of financing to support the undertaking of research AND use together and not as sequential steps. It also confirms the importance of roles played by different types of agencies in the innovation process, which requires adopting capacity building agendas in a system sense rather than technology transfer agendas. The paper then highlights the important roles played by the pivotal agencies of the innovation process — that have pro-poor agendas — to steer innovation trajectories in order to achieve poverty reduction objectives.

From here on, the paper is organised as follows. Section 2 presents a framework for exploring the location of research in agricultural innovation. Section 3 presents the case studies that are then discussed in Section 4 to bring out key issues regarding the nature of agricultural innovation trajectories and the use of research within these. The paper ends with policy implications for putting research into use in Section 5.

2. A FRAMEWORK FOR EXPLORING THE WHEN AND WHERE OF RESEARCH IN AGRICULTURAL INNOVATION TRAJECTORIES

In recent years innovation systems conceptualisation of agricultural development has rested on the importance of multi-actor processes and the institutional context in which knowledge generation, dissemination and use takes place (Hall et al., 2004). This highlights the point that technological, institutional and policy innovations are interlinked and, thus, networking different actors in order to facilitate the sharing of ideas and resources is a critical strategy for enabling the process of innovation (World Bank, 2006). To support this conceptualisation there is growing evidence to suggest that embedding research in the system of technology users and intermediaries would aid in better use of research products (Hall and Sulaiman, 2008). Barnett (2006) provided evidence for a DFID-funded research programme around the notion that organising research as part of a coalition of development, entrepreneurial and policy actors could improve impacts. Experience has also shown that when organisations with varying expertise network together and start engaging in joint activities, it leads to organisational and institutional changes and enhances application of new knowledge. Moreover, the process also leads to raising new and relevant research questions, as well as triggering new demands for technical support (Hall et al., 2009; Sulaiman et al., 2010).

How, then, can these emerging ideas about innovation be used to make sense out of experiments that explore the relationship between research and innovation (such as the case of RIU that this paper is investigating)? It seems that a good starting point might be to try and locate research in space and time.

Locating Research in Configurations of Organisations and Their Roles

The discussion above clearly points to the importance of the innovation management tasks associated with the development of networks and various configurations of organisations and individuals involved in the innovation process. The logic behind this is that partnerships and other forms of social interaction are the domain in which knowledge (be it from research or elsewhere) is shared and where learning and innovation actually take place. Key analytical concerns are about the nature of configurations (range of players involved; different types of arrangements connecting them together; and the roles played by different organisations in these

configurations). Analytically the question about roles is important in order to understand the mix of resources, expertise and tasks that need to be combined with research for innovation. It also reveals the differences between organisations that are involved in innovation and have a direct economic or social stake in its outcome and those organisations that have a facilitative role in helping manage innovation — these are the third party or intermediary organisations that have been referred to earlier as brokers. Examining the nuances of this role provides insights into the types of organisations in any given development arena that may, given adequate financial resources, be able to play a role of this sort when they do not have any direct financial stake in the process.

Locating Research in Different Points in the Innovation Trajectory

Unlike many of the analytical instruments from the neo-classical economics tradition the Evolutionary Economic Perspective on Innovation (Nelson and Winter, 1982) — and analytical perspectives aligned to that tradition (notably innovation systems ideas, but also others) — suggests that a sense of history is an integral element of the analysis. The reason for this is that the roles and configurations discussed above evolve over time and play out in an unfolding innovation trajectory, which responds to various economic, social and policy triggers in the wider environment. This evolution arises partially because organisations involved in innovation continuously learn how to do things better and continuously adapt how they do things because the context they operate in is also constantly changing and they need to respond to this. Path dependence and the unpredictable nature of the shaping environment intersect to produce a limitless range of innovation trajectories.

In addition, as specific products and services are brought into use, different skills, resources and expertise are required at different times in the unfolding performance. Research may be more important at a discovery stage and at a troubleshooting stage when second generation problems occur, but may become less important when diffusion, adaptation and application are taking place. This is not to say that there is a predetermined sequence of events involved in innovation — this would take us right back to end-of-the-pipeline notions of research and technology transfer, which we now know are only effective in a relatively limited set of circumstances. Instead, the analytical insight that comes from exploring innovation trajectories is that it starts to

reveal how organisations involved in innovation marshal expertise and resources to meet the challenges of an unpredictable context and how they tackle complex social phenomena, such as poverty, that is itself embedded in its own dynamic context. These concepts, which are now well-founded in the literature, suggest that the task of putting research into use, therefore, does not become a post-research task — an afterthought to make more out of previous research investments. Rather, it suggests that research into use is a capacity building task, where the main organising devices for assistance are not the projects; usually these are conceived as either research or development-oriented and in reality are always administered and implemented in isolation from each other. Instead, contemporary debates would seem to suggest that it is the innovation trajectory itself that is the organising device for putting research into use. The reason for this is that the innovation trajectory is a domain that brings together both research and development activities (the former aimed at discovery and the latter aimed at social and economic gain) in an integrated way.

We devote the rest of this paper to exploring three of RIU's projects in Asia from the perspective of locating the research within innovation trajectories and within the configurations of organisations existing at different points in that innovation trajectory.

3. THE VALUE CHAIN-ORIENTED PROJECTS OF RIU IN SOUTH ASIA

Ten years (1995-2006) of research, funded by DFID's Renewable Natural Resources Research Strategy (RNRRS), generated new knowledge in the expectation that it would address the needs of poor communities living in Asia and Sub-Saharan Africa. The final evaluation of the DFID programme suggested that although it had generated good scientific research, its developmental impacts have been modest (Hall et al., 2010a). Subsequently, DFID commissioned the Research into Use (RIU) programme in 2006. The programme's underlying premise was that an additional set of activities beyond research could help extract more impact from earlier investments in research. The ideas informing how this might be achieved have matured considerably between the time when RIU was set up to the time of writing this paper (2010). The projects discussed in this paper were set up in the earlier stages of the programme. At that time the guiding principle was about identifying existing technologies and looking for ways of scaling these out. The operationalisation of this principle, on paper at least, built largely on earlier research project thinking and the understanding of this by research teams. As will be illustrated, however, these projects, when examined through the eye of the analytical principles suggested in the previous section, are proving to be a rich source of insights into the organisation of the innovation process over time.

The projects selected for the current paper have all focused on innovation associated with value chain development.

A longitudinal case study method was adopted for understanding the cases. Data was collected during periodic visits to the project locations and through semi-structured interviews with key informants from different stakeholder groups. A review of literature provided information on the historical aspects of the cases. The agricultural innovation systems analytical framework employed by the World Bank (2006) was used to comparatively analyse the cases.

About the Cases

The three cases presented in this paper involve RIU projects in South Asia — in Bangladesh, Nepal and India, specifically — that focused on facilitating the wide-scale application of three different knowledge products/ processes developed under DFID's RNRRS programme. In Nepal the international development agency International Development Enterprises (IDE) has used the Participatory Market Chain Approach (PMCA) to strengthen the vegetable value chain and connect smallholder farmers to larger markets. The project in Bangladesh, led by the NGO Rangpur-Dinajpur Rural Services (RDRS), has been supporting the fish-seed value chain by putting into use the idea of Decentralised (fish) Seed Production (DSP). In India the Coalition to Diversify Incomes through Underutilised Crops (CoDI), involving the International Centre for Underutilised Crops (ICUC) and BAIF has built a value chain for underused crops and connected smallholder producers to markets through a multi-pronged approach that was developed by integrating different knowledge products. Table 1 below presents some of the key features of these three cases.

Table 1. Key Features of the Value Chain-Oriented RIU projects in South Asia

Feature	IDE (Nepal)	RDRS (Bangladesh)	CoDI (India)
Assembly of the cluster of actors	*At programme level:* Key stakeholder representatives, as members of an advisory committee, supervised project implementation *At field level*: Key actors of the existing value chain were brought together through the PMCA approach	*At programme level:* Key stakeholder representatives, working as part of a loose network, supported project implementation *At field level:* Value chain developed by creating new roles and strengthening linkages among existing actors	*At program level*: Key stakeholder representatives, organised into a coalition, were involved in programme implementation *At field level:* A multi-pronged approach brought together different actors along the agricultural value chain to build a value chain around underutilised crops
Approaches/ strategies for putting existing knowledge from RNRRS into use	Proven knowledge was adapted and adopted in a different context	Proven knowledge was scaled-up/out in a larger area through	Different streams of knowledge were appropriately mixed to continuously develop an approach

	for innovation around value chains	innovation around value chains	for value chain innovations
Mechanisms/ strategies for integration of research into the innovation process	Smallholder organisations were capacitated to articulate their need for research outputs to research agencies	Research organisations were part of the network and there was two-way feedback and information sharing	Research organisations were part of the coalition and there was two-way feedback and information sharing
Features and ways of making the effort pro-poor	Focus on building capacities of smallholder organisations	Focus on developing smallholder rice field farmers and seasonal pond owners as producers of fish seed	Focus on vegetables and fruit that are mostly cultivated by smallholder farmers on degraded lands
Commodity in consideration	Mainstream fruit and vegetables	Fresh water fish species that are self-recruiting	Underused crops (cereals, fruits and vegetables)
Status of the existing value chain (prior to the RIU intervention)	Mostly present but with inefficiencies and missing links	Mostly present but with inefficiencies	Mostly absent
Intervention in the value chain	Building capacity of smallholder organisations to identify and respond to market opportunities. Building linkages among different components of the existing value chain	Creating a role for smallholder farmers in the fish seed value chain and strengthening linkages among existing components of the fish-seed value chain	Simultaneously building different components of the value chain. Allowing existing components of the value chain to join in, in accordance with their individual business interests

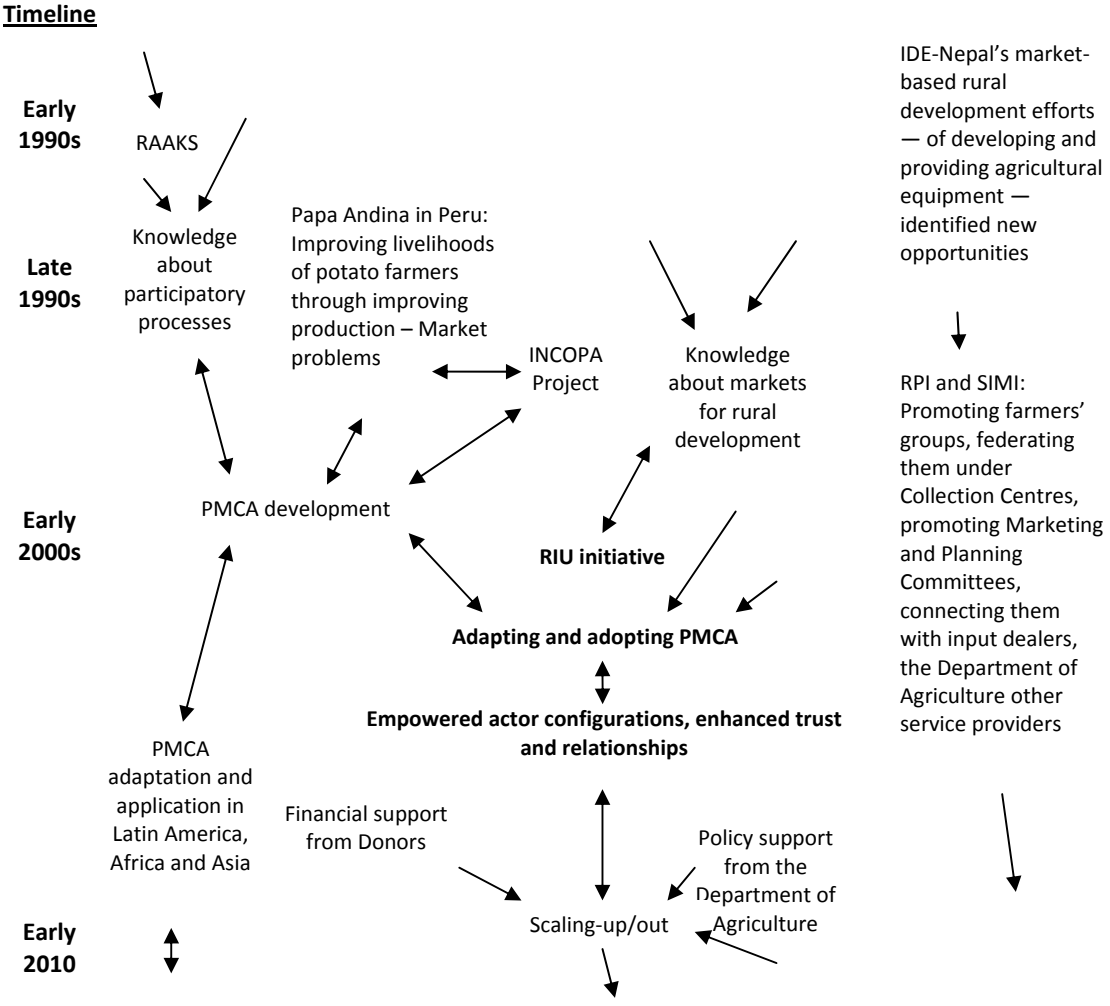
What follows is an analysis of these three cases by using the analytical framework discussed in the previous section.

3.1 Case 1: Application of the Participatory Market Chain Approach (PMCA) in Nepal

This project — which is all about connecting smallholder vegetable growers to larger markets and other service providers by building configurations of relevant actors in Nepal — is led by IDE Nepal, an NGO that is well-known for its unique market-oriented approaches to rural

development. IDE Nepal's long-term efforts — of building actor architectures of smallholder vegetable grower groups and connecting them to different agencies and service providers in order to enable better access to markets — received a boost through RIU, under which it adapted and applied the Participatory Market Chain Approach (PMCA) to move these actor architectures to a higher level of operations. Figure 1 below presents the innovation trajectory of PMCA adaptation and application in Nepal.

Figure 1. Innovation trajectory of PMCA in Nepal under RIU



Development of PMCA in South America

The origins of PMCA can be traced to the efforts of Papa Andina, a regional programme initiative by the International Potato Centre (CIP) with activities spread out in Bolivia, Ecuador

and Peru. Started in 1998, with the aim of improving the livelihoods of low-income potato farmers in the region, Papa Andina's initial activities were focused on improving production through technological solutions. When marketing problems began to impinge upon improvements in production, the programme team began to explore ways to enhance the participation of smallholder farmers in market chains (Horton et al., 2009). To achieve this it worked with another CIP initiative — the Project for Potato Innovation and Competitiveness in Peru (INCOPA) — and used the Rapid Appraisal of Agriculture Knowledge Systems (RAAKS) methodology (Engel and Salomon, 2003) together with other participatory approaches. These efforts gradually evolved into a new approach called PMCA (Horton et. al., 2009).

Demand for New Knowledge: IDE Nepal's efforts toward Market System-Based Development

Since the early 1990s IDE's key activities have involved participatory research to develop and provide appropriate micro-irrigation technologies in Nepal. Later, based on demand, it expanded its product portfolio to provide equipment for agricultural production and processing. It was through these activities that IDE began to recognise the opportunities for smallholder farmers to rapidly increase their incomes by supplying agricultural produce, especially vegetables, to larger national and international markets. However, realising these opportunities was not going to be easy, given that farmers were unorganised and produced only small quantities of vegetables — compounded by the problem of inefficiency in the existing value chains characterised by missing actors and insufficient connections between existing ones (See Figure 2).

In order to address these constraints and connect farmers to markets, IDE facilitated[4] the construction of community managed collection centres at various district blocks, which served as points of accumulation of vegetables to attract local traders. Individual farmers were organised into farmer groups, supervised by the block collection centre. IDE also appointed an executive body for each centre, called the Marketing and Planning Committee, to represent the interests of members to different stakeholders. Input dealers who operated in various regions were given resource books on crop production practices and were encouraged to share copies of these with their farmer clients at a nominal cost. These input dealers were also encouraged to attend

[4] Facilitation involved conceptualisation of the idea, encouraging communities, troubleshooting, and mobilising financial resources and necessary policy support.

meetings at the collection centres. The Marketing and Planning Committees were trained and encouraged to contact the Department of Agriculture and village development committees at the local level to access various programmes and funding schemes. IDE also registered the farmer groups it formed with the Department of Agriculture and the marketing and planning committees under the Cooperatives Act in order to formalise and institutionalise these organisational structures and ensure their sustainability.

This creation of social architectures[5] — under IDE's Rural Prosperity Initiative and Smallholder Irrigation Market Initiative — helped farmers receive better prices, mainly because the marketing and planning committees were able to use their bargaining capabilities for the produce at the collection centres. However, despite all efforts, there still existed an element of mistrust between farmers and traders. This translated into traders not openly sharing prices, farmers complaining about exploitation by traders and traders complaining about the lack of regularity in supplies from farmers. The marketing and planning committees lacked the requisite skills to address these issues at the time. The linkages among different agencies that IDE created through the collection centres remained structural but not functional. As a result, the impacts of these interventions were not as high as expectations.

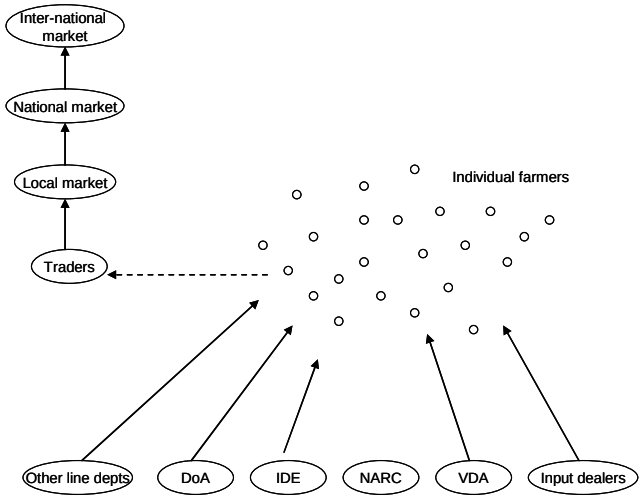
Application of PMCA under the RIU Initiative

At this stage, IDE felt PMCA could be a useful tool to address these problems and move current initiatives to the next level of market operation. IDE expected the tool to help them in building management capacities in the marketing and planning committees that would help them respond to different types of market opportunities and try and build trust among different agencies. Given that PMCA was originally developed in a completely different geo-political-cultural-market context, IDE decided to adapt it to the local context. For this, it collaborated with PMCA's developers to understand the tool's conceptual underpinnings. While sticking to the broad framework, IDE customised the different activities to be undertaken under each of the three stages of the approach. The thematic groups suggested in the approach were promoted as mechanisms for different agencies to come together to discuss and jointly plan initiatives. The

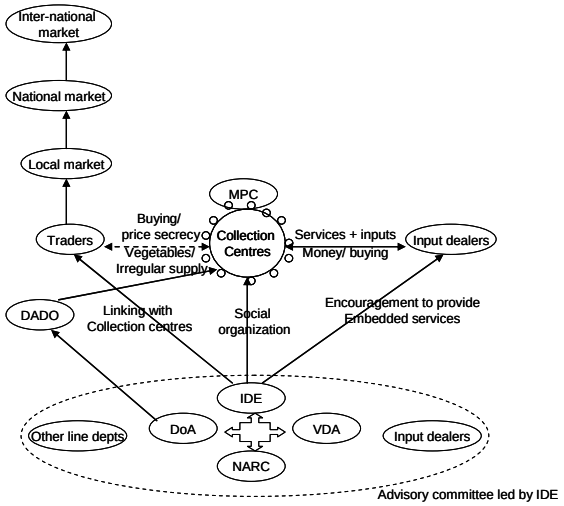
[5] The 'creation of social architectures' here refers to the activity of bringing relevant agencies together and developing/ strengthening functional relationships among them.

social architectures established under IDE's previous initiatives were used as starting points to apply the PMCA approach.

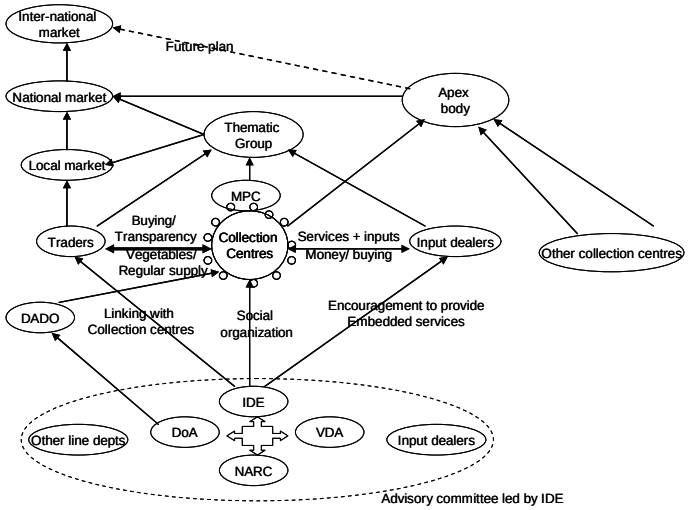
Figure 2. Different Stages of Stakeholder Architecture in Promoting PMCA



Situation 1: Relevant actors and their relationships – Starting conditions



Situation 2: Relevant actors and their relationships – Institutional architecture created through other initiatives before introducing PMCA



Situation 3: Relevant actors and their relationships – PMCA introduced and relationships promoted to the next level

Post RIU: Sustainability and Scaling up/out

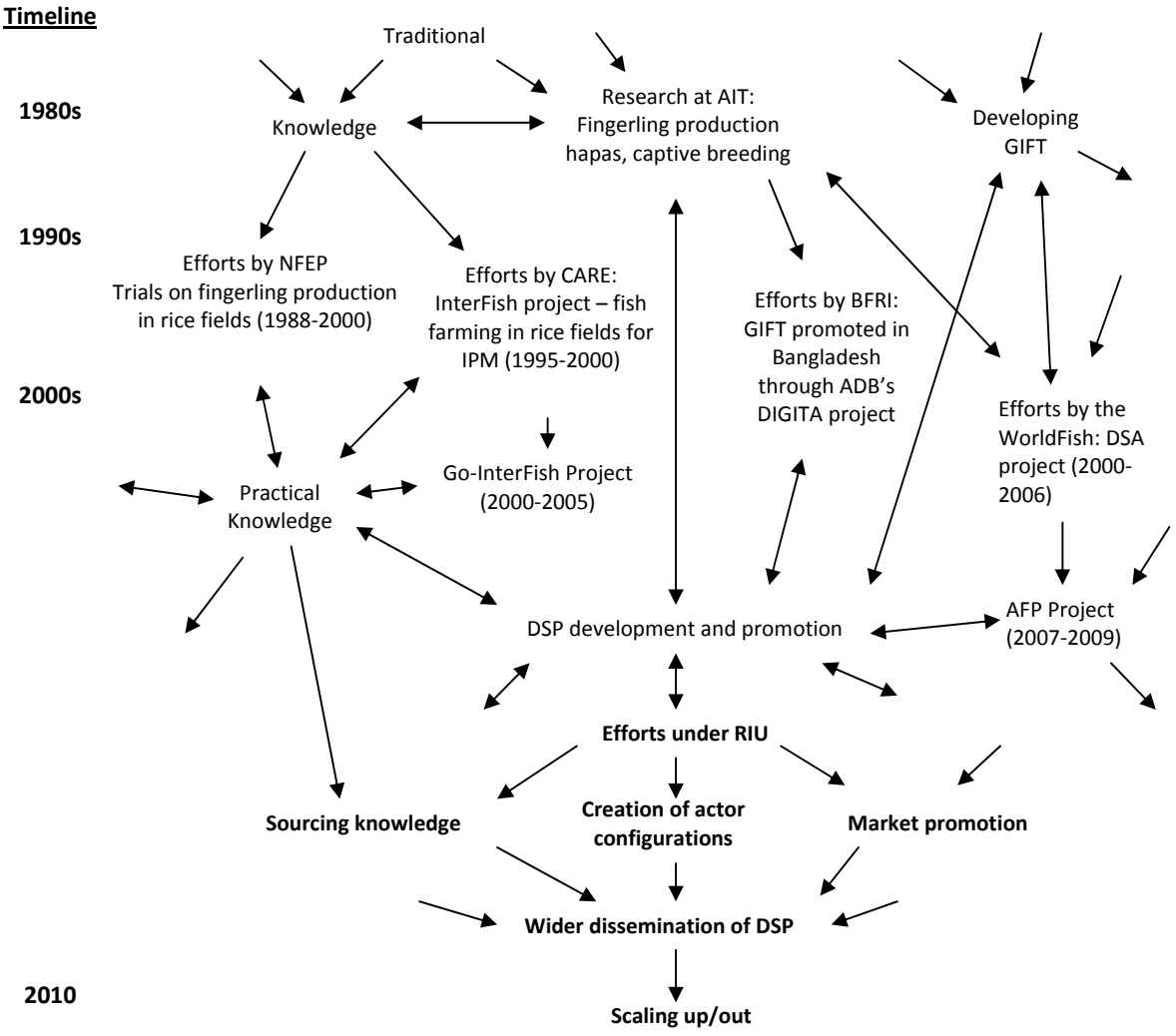
Improved interactions and trust among different actors, created through the application of PMCA, ensured a win-win situation for everyone involved. For example, farmers received better prices, became aware of opportunities in different markets and expanded vegetable growing areas; traders accessed graded and good quality vegetables in large quantities and expanded their business frontiers; restaurant owners and other consumers accessed vegetables in required quantities and at better prices; input dealers increased their businesses and received feedback on how to improve their operations, etc. This newly created trust not only helped different actors improve their current operations, but also helped them plan for future activities (for example, plan on expanding activities to organic agriculture, reaching international markets, etc.). In this scenario, each of the participating stakeholders in the initiative is striving to sustain it and further expand it in order to further its own business interests. IDE plans to continue with the thematic groups and other PMCA initiatives beyond the RIU project period.

IDE Nepal has been successful in mobilising further donor support to scale-up/out the initiative. It has also been successful in efforts to impress upon the Department of Agriculture, whose director general is the chairman of IDE's advisory board, the need to partner with it in scaling-up/out this initiative.

3.2 Case 2: Application of Decentralised Seed Production (DSP) in Bangladesh

This RIU project in Bangladesh is focused on setting up a decentralised, micro enterprise-based supply network to supply fingerlings of an improved breed of tilapia[6], using an approach referred to as Decentralised Seed Production (DSP). The project is led by Rangpur Dinajpur Rural Service (RDRS), a well-established and well-respected NGO based in northwest Bangladesh — an area of heightened rural poverty where integrated fish and rice production systems are key livelihood strategies. The project builds on an extensive history of research and development activities in Bangladesh and internationally. This innovation trajectory is illustrated in Figure 3.

Figure 3. Innovation Trajectory for the Application of DSP under RIU



[6] The project refers to this as fish seed.

Developing the DSP Approach

Several largely un-connected efforts appear to have contributed to the development of the DSP approach. One stream of efforts was first launched in 1991 by a project called Northwest Fisheries Extension Project (NFEP)[7] in northwest Bangladesh. The research-oriented staff of NFEP attempted decentralised common carp seed production through the collection and translocation of spawn deposited by annual floods on aquatic plants in household ponds and ditches to rice fields. The encouraging results of this initiative prompted the Integrated Rice Fish (InterFish) Project[8] to promote fish cultivation in rice fields as part of efforts at Integrated Pest Management (fish eat pest larvae). In this early stage efforts were limited to common carp. This, however, changed with the introduction of GIFT (Genetically Improved Farmed Tilapia), which had originally been developed by ICLARM (International Center for Living Aquatics Resource Management)/ World Fish in collaboration with several research and development agencies[9]. Asian Development Bank (ADB) also helped the Bangladesh Fisheries Research Institute (BFRI) to introduce GIFT in 1994, as part of a project on "dissemination and evaluation of genetically-improved tilapia in Asia". In 1999, NFEP introduced this improved strain of tilapia as part of a research trial with farmers. The Go-Interfish project, implemented by CARE during 2000-2005, also further promoted the production of common carp and GIFT in rice-field plots.

Another stream of efforts that contributed to the development of DSP was the result of collaboration between the Asian Institute of Technology (AIT), Worldfish Centre (a CGIAR centre) and the Institute of Aquaculture in the University of Stirling, UK. Financial support for these initiatives came largely from the UK's Overseas Development Administration (ODA, the predecessor to DFID) through its RNRRS programme and the Asian Development Bank. These partners worked with national government departments and NGOs to advance technical aspects

[7] The Northwest Fishers Extension Project (NFEP) was supported by DFID in two phases during 1988-2000. The regional focus was the impoverished Northwest region of Bangladesh. NFEP trained and used more than 1,000 fish seed traders and more than 250 secondary school teachers as extension agents. It established more than 200 model villages where more than 9,000 farmers received training in aquaculture.

[8] The InterFish Project was implemented by the Cooperative American Relief for Everywhere (CARE) with financial support from DFID.

[9] Research efforts to develop GIFT were initiated in 1988 through a collaborative initiative involving ICLARM, the Institute of Aquaculture Research of Norway (AKVAFORSK) and three organizations from the Philippines: the Freshwater Aquaculture Centre of Central Luzon State University, the Marine Science Institute of the University of the Philippines and the Bureau of Fisheries and Aquatic Resources.

of developing appropriate hatchery systems for low-cost, freshwater fish. As a result, technologies for tilapia (in both commercial and smallholder situations), small carp and snakeskin gourami[10] were developed or refined. The RNRRS project, "Aquaculture Outreach project", promoted improved availability of quality fish seed to farmers and explored different approaches to suit different conditions. As a result of these efforts, greater numbers of farmers began to produce greater and more improved quantities of seed. Subsequently, a research project on "improving fresh water seed supply and performance in smallholder aquatic systems in Asia" (funded by DFID through its RNRRS strategy, R-7052) clarified many earlier perceptions and further advanced knowledge about freshwater fish seed production in Asia. The DSP approach, therefore, evolved by building on knowledge from these different research and development efforts.

Emerging Demand for DSP to Address Problems in Freshwater Aquaculture

Freshwater aquaculture is very important to the livelihoods of villagers in northwest Bangladesh. Good quality fish seed is critical for the success of freshwater aquaculture. Although there are many public and private sector hatcheries, these exist in clusters and are distantly located. Poor transport facilities (fish seed is usually transported by seedling traders or '*patheelwalas'* in metal pots tied to bicycles) and longer distances result in higher mortality and transportation costs. Monsoon-dependent farming in these areas results in higher demand and higher costs of fish-seed during peak seasons. All these factors act as serious constraints for smallholder farmers when it comes to accessing good quality fish seed. To address these issues, decentralised fish-fingerling production in rice fields by farmers was suggested as an option, after establishing its feasibility through the efforts mentioned above.

Several attempts were made to popularise this decentralised approach by agencies such as the Department of Fisheries (DoF), Bangladesh Fisheries Research Institute (BFRI), WorldFish and several NGOs. These included special projects such as the Decentralization of Sustainable Aquaculture Project (DASP)[11] and the Adivasi Fisheries Project (AFP)[12], which demonstrated

[10] A type of fish with the biological name ***Trichopodus pectoralis***

[11] Implemented by WorldFish in collaboration with about 40 NGOs throughout Bangladesh during 2000-2006. Activities focused on creating awareness and training NGO staff on DSP.

[12] WorldFish promoted DSP with common carp, GIFT and carp in rice fields through its Adivasi Fisheries Project in the northwest (Rangpur, Dinajpur and Jaypurhat districts) and the north (Sherpur and Netrokona districts) in Bangladesh.

the usefulness of this approach to farmers — through campaigning on the radio and television and by the efforts of NGOs such as RDRS. Individual farmers who participated directly in these efforts continued to grow fish seed in their rice fields. However, the approach was not taken up widely. The main reason for this was the lack of an appropriate supply chain and support services — to ensure regular supply of GIFT fingerlings, to provide necessary technical knowledge and to purchase multiplied fingerlings (See Figure 3).

Application of DSP through the RIU Initiative

It was at this point that support from RIU entered the picture. To address the constraints discussed above, RDRS led a consortium of NGOs from the northwest to collaborate with partners with specific expertise. These included IDE Bangladesh (International Development Enterprises) for its market development expertise, WorldFish Centre for its technical expertise and the Bangladesh Department of Fisheries for its technical advisory mandate. The consortium built the necessary actor architecture to apply the DSP approach. Rice field farmers, table fish farmers, seasonal pond owners, and fingerling traders were selected and encouraged to be part of the initiative. Roles to be played by each were specified and interactions among them facilitated. Farmers and traders were supported with necessary training and finance. A few selected table fish growers (pond owners) in different regions were encouraged to play the role of 'satellite brood rearers' (suppliers of GIFT brood fish to interested rice field farmers). A number of educated and unemployed youth from local areas were selected and trained to play the role of field technicians to provide motivation and technical knowledge, and clarify any doubts farmers interested in DSP may have had. WorldFish representatives and personnel from the Department of Fisheries helped these field technicians through technical backstopping. IDE, which has extensive expertise in developing rural markets, designed and implemented locally-specific activities to develop markets for fingerlings and build relationships among different actors along the fish seed supply chain. The Department of Fisheries promoted and managed a "brood bank" to ensure a sustainable supply of brood stock to satellite brood rearers. Some individuals — selected from fingerling traders, rice field farmers and table fish growers — were promoted as 'local entrepreneurs' and were provided with necessary knowledge and skills to promote the DSP concept, benefiting in the process through increased business. Many locally-relevant ideas were implemented with regards to the composition of fish species to be cultivated, size of the

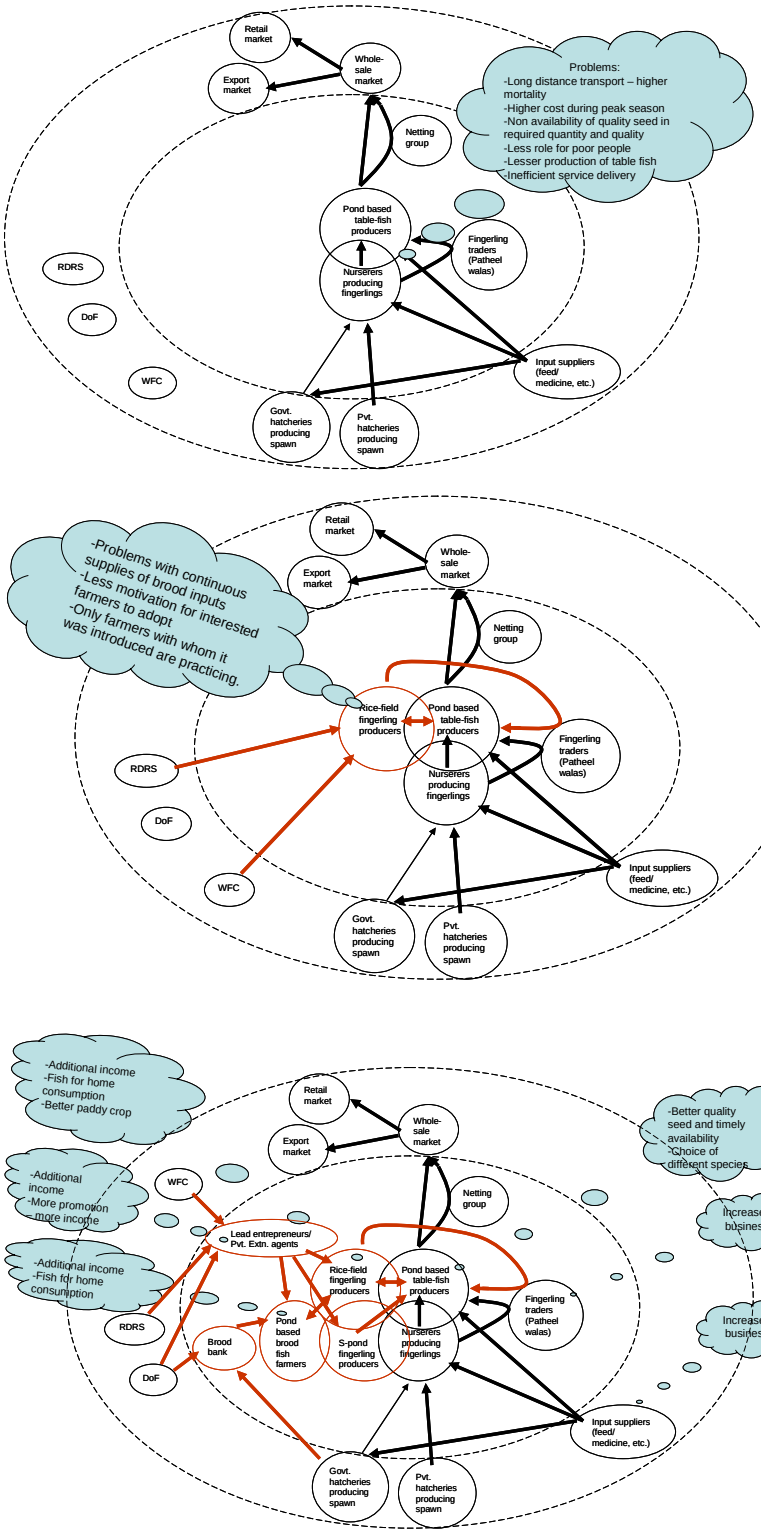
ditch and bunds in the rice fields, feeding patterns, ensured water supply during dry seasons, etc. The tacit knowledge of different functionaries (including field technicians, rice field farmers, satellite brood rearers, fingerling traders, nursery owners, DoF officials, NGO staff, etc.) was utilised for devising these approaches.

What is important to note at this point is that the resources of RIU were mainly used by the project to help bring in partners to an initiative that had, in many senses and in many different forms, been in operation for more than 10 years. The main feature of what the partners actually used RIU resources for was to improve the scope and quality of relationships and attendant processes necessary for innovation. In this case the innovation was a marketing and institutional innovation that allowed poor farmers to access and benefit from improved fish breeds. It is also important to realise that RIU provided no recipe for how these processes should be managed; this was left to the resourcefulness of the partners involved. A critical element of this was the identification of skill sets required to address emerging issues. For example, the project struggled initially as RDRS had little marketing expertise. This was resolved by bringing in IDE, which has a strong track record in setting up marketing systems for the poor. This meant that the patterns of partnership evolved considerably as the innovation trajectory of DSP unfolded (see Figure 4).

Post RIU: Sustainability and Scaling Up/Out

Part of the task of selecting and managing an evolving configuration of partners was to create a win-win situation for all participating agencies. In this scenario, rice field farmers benefited from additional income with minimal adjustments to their rice plots and little additional investments. Table fish pond farmers, who acted as ‘satellite brood rearers’, benefited from additional income by selling brood fish to rice field farmers. They promoted rice field fingerling production as they could sell brood fish to more farmers. Fingerling traders benefited from accessing good quality fingerling locally and at better prices. Thus, they were also keen on promoting rice field fingerling production. The project, therefore, shows great potential for sustainability, given the promotion of DSP by different agencies to further their individual business interests.

Figure 4. Different Stages of Stakeholder Architecture in Promotion of DSP



Situation 1: Relevant actors and their relationships – Starting conditions in the innovation trajectory

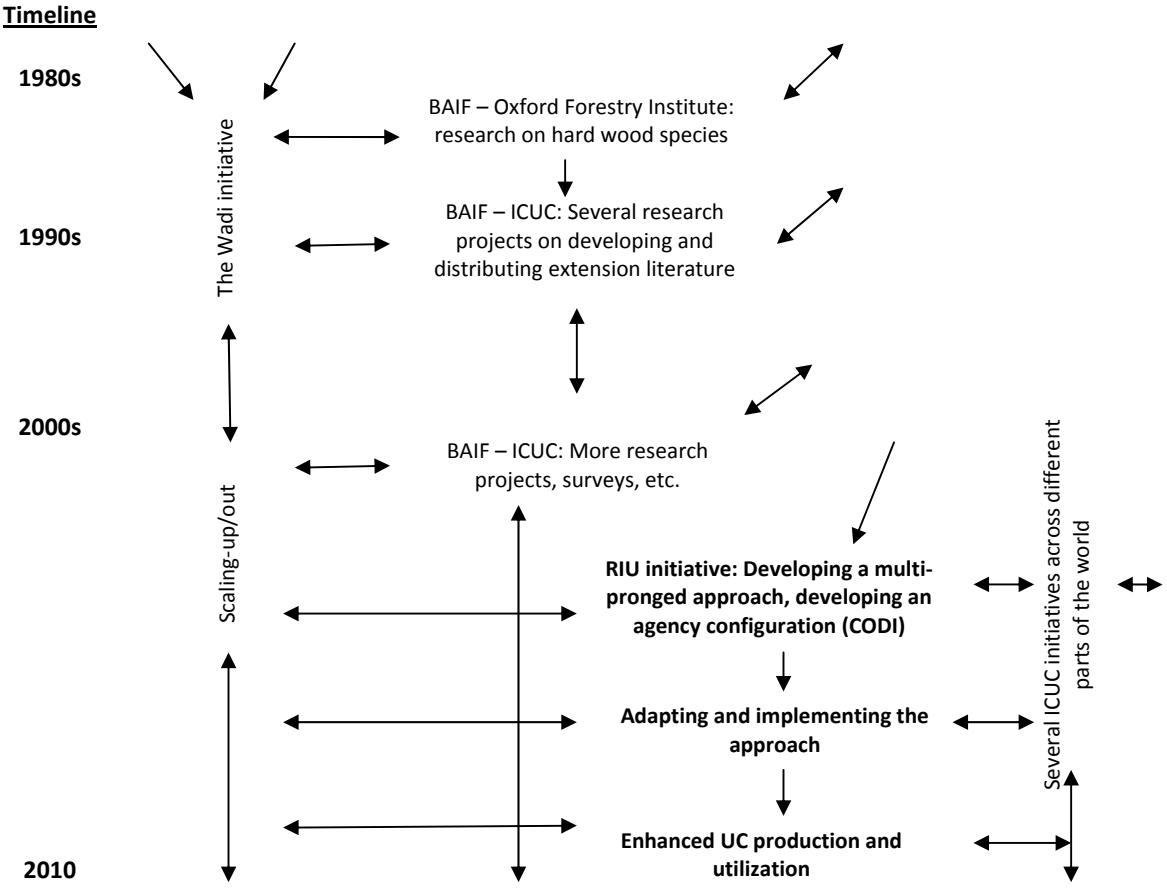
Situation 2: Relevant actors and their relationships – DSP introduced in individual farmers' fields

Situation 3: Relevant actors and their relationships – DSP introduced by creating appropriate architecture of stakeholders

3.3 Case 3: Application of a Multi-Pronged Approach to Promote Underused Crops

This RIU project focused on creating actor architectures to develop a value chain for underused crops in India. The International Centre for Underutilised Crops (ICUC) collaborated with a reputed national NGO, BAIF, to achieve this by developing a multi-pronged approach based on several knowledge components that were each successfully tried in different contexts. Figure 5 presents the innovation trajectory of developing and applying this multi-pronged approach.

Figure 5. The Innovation Trajectory to Apply a Multi-Pronged Approach for Underused Crops under the RIU Initiative



Development of the Multi-Pronged Approach to Promote Underused Crops

The multi-pronged approach used by the RIU initiative appears to have emerged from several independent research efforts and experiences. The International Centre for Underutilised Crops (ICUC) led one group of such efforts, which initially focused on collating local and scientific knowledge on production and post-harvest aspects of underused crops from the extension literature and promoting the wider dissemination of this material. ICUC collaborated with many research and implementing partners in these efforts. Through projects such as the 'Fruits for the Future Programme' (an RNRRS initiative – R7187), it worked with national research institutes and developmental partners to produce extension literature and organised training programmes to disseminate this. ICUC also realised that simply making this knowledge available addressed only one aspect of the problem. There were other constraints to promoting underused crops, such as the lack of free access to plant propagation material of required species; unavailability of post-harvest and processing technologies; and lack of linkages to markets and other service providers. Thus, ICUC began to realise the need for broader engagement with diverse stakeholders.

Based on these lessons, ICUC subsequently implemented a project on "Improved livelihoods through the development of small-scale fruit processing enterprises in Asia" (an RNRRS initiative – R8399), in which capacities of local partners were built in the production and processing of underused crops through training and financial support. These local partners were then expected to identify, encourage and support potential entrepreneurs to set up production and processing facilities, so that producers of underused crops could benefit from these. In India, BAIF, which was ICUC's local partner, established three fruit processing facilities — 'resource centres' — through self help groups of small entrepreneurs. However, these fruit processing enterprises collapsed despite some initial success. This was mainly because of the lack of business skills among these small entrepreneurs, which could have enabled them to access credit facilities, markets and raw material. The lessons from these earlier efforts formed the basis of efforts to develop a multi-pronged approach to address all aspects of the problem.

BAIF-ICUC Efforts Leading to the Application of a Multi-Pronged Approach under RIU

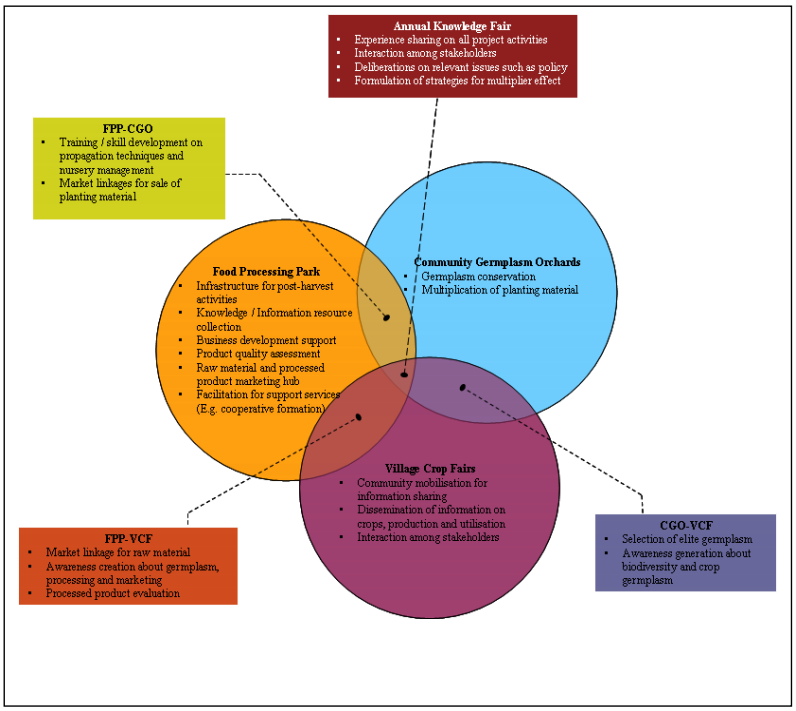
The BAIF Development Research Foundation has been encouraging the production and use of underused crops to support rural livelihoods since the late 1980s. Together with collaborative

activities with agencies, such as the Oxford Forestry Institute, to identify suitable hardwood species for fodder and fuel needs of rural communities, BAIF has implemented large-scale initiatives, such as the *Wadi* programme[13]. Recognising BAIF's expertise in the area, ICUC embarked upon a collaborative initiative on research around underused crops.

Application of the MPA under the RIU Initiative

To address the problems in production and use of underused crops, a multi-stakeholder group called the Coalition to Diversify Incomes through Underused Crops (CoDI) was formed, comprising representatives from different organisations. The coalition developed a multi-pronged approach (see Figure 6) by putting together knowledge generated from various research and developmental initiatives.

Figure 6. The Multi-Pronged Approach Promoted by CoDI



Source: Project documents of CoDI

[13] BAIF launched the *Wadi* programme in the Valsad district of south Gujarat in the late 1980s. The programme was aimed at promoting agri-horti-forestry plots on degraded lands belonging to resource-poor villagers. The success of the programme in the area encouraged BAIF to promote it in six states, covering about 0.1 million families and 40,000 hectares.

The multi-pronged approach essentially comprised three components: Community Germplasm Orchards, Village Crop Fairs and Fruit Processing Parks. The orchards were organisational structures created to multiply plant material to be supplied to interested growers. Necessary training and financial support was provided to each orchard team. The crop fairs were events where different agencies could come together to share lessons and interests about underused crops. The processing parks were places where all the necessary facilities/ resources concerning post-harvest activities and marketing of underused crops could be accessed. This approach was implemented in areas where BAIF's *Wadi* programme had already created the necessary social architecture and linkages among relevant agencies, and complemented this earlier initiative. Underused crops were added to the existing *Wadi* agri-horti-foresty plots, while the orchards and processing park facilities helped both initiatives to benefit. Linkages established with universities and research stations helped extend technical support for underused crops while the market channels established helped promote these crops. BAIF, which was anchoring the adoption of this approach, played a central role by bringing relevant actors — such as technical experts, market players and community members — together to promote underused crops. CoDI made several adjustments to the approach during the implementation stage, based on feedback after the first round of activities, in order to meet specific local requirements.

Post RIU: Sustainability and Scaling Up/Out

A farmers' producer company called Vasundhara Agri-Horti Producers Company Limited (VAPCOL), which was promoted by BAIF under its *Wadi* programme, has been spearheading this stage of the initiative. VAPCOL has an elaborate network of processing and marketing facilities where underused crops are promoted, and thus, has ensured that there is a market for these crops. At the local level, private sector actors, such as those involved in the horticulture/ nursery business, have been acting as community germplasm orchards, supplying good quality planting material and, in turn, helping to expand the area under the initiative. The village crop fairs have become mechanisms for different private entrepreneurs to participate in and propagate their businesses and, in turn, promote underused crops. All these actors have been contributing to the sustainability of project initiatives as a result of their own business interests.

4. EXPLORING THE WHEN AND WHERE OF RESEARCH IN AGRICULTURAL INNOVATION TRAJECTORIES

This paper sets out to understand the nature of agricultural innovation trajectories and the location of research in them. The cases discussed in the paper provide useful insights, elaborated below, about the nature of the agricultural innovation process.

(i) Knowledge products need adaptation to local contexts. This involves a range of partners, going beyond field-level implementers transferring technology. Institutional adaptation — such as new marketing arrangements — may also be needed to help integrate these knowledge products.

The three cases discussed in this paper illustrate that the application of a specific research-derived knowledge product in practice is a complex process, and one that cannot be achieved by simply providing financial resources to an actor to transfer ideas to relevant implementing agencies. At the start of these RIU initiatives, the lead actors involved simply set out to apply specific knowledge products (the DSP approach, PMCA and the multi-pronged approach to promote underused crops) widely by working with relevant field-level implementing agencies. However, along the way they had to facilitate a process of adapting the knowledge product to specific, local contexts. For instance, the DSP approach was developed further by incorporating the basic concept of producing fish-fingerlings in rice fields with other processes/ activities — by creating new roles for different fish-seed value chain actors, connecting them in an appropriate way, building relationships, developing markets, etc. — in order to ensure largescale application of the approach. To achieve this project implementers identified different actors to play specific roles, trained and motivated them, and interactions among them. For example, satellite brood rearers and seasonal pond rearers were identified and supported with technical and financial inputs to maintain regular supplies. Local Entrepreneurs were identified and trained to technically backstop, troubleshoot and motivate field-level agencies to continue with the DSP approach even beyond the life of the project. The project team devised compositions of fish species to be cultivated in the rice fields and decided appropriate sizes of ditches and bunds, as well as feeding patterns, based on farmers' preferences and conditions. Different locally specific market development strategies were used. In the end, the actual rearing of fish fingerlings in rice

fields — in essence what the DSP approach is all about — is just one component of the many processes and activities of the entire project. Tacit knowledge (for example, on the ways of managing water shortages in ditches during dry seasons or on designing feeding strategies, etc.) from different sources was important in devising the different initiatives and activities that were combined to promote the DSP approach.

A similar pattern can be observed in the other two cases. IDE adapted the PMCA approach to the local context by including locally relevant activities and processes under three stages of the approach. Different actors from the thematic groups set up were encouraged and trained to use meetings and other activities as mechanisms for building interactions and trust among different stakeholders — a key constraint that IDE-NEPAL faced in the project location. The multi-pronged approach for underused crops was also one that continuously evolved during the entire process of implementation. Different components of the approach were modified based on emerging lessons — for example, the village crop fairs were scaled down to village-level activities from the originally planned large regional events.

(ii) Adaptation of knowledge products involves combining ideas with other sources of knowledge from other streams of research.

The three case studies show that the application of knowledge involves further development of the knowledge product and adaptation to specific contexts. For this, many other knowledge products, that themselves resulted from different innovation trajectories, are required. This process involves different agencies getting together into fit-for-purpose configurations, with members having appropriate skills and resources and finding their way forward. The composition of such configurations and the roles played by different members depend on specific contexts of the area and topic being tackled. Since the context is dynamic, the actor configurations and their strategies are adapted accordingly over time. Significantly, in all the cases studied, it was observed that the conventional research organisations in the actor configurations played a largely supportive role while other organisations agencies took the lead during this ‘knowledge adaptation stage’.

(iii) Non-linearity of stages of innovation means that research can be important at any stage of the innovation trajectory.

The three cases seem to suggest that the innovation trajectory has three distinct stages — the knowledge generation stage, the knowledge adaptation stage and the knowledge application stage — which can either occur simultaneously, sequentially or can overlap. For instance, in the case of the IDE Nepal-led project, the 'knowledge generation stage' of the approach used took place in South America, where the Participatory Market Chain Approach was originally developed by the International Potato Centre (CIP) in the period between the late 1990s and early 2000s. The 'knowledge adaptation stage' in this case was facilitated by an actor configuration led by IDE in Nepal later on under the RIU initiative. The 'knowledge application stage' of this case coincided with the preceding stage, with different entrepreneurs taking the lead in order to further their own business interests. This stage is also currently receiving support from the Nepalese Department of Agriculture, which is considering favourable policies to upscale similar initiatives in larger areas, and from other international donors.

In the case of Decentralised Seed Production in Bangladesh the 'knowledge generation stage' was led by different research agencies at different periods and in different locations. There appears to have been some amount of sharing of formal and informal knowledge among the actors involved, with each contributing to the development of DSP as a replicable approach. The 'knowledge adaptation stage' under the RIU initiative overlapped with parts of the previous stage. Here, the implementing actors took a lead while the research actors played a largely supportive role. The 'knowledge application stage' occurred at the same time as the adaptation stage, with different entrepreneurs taking the lead in order to further their own business interests. A similar pattern was observed in the case of the multi-pronged approach to promote underused crops in India.

(iv) Knowledge use only takes place within enabling social architectures. Embedding research in these architectures improves its relevance and impact.

The construction of appropriate 'social architectures' (in other words, organising different actors appropriately and building relationships among them) appears to have been critical for putting knowledge into wide-scale use. This appears to have served two purposes: articulating demand

for knowledge and creating an enabling environment for putting knowledge into use. Decentralised Seed Production DSP was a proven knowledge product with relevance to the area it was developed in. Government departments and other agencies used conventional ways to promote its wide-scale application, but their efforts were largely unsuccessful. Under the RIU initiative, a 'social architecture' was created, consisting of different actors in the fish-seed value chain. The project created new roles (for example, that of 'satellite brood rearers', 'seasonal pond owners', 'local entrepreneurs', etc.) to complete this architecture., which seems to have been important for the wider application of DSP.

Similarly IDE Nepal's efforts under its previous initiatives had created the necessary architecture of actors. This had helped to articulate demand for elaborate functional interactions embedded with honesty, openness and trust among the actors and enabled the project to move to the next level of operations under RIU. Thus, the Participatory Market Chain Approach could be successfully applied in this context. The multi-pronged approach for underused crops was also primarily based on the creation of an architecture of different types of actors with functional relationships among them.

5. IMPLICATIONS FOR PUTTING RESEARCH INTO USE

An analysis of the three case studies examined in this paper provides the following key lessons for putting research into use:

- A two-stage process of knowledge generation and its application does not exist in practice. In fact, there is nothing like a final knowledge product. Each knowledge product needs further research and development to be applied in specific contexts. This effectively blurs the difference between research and development. In order to be appropriate, research and use should be undertaken simultaneously by building partnerships among researchers and practitioners and embedding this relationship in the wider social architectures that enable innovation. This has significant implications for the way agricultural research (and, more broadly, innovation) is funded as it suggests that research should be funded as part of wider development activities. Or, alternatively, research funds should be made available to support ongoing dynamic trajectories and opportunity-driven circumstances. .
- The agricultural innovation process involves a wide diversity of actors, including researchers, NGOs, government departments and market agencies. Each of these actors has a unique and significant role to play to ensure successful and sustainable innovation. It is necessary to recognise this fact and appreciate the strengths and weaknesses of each actor in the architectures. This also suggests that developing networks of relevant actors is a necessary pre-condition for putting research into use. Programme planners should give emphasis to this generalised need to both build up the interconnectedness of different actors, but also to the need to expose actors to the experience and benefits of working in a more joined-up way.
- The cases reviewed all had explicit pro-poor agendas. While the direct impact on the poor has not been measured, this is where the focus and intent of these initiatives lay. The configurations of actors observed have not all had explicit pro-poor or even development agendas. However, what is important is that the pivotal actors in these projects had pro-poor agendas and were able to steer innovation trajectories to towards benefiting poor people. The flip side of this observation is that agricultural innovation trajectories do not

seem to be inherently pro-poor. What is perhaps most interesting, and where policy can play a role, is that the nature of the rural development projects observed illustrates the way development practice has drawn in entrepreneurial perspectives and is starting to use these in ways that have a likelihood of addressing poverty. This points to the need for policy support to focus on nurturing this emerging mode of enterprise-rich development practice.

The innovation trajectories explored for each of the RIU projects reveal a process of research, networking, application and change, which, in many senses, has no end point. Perhaps this is a metaphor for the process of development itself — a process of muddling through, using the best ideas available at a given point in time and trying to move forward in a way that addresses certain social, economic and, increasingly, environmental aspirations.

The RIU cases suggest that these innovation trajectories involve a fluid group of actors who, for a variety of reasons, become aligned to a particular idea or theme. These trajectories are not the property of any particular actor, although they all have (different) stakes in the outcome. Nevertheless these trajectories have a dynamic and are propelled forward. And there are probably many thousands of such identifiable trajectories, continuously merging and branching out.

Taken together, these observations would seem to have important implications for the way policy tackles the science, technology and development conundrum. Most profoundly, it suggests that the main task of policy is not to fund the generation of new knowledge through research, or to "do development" — although these activities remain important. Rather, the main task of policy may be to have a capacity strengthening agenda. This capacity strengthening goes beyond developing the technical skills of actors and empowering poor people (again, these remain important). It concerns strengthening the collective dynamic of innovation trajectories and strengthening the orientation of these trajectories towards the development aspirations of policy. For programmes like RIU that are trying to make more effective use of existing public policy tools, such as agricultural research, it means that the starting point should not be promising technologies themselves. Instead the focus of RIU-like

programmes should be on existing innovation trajectories that show promise for achieving developmental goals. Financial, managerial, business and technical support to these trajectories could propel innovation toward policy ambitions and, in the process, put agricultural research to better use.

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