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Reframing technical change: Livestock Fodder Scarcity Revisited as Innovation Capacity Scarcity

Part 2. A Framework for Analysis

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Andy Hall[1], Rasheed Sulaiman, V.[2] and Peter Bezkorowajnyj[3]

Abstract

This is the second in a series of three papers that develop a conceptual framework for a project on livestock fodder innovation. The paper begins by reviewing the evolving paradigms of agricultural research and innovation over the last 30 years or so and explains the emergence and relevance of the innovation systems concept to agricultural development. The paper then presents a framework for exploring fodder innovation capacity. This framework gives particular emphasis to the patterns of interaction needed for innovation and the policy and institutional settings needed to enable these processes. The paper concludes with some comments on the difficulties of measuring institutional change and the desirability of tracking institutional change and its relationship to welfare outcomes.

Key words: livestock innovation systems; innovation capacity; institutional change; fodder; welfare outcomes; counterfactual; parallel universe; plausible causal connections

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1. Introduction

Acute fodder shortage[4] — resulting from the increased competition for limited resources, environmental degradation in common property areas and the need to increase animal intake in intensive production systems — is a common problem affecting millions of poor people across the developing world dependent on livestock for their livelihoods. Maintaining or improving livestock production is crucial to improving social and economic conditions in these communities. In addition, up-grading throughout the livestock value chain is needed to survive, cope and compete in dynamic production and market conditions at sub-national, national and global scales.

Rural development strategies in developing countries have tended to focus either on importing technology from the developed world or on research-driven technology transfer over the last 50 years. Typically, the agricultural research community has approached the problem of fodder scarcity by developing new fodder technologies and introducing new fodder varieties and feeding systems. While there has been some measure of success, persistently inadequate supplies of fodder in the developing world is a reminder of the poor performance of this strategy, and it is time to tackle this problem from a new perspective.

This is the second of a set of three linked papers that develop a conceptual framework, drawing from contemporary ideas on innovation, to revisit this problem. Its was prepared for a project exploring fodder scarcity from the perspective of innovation capacity being undertaken by The International Livestock Research Institute (ILRI), UNU-MERIT, The International Crops Research Institute for the Semi Arid Tropics (ICRISAT) and the International Institute of Tropical Agriculture (IITA) and their partners. Instead of approaching the issue of fodder shortage from the perspective of information and technological scarcity, the project explores capacity scarcity in relation to fodder innovation. The empirical focus of the papers is the case of livestock fodder scarcity in Nigeria and India. The first paper in this linked series of three dealt with the historical experience of fodder research and technology transfer. The third paper explores tools and methods to assist with research on innovation capacity. This paper develops analytical framework for research on fodder innovation capacity.

2. The Generic Problem of Translating Agricultural Research into Innovation

The problem of translating fodder-related research and technology development into improvements in fodder availability in different animal production and marketing environments is not a unique one. Evidence suggests that agricultural research has largely failed to make its promised contribution to social and economic development. There is now broad agreement that research-led technology transfer is ineffective in bringing about innovation. Here, we use the term innovation to refer to the whole process by

[4] The term fodder is used in the sense of plants grown specifically for feeding animals. These include grass, legume and tree species as well as crop residues.

which knowledge is created, diffused, accessed, adapted, and, most critically, put into use.

From decades of agricultural research and technology promotion experiences[5], a number of important principles have emerged. These are summarised by Hall, et al (2007) as follows:

(i) Despite the planning emphasis on setting up specialised research centres for developing agricultural technology, success rarely takes place unless technology users are consulted and involved in the R&D process from a fairly early stage.
(ii) Technology development is only a relatively small component of the larger process of technology production, supply and use — i.e., the entire innovation process — and technical change often requires complementary changes in, for example, the organisation of production or the marketing of products. As a result, interaction within a diverse set of players, who embody different information and skills, is required for innovation to take place.
(iii) While innovation may involve radical technical changes such as a new crop variety, animal breed or a new type of machine, it is usually a series of incremental changes — tinkering, adaptation and creative imitation — in technology, organisation or strategy.
(iv) Innovation can be triggered in many ways, not just by research; for example, changes in policy; patterns of competition and consumer demand; pest and disease outbreaks; and international trade rules or domestic regulations.
(v) Technology delivery processes need to adapt to the agricultural, market and livelihood conditions prevailing in specific contexts at specific points in time — in other words, there is not a one-size-fits-all recipe for this. As a result of this context specificity, local processes of experimentation and learning assume great importance in the innovation process.
(vi) It is the institutional context of technology development/ promotion initiatives — i.e. the combinations of different organisations, and the roles, routines and rule sets associated with them — that determine the extent to which these wider processes operate effectively and thus whether innovation is enabled or not. If welfare of poor households is to be addressed by innovation, specific institutional and governance innovations are usually required.

It is becoming increasingly apparent that institutional contexts, because of their centrality to the innovation process, determine the extent to which agricultural technology-related interventions result in technological change (Biggs 1990, 1995; Hall 2002, Hall et al 2003; Watts et al 2003). Institutional settings thus determine whether agricultural technology contributes to the development process. An important point of departure in contemporary thinking on the production and use of knowledge is the recognition that institutional factors are a central component of capacity (Edquist, 1997; Oyelaran-Oyeyinka 2005, Fukuda-Parr et al 2002). These perspectives resonate with the empirical findings of Phase I discussed in part 1 of this paper. These are also perspectives that reflect recent thinking associated with the use of the analytical concept based on the notion of an innovation system. Before explaining the historical development of this

[5] Biggs and Clay; Biggs 1990; Chamber; Richards; Byerlee 1998, Hall 2001, World Bank 2006

concept and its key analytical insights, it is useful to first locate this perspective within the changing paradigms of agricultural research over the last 40 years or so. This helps highlight the key points of departure and the additional analytical insights that the innovation systems concept will contribute to this study.

Why is Agricultural Innovation so Difficult?

Agricultural innovation in developing countries presents some particular problems. In contrast to the industrial value chain, agricultural production is different in four major respects, as detailed below.

(i) The production context (agro-ecological conditions) is highly variable both between locations (soil type, climate) and over time (pest incidence, markets, climate).

(ii) This heterogeneity is compounded by the fact that the sector is made up of very large numbers of uncoordinated production units, namely farmers. Social variability — wealth, gender, ethnicity, individuality — is also very high. This means that technology and innovation need to address multiple and often micro agendas and application contexts, thereby reducing the effectiveness of strategies that rely on the centralised development of generic technologies.

(iii) Much of agricultural technology is embodied in biological material (new seed varieties or animal breeds), which, being highly sensitive to production conditions, tends to compound the problems of production heterogeneity.

(iv) Due to the perceived importance of agricultural research as a public good, policy emphasis has tended to stress the separate roles of public and private sectors. This has been based on the misplaced idea that public goods should not be sullied by the profit-driven private sector. However, paradoxically, public policy has often falsely assumed that the market can act as an effective mechanism for the development and delivery of certain types of agricultural technology. Policy has thus reinforced the division of labour between the public and private sectors and has consequently missed opportunities for collaboration toward innovation.

3. Evolving Paradigms of Agricultural Innovation

The recent focus on innovation and the use of ideas like the innovation systems concept is relatively new to policy and other forms of support to the agricultural sector in developing countries. The traditional focus in these countries, and in donor assistance to them, has been on building the capacity of agricultural research systems and related technology transfer arrangements, as well as providing operational funds for these. Over the last four decades, agricultural innovation has revealed itself to be much more difficult than initially assumed. While there have been many critiques of the research-led technology transfer approach it is useful to recognise that approaches have evolved over time with a number of distinct paradigms apparent. The characteristics of these different paradigms are summarised in Table 1.

Table 1. Characteristics of Different Paradigms of Agricultural Innovation

Paradigm	Transfer of Technology	Farming Systems Research	Farmer First / Farmer Participatory Research	Interactive Learning for Change/ Innovation Systems
Era	Widespread since the 1960s, but building on a very long history	Starting in the 1970s and '80s	Starting in the 1990s	Work in progress
Organisational focus	Agricultural research laboratories and field stations arranged as National Agricultural research Organisations, with a separate agricultural extension service	Agricultural research organisations arranged as part of a National Agricultural Research System (NARS) with a separate agricultural extension service	NARS as part of a Agricultural Knowledge and Information System (AKIS) including agricultural extension and education organisations	NARS as part of agricultural innovation systems
Mental model of activities	Supply through pipeline	Learn through survey	Collaborate in research	Interact and learn for innovation
Farmers seen by scientists as	Progressive adopters, laggards	Objects of study and sources of info	Colleagues	Key actors among many others
Farmers' roles	Learn, adopt, conform	Provide information for scientists	Diagnose, experiment, test adapt	Co-generate knowledge, processes and innovation
Scope	Productivity	Input-output relationships	Farm-based	Beyond the farm gate
Core element	Technology packages	Modified packages to overcome constraints	Joint production of knowledge	Facilitated interactive innovation, learning and change
Driver	Supply push from research	Scientists' need to learn about	Demand pull from farmers	Responsiveness to changing contexts

		farmers' conditions and needs		
Key changes Sought	Farmer behaviour	Scientists' knowledge	Scientist-farmer relationships	Institutional, professional and personal, affecting interactions and relationships between all actors
Intended outcome	Technology transfer and uptake	Technology produced with better fit to farming systems	Co-evolved technology with better fit to livelihood systems	Enhanced capacities to innovate
Innovators	Scientists	Scientists adapt packages	Farmers and scientists together	Potentially all actors
Intervention mode	Core funding of research and research infrastructure development			Strengthening systemic capacity to innovate
Role of policy	Set priorities and allocate resources for research			Embedded part of innovation capacity

Source: Hall et al 2007 cited as adapted from an unpublished note by Robert Chambers and Andy Hall and othesr, Montpellier IAASTD meeting, 2005

There are perhaps two points about the changes illustrated in Table 1 that are worth emphasising. The first is that the technology transfer paradigm has been questioned by scientists and social researchers since at least the 1970s. In other words, the question of how to organise the process of agricultural innovation has been with us for a long time. The fact that fortunes of some of the technology transfer and alternative paradigms have waxed and waned, however, does not necessarily mean that they should be judged inferior. Indeed it has been argued that the technology transfer paradigm was quite sufficient for the food production strategies required in the development scenario of the 1960s and '70s. The fact that the development scenario has become much more multidimensional and that markets, technology and agendas are changing much more rapidly and that new players, particularly the private sector, have emerged means that the old technology transfer paradigm is simply no longer adequate (Hall et al 2001).

Nevertheless, farming systems and participatory research paradigms were important institutional innovations and helped build up further knowledge on the relative merits of alternative ways of organising the innovation process. These models, in many senses, laid the foundations for the innovation systems paradigm. They legitimised the role of technology users in the innovation process; they recognised that innovation draws

information from multiple sources; they championed the idea of participation; and they saw how action research could be used to explore development phenomena that are complex and evolutionary in nature.

While the actual idea of an innovation system emerged in parallel with economic studies of industrial countries, its central ideas resonated with the institutional innovations taking place around agricultural research approaches in the 1990s. Moreover, there are many parallels between the economic context of industrial countries and those now faced by developing countries: increasing exposure to global markets, and with this, increasing competition and ever more stringent quality standards. As a result there is a need to deal with the development scenario that is changing rapidly and in unpredictable ways. Of course, social equity and the need to improve the livelihoods of poor rural households in developing countries is an additional and unique concern for agricultural development policies. Innovation system ideas, however, brought fresh thinking and impetus to the discussion of agricultural science, technology and innovation in development that had, in many senses, got stuck and had, to a large extent, slipped off the agenda of many development agencies.

The second and arguably most important point about the changing paradigms is the gradual shift from technology delivery to capacity enhancement and, specifically, the capacity to innovate. Underlying this is the idea that in order to be effective in an ever-changing world a continuous process of innovation is required to adapt the economic process to presenting situations — for example, livestock disease outbreaks or changing consumer preferences. As a result, it is not technology *per se* that is important, but the ability to adapt — often through technical or design changes — to meet the new demands of production conditions, markets or technology users. The caveat is that changes in ways of working (institutional innovations) go hand in hand with these technical and design changes and thus the propensity for institutional learning and change is central to innovation capacity. This is a considerable break from the linear technology-led way of promoting innovation

This is where the innovation systems perspective is particularly valuable because it is a way of conceptualising capacity in terms of the different players, processes, skills and resources that are needed to allow innovation to take place on a continuous basis. This is a major departure from earlier agricultural innovation paradigms. To make the same point differently, the innovation systems perspective shifts the underlying premise of agricultural development interventions from framing them as a problem of information and technological scarcity on production, processing or markets, to framing it as capacity scarcity in relation to the ability to innovate.

4. Analytical Insights from the Innovation Systems Concept

The concept provides a number of key policy and analytical insights that have relevance to the nature of capacity development[6].

Focus on innovation: In contrast to most economic frameworks, which focus on production (output), the innovation systems framework focuses on innovation processes. Innovation is often confused with research and measured in terms of scientific or technical outputs. However, the framework stresses that innovation is neither research nor science and technology, but rather the application of knowledge (of all types) to achieve desired social and/ or economic outcomes. This knowledge may be acquired through learning, research or experience, but until applied it cannot be considered innovation. These processes of learning and acquiring knowledge are interactive, often requiring extensive links among different sources of knowledge. The implication is that capacity development needs to focus not just on enhancing the ability to produce knowledge, but also the ability to put it into productive use.

The role of institutions: Institutional settings play a central role in shaping the processes critical to innovation: interacting, learning, and sharing knowledge. Again, the meaning of institutions is often misunderstood. The innovation systems framework distinguishes institutions from organisations. Organisations are bodies such as enterprises, research institutes, farmer cooperatives, and government or non-government organisations (NGOs), while institutions are the sets of common habits, routines, practices, rules or laws that regulate the relationships and interactions between individuals and groups (Edquist, 1997). Because institutions shape innovation, institutional change is a large element of capacity development.

The role of policies: Policies are also important in determining how people behave. However, an environment that supports or encourages innovation is not the outcome of a single policy but rather of a set of policies that work together to shape innovative behaviour. Furthermore, habits and practices interact with polices. Therefore, to design effective policies it is necessary to take into account the habits and practices of the people affected (Mytelka, 2000). For example, the introduction of more participatory approaches to research is often ineffective unless the habits and practices of scientists are also changed. Capacity development therefore needs not only the clusters of policies needed to support innovation, but also the interaction of these with institutions. This hints at the embedded, context-specific nature of capacity.

Stakeholder involvement and demands: The framework stresses the importance of including stakeholders and of making organisations and policies sensitive to their agendas and demands. Demand shapes the focus and direction of innovation. It is articulated not simply by the market but also by non-market drivers, such as collaborative relationships between the users and producers of knowledge. Demand for certain sorts of innovation can also be stimulated by policy — for instance, by providing incentives to

[6] This section draws heavily on the lead authors earlier published as Hall, et al 2005 a background paper for World Bank 2006.

adopt a certain technology or management practice. This can be especially important where key stakeholders are poor and have limited social and economic power or where the negative environmental impact of development needs to be addressed. Skills and institutional settings needed to create stakeholder involvement are thus part of capacity.

The dynamic nature of innovation systems: The habits and practices that are critical to innovation are learnt behaviors that may change either gradually or suddenly. They are often enshrined in institutional innovations, such as farmer field schools or participatory plant breeding that emerge through scientists' experimentation and learning. These new approaches to research and development often require not only new ways of working but also new partners. Thus capacities develop in incremental ways through learning. However, a key element of capacity is the ability to reconfigure approaches and patterns of partnership to deal with changing circumstances.

Changing in the face of change: One characteristic of a successful innovation system is that its component organisations tend to create new partnerships and alliances in the face of external shocks. Examples of such shocks might be: a new pest problem that requires collaboration between a different set of scientific disciplines; the advent of a new technology, such as GM crop varieties, which requires the formation of partnerships between the public and private sectors; or changing trade rules and competitive pressure in international markets, which creates the need for new relationships between local companies and research organisations. It is not possible to determine the kinds of networks, links and partnerships that will be needed in the future as the nature of future shocks is, by definition, unknown. The way to deal with this is to develop capacity that creates the flexibility in working habits and institutions that allows dynamic and rapid responses to changing circumstances.

There is as yet no accepted definition of the term *innovation capacity*, but it captures the creative and non-linear events that sustain the change process. In a similar vein, more than a decade ago Bell and Pavitt, (1993) used the narrower term *technological capacity*. They contrasted research capacity and technological capacity, stating that the former concerns the resources needed to conduct scientific research. In contrast technological capacity concerns the resources needed to manage technical change — including skills, knowledge and experience (scientific, but also entrepreneurial), institutional structures and linkages or networks connecting science, consumers, entrepreneurs, intermediary organisations and policy bodies.

The innovation capacity concept recognises these same broad sets of skills, links and structures, but does so in relation to the total process of producing, accessing, diffusing and, most importantly, putting into use knowledge in socio-economically useful ways. It stresses that institutional settings (including the policy environment) are a critical part of this capacity and that capacity development is often an issue of institutional and policy change. Innovation capacity is thus an embedded capacity that cannot be understood or developed without considering its contextual setting. Furthermore innovation capacity is a dynamic capacity not just concerned with systems, linkages and institutions as they exist today, but also with the ability to reconfigure these arrangements in response to

changing demands and circumstances. As Clark (1995) points out, the need is to understand capacity in terms of holistic evolutionary systems of learning and change, where future states were unknown and unknowable.

A working definition of the concept of innovation capacity might be as follows:

> *"The context-specific range of scientific and other skills and information held by individuals and organisations and the practices and routines (institutions), patterns of interaction and policies needed to create and put knowledge into productive use in response to an evolving set of challenges and opportunities. A large element of this capacity arises from learning-by-doing, whereby organisations engaging in the innovation process continuously adapt ways of working and routines — institutional learning — thus incrementally improving their ability to utilise knowledge and information." (Hall, 2007—Global STI forum paper Washington 14-16 Feb 2007)*

The generic elements of agricultural innovation capacity might resemble the following[7]:

- National culture appreciative of the value of the scientific knowledge in enterprise and development
- A critical mass of scientists trained in biological science and the scientific infrastructure and funds to productively employ them in research and development roles in the public and private sectors. (This would include the training organisations needed to create this human capital)
- A range of players with different types of agricultural knowledge, codified and tacit, in the public, private and NGO sectors
- Linkages between key sources of knowledge and the social capital needed to allow new linkages to be brought into play when needed
- Relationships and institutions (including habits and practices) that support dialogue, knowledge access, sharing, and learning between different sources of knowledge; between different interest groups including the poor; and between policy actors, practitioners and researchers
- A range of skills in research and entrepreneurial organisations including: scientific, technical, managerial entrepreneurial skills and skills and routines related to partnering, negotiating, consensus and learning
- Clusters of supportive policies that allow both the production of knowledge (i.e., science and technology policy) as well as the productive use of that knowledge (i.e. market and trade policy, investment incentives, regulatory regimes, bio-safety protocols; IPR)
- Change management competencies and mechanism to help predict and cope with evolving innovation environments (i.e., technology foresight). This will include the ability to link scientific knowledge to policy, problem-solving and long-term planning
- Coordination and facilitation mechanisms (i.e., sector associations, development

[7] This list is adapted from Hall 2005.

authorities or boards) and incentive and support structures (i.e., subsidies, credit) to strengthen systems coherence in the absence of market signals
Policy capacity to plan and promote innovation as a systemic phenomenon

5. What will fodder innovation capacity look like and how can it be strengthened?

To give operational focus to the Fodder Innovation Project's investigation of innovation capacity, it is probably not particularly useful to think in terms of a national fodder innovation system. A more useful approach would be to think of loose networks of livestock and fodder-related players in the domains in which project partners are working. The project partner would form a node around which other players would be coordinated. The precise nature of the players in this network will be dependant on the particular focus of the project partner. So, for example, the players related to innovation in a nomadic pastoralist system are likely to be very different from those in a cooperative dairy system. It is anticipated that players in this loose network will be from the public, private and civil society sectors — including livestock keepers — and that these players will be related to livestock production, marketing and related services as well as to development agencies working with livestock-dependant poor people.

The term 'loose' is important here as this does not mean that this capacity will be a set of rigid partnerships, nor does it mean that the boundaries are fixed. Rather it will resemble a fluid cloud of players — an innovation cloud — some of whom will connect together at particular points in time in response to particular needs and innovation tasks. It may be around seed supply, around market access or around dealing with animal disease outbreaks, for instance. There may be a number of firm connections within a particular cloud and new players may become part of that cloud.

This innovation cloud would ideally also have connections to research and policy bodies at a national level that may be geographically distant (although not necessarily dependent on location). Market links could also connect to organisations/players, environments, opportunities and challenges beyond the immediate scale of the project. In other words a fodder innovation system would have a nucleus of dense interactions in geographic proximity to a project partner's intervention domain — what we are calling an innovation cloud. However, connections to national and even international research and policy bodies and the market would also be a critical part of this capacity. A national fodder innovation system would, therefore, be made up of a collection of these dense interactions. This might be viewed as the architecture hardware of this capacity.

However, of equal importance is the software of fodder innovation capacity outlined in principle in the list above. This is really the largely invisible things that pattern how organisations and people do things, and most critically in relation to innovation, how these interact to share knowledge; how they create and adapt knowledge; how they learn; and how they take risks.

What are these invisible things? Confusingly referred to as institutions, these are the usually unwritten set of rules that guide us all: for example, an organisation might have a

very top-down working style and this will prevent it interacting effectively with other players in an innovation cloud. A research organisation might have a tradition of focusing on technology promotion through demonstration, when actually the nature of the fodder problem is access to credit to buy fodder. The private and public sectors often have a tradition of mistrust and this prevents them working together. NGOs might have a habit of participating in development projects with research organisations simply to access technologies and they may not be interested in working on projects that explore how projects learn from mistakes. Other organisations might have a habit of hiding mistakes and this can prevent them from learning.

As can be seen, institutions are a very diverse set of social incentives, but are clearly critical to the effectiveness of the architectures associated with the innovation cloud and its links to other players and contexts. It is anticipated that a fodder innovation capacity will include an institutional setting that is conducive to the critical innovation processes mentioned above. The precise nature of these habits and practices is difficult to predict in advance. Following the logic of the innovation systems concept one should not get particularly fixated on "ideal ways of working". Rather the concept would anticipate that the ability to change habits will be a more critical factor and hence the habits about practices that facilitate institutional learning and change (ILAC) may ultimately be more important (this is dicussed in part 3 of this paper that reviews of tools and methods). Building ILAC processes in combination with the creation of appropriate links is anticipated to be the main way of strengthening innovation capacity.

The final elements of innovation software are the incentives and other devices that pattern behaviour and are found in the wider policy and institutional environment at a national level. The question of which policies and institutions — beyond the obvious ones relating to R&D and livestock sector development — are likely to affect the enabling environment for fodder innovation is largely an empirical one and will have to be investigated by the project. However, it is anticipated that these may include not only policies related to common property resources and waste land development, but also those related to the regulation and promotion of milk marketing. Also, understanding how policy change takes place is equally important as formulating new policy recommendations. By extension of this policy research should be an interactive process whereby key stakeholders are closely involved and where there is interaction between field level results, policy imperatives, and different stakeholder agendas as well as the wider set of institutional settings that shape behaviour and mediate or skew the outcomes of different policy initiatives. Principles on how to conduct research in this sort of interactive way still need to be developed and insight into what these might be would be a valuable contribution to rural development.

Table 2. Similarities and Differences between Agricultural Research Capacity and Agricultural Innovation Capacity

Institutional Features	Agricultural Research Systems	Agricultural Innovation Systems
Guiding agenda	Scientific	Sustainable and equitable development
Role of actors	As researchers only	Multiple and evolving
Relationships involved	Narrow, hierarchical	Diverse, interactive
Partners	Scientists in agricultural research organisations and other public agencies such as universities	Evolving coalitions of interest. Various combinations of scientists, entrepreneurs, farmers and development workers from the public and private sectors
Policy focus	**Narrow,** related to agricultural research and agriculture and food policy. **Disconnected** from other policy domains	**Broad,** also inclusive of trade, rural development, industry, environment, education **Integration and coordination** between many policy domains
Policy process	**Disconnected** from actors and knowledge in the research system	**Integrated** with actors and knowledge and sensitive to agendas in the innovation system
Knowledge produced	Codified Technical/scientific	All forms of codified and tacit knowledge Scientific, technical, organisational, institutional, marketing and managerial
Indicators of performance	**Short term:** scientific publications, technologies and patents **Long term**: patterns of technology adoption	**Short term:** institutional development and change / new behaviours, habits and practices/ patterns of linkage **Long term:** social and economic transformation
Responsibility for achieving impact	Other agencies dedicated to extension and technology promotion	All partners in the innovation system
Capacity development	Trained scientists and research infrastructure	Training and infrastructure development related to a range of research and economic activities and people Policies, practices and institutions that encourage knowledge flows, learning and

		innovation among actors in the innovation system

Source: Hall 2005

6. Where do institutional innovations come from?

Since the preceding conceptualisation places such strong emphasis on the role of institutional innovations in strengthening innovation capacity, it is worth considering how these emerge. In traditional development practice these have emerged through centrally planned schemes and projects; for example, a new extension approach; new seed laws or seed systems; new tertiary agricultural education arrangements; new rural credit schemes. Almost inevitably these scheme-based institutional innovations have been generated externally (to a specific rural area or often the specific country). And, almost inevitably, these have failed.

It is now well established that technical innovations and institutional changes need to emerge from — and only have meaning in — particular social, historical, economic and political settings.(Brass 1982, Land Grant Universities in India, Biggs 1991, 2006 projects in India and Nepal; Cosmas Ochiegn, 2006 The Kenyan Agricultural Research Institute). In reviewing a number of cases where unexpected institutional innovations have arisen out of projects, Biggs (2006) observes that "there were no 'spontaneous developments', 'hidden hands' or 'natural' evolutionary processes that gave rise to institutional innovations and change. There were continuous political/cultural battles taking place, with effective people and coalitions taking actions to bring about changes in power structure." He explains that where social inclusion is part of the agenda of influencing local/ project actors, institutional innovations that support the poor can occur, although rigorous and continuous analysis of outcomes on the poor is required to ensure this and support the scaling up of such innovations.

The innovation systems conceptualisation is very much in line with these perspectives, arguing that institutional changes are often a learnt response to new information or changing conditions; and that institutional innovations are often a way of bringing about technological innovation. For example, reviewing the promotion of small scale irrigation technology in Bangladesh, Hall et al (2007) explains how the success of the programme was largely a result of institutional innovation around pump quality standards. The NGO running the programme initially insisted on promoting a high quality, but also relatively expensive, pump that could last seven years. However, noticing that copycat fabricators were producing and selling a "cheaper and just about good enough" pump that only lasted two years, the NGO changed its strategy to promoting a range of different priced pumps with different qualities. The lowest quality pump proved the most popular and, of course, this was the pump of choice for households with the lowest spending power — and the target of the NGO's programme.

What this means for a project investing innovation capacity is that rather than testing out different institutional models — the usual approach of many development projects — the focus of the project should be on experimenting with ways of stimulating institutional innovations and identifying "spontaneous" institutional innovations for up-scaling. The approach also needs to be aware of the fact that these institutional innovations may be changing that bring up-scaling into wider practice either like the Bangladesh case or by changing approaches taken by government schemes.

7. Research Hypothesis on Fodder Innovation

In the initial design of this project a number of stakeholders felt that the project should test two contrasting hypotheses:

1. The entry point for strengthening innovation capacity is new technology — for example, a new fodder variety.
2. The entry point is to create capacities as technological solutions already exist.

These hypotheses would clearly have implications for the choice of case study. Now that the conceptualisation of the project has been more fully elaborated in this paper, these contrasting hypotheses seem less relevant. This is because the research question is now framed as one about capacity and the institutional changes needed to develop this capacity. The Phase 1 project (discussed in part one of this paper) illustrated that with technology as an entry point, institutional changes were required to embed and utilise this knowledge in a system of innovation. The need for institutional change is therefore now a given and this points to the need to take a lead from a diagnosis of gaps in innovation capacity in a particular location and the identification of any positive institutional changes that warrant further development and promotion. This diagnosis will define the entry point. It is anticipated that in some cases it will be technological; in some institutional; and in others a more likely combination of the two.

The word entry point — actually starting point — is important here. The project's conceptualisation predicts that problems will reveal themselves more fully. However, as different capacity gaps are resolved, this, in combination with the changing contexts that interventions are likely to encounter, will lead the project in a different direction. Thus, the initial starting point will have little relevance as an analytical parameter.

Instead, the variable for comparison in the project will be location diversity, as sufficiently generic principles can only be derived by a comparative analysis of approaches to institutional change and capacity development in different contexts. Sulaiman et al (2007), in their development of partner selection criteria for this project, define this diversity in terms of three characteristics: (i) organisational types (public, private, NGO); (ii) fodder regimes (embodies agro-ecological and social diversity); (iii) degree of market integration (covering commercial to subsistence spectrum). They go on to stress that, "There is no indicator of diversity of individual organisations. What is required, however, is that sufficient diversity is created across the selected partners, remembering that the selected partner will form the nucleus of a number of clusters or

coalitions of organisations and individuals around specific innovation themes." Partner selection has been explored in a companion paper (Sulaiman et al., 2007).

The formal hypothesis for this study is as follows:
'Generic principles on how to strengthen fodder innovation capacity can be derived by experimenting and learning from institutional and policy change processes across the local to national levels in India and Nigeria that are inclusive of the livelihood needs of livestock dependant poor people.'

'Fodder innovation capacity will be strengthened when institutional and policy change enable a continuous process of framing and reframing of the way fodder-relevant knowledge is created, diffused, adapted, shared and put into use in ways that are inclusive of the livelihood needs of livestock-dependent poor people.'

8. Measuring innovation capacity development and its value

We have put forward the argument in this paper that a better way to address fodder scarcity than the usual technology transfer approach is to concentrate on building the network of linkages and associated institutional developments needed to enable innovation. Our bigger argument being that if innovation is enabled welfare outcomes will be felt by livestock dependant poor people. We bolster this argument by saying that we are not just going to identify the institutional changes that can enable innovation, but specifically those changes that will make processes and outcome more relevant to the poor. How do we prove that this approach is actually working better than existing alternatives and how do we know when we have "better" innovation capacity? Of course there are huge amounts of well documented empirical evidence that underpin the general principles embodied in interactive approach to innovation that we are adopting and the sort of institutional changes we are seeking to bring about – for example participation, inclusiveness, and so forth. But it is still worthwhile setting out the logic that would create that proof and explaining what that proof would look like.

The counterfactual approach

The term counterfactual is used by economists to mean the outcome of a similar situation without the project intervention. Biological scientists call this a control, and in laboratory experiments it is feasible to create a scientifically convincing design with a without situation. In clinical trials the counterfactual is the double blind placebo. The counterfactual approach to project evaluation was championed, among others, by Gittinger (1982) and his 'with and without' appraisal techniques. The simple logic behind this is that the marginal social and economic benefits of a "with" situation could be compared to those of a "without". Judgments could then be made of the cost/benefit ratio of the intervention.

However, even in a fairly straightforward situation of examining what would have happened with and without, for instance an irrigation scheme, it is extremely difficult to try to control for pre- and post-project conditions in two different locations. Impact assessment of returns to investment in research follows a similar logic. In recent years

the use of such approaches to track the performance of public investments in international agricultural research in rather has been criticised because of their limited contribution to learning how to organise science for better impact (Horton and Mackay 2003; Hall, 2003).

Innovation capacity as a project outcome is even more problematic given the difficulty in setting up reliable counterfactuals that will allow a "with and without" type impact assessment. This is because innovation capacity in any particular location is very much a product of the history, starting conditions and evolution of those conditions over time. In other words it is a classic complex systems phenomenon and, as Ekboir (2002) and others have argued, it would be foolhardy to apply conventional impact assessment approaches.
The counterfactual approach seems to thus present 3 difficulties for measuring and proving the worth of innovation capacity development.

The absence of a parallel universe.
The capacity to bring about fodder innovation in, for instance, Ananthapur, Andhra Pradesh, India in July 2007, has unique characteristics that are related to this place and time and the history, starting conditions and evolution that go with it. Of course one could argue that you could compare the effectiveness of the innovation capacity developed in Ananthapur with a situation in a similar district in Andhra Pradesh. However, the people, the organisations, the administrative traditions and local politics — all key determinants of innovation capacity — would be different. If one was willing to ignore these differences, one could fool oneself into believing that this was a valid comparison. In reality, the only way to get a scientifically valid comparison based on the "with and without" logic is to compare the situation of Ananthapur in July 2007 in a parallel universe where there has been no intervention. As far as the authors are aware, economists have not yet mastered this parallel universe approach, although one could imagine that fiendishly elaborate data intensive simulation modelling might start to address this.

The inappropriateness of comparator metaphors
Even if one chooses to ignore the parallel universe argument, unlike irrigation infrastructure (the classic metaphor for Gittinger's with and without project appraisal approach) the ideas about building innovation capacity by strengthen links and networks will spread beyond and point of intervention. So at best it will be "with" and "with-some". Similarly if one takes the biological research counterfactual metaphor of with a fertiliser treatment and control, the case with building innovation capacity is that the treatment is going to start off as a fairly weak chemical nitrogen fertiliser, increase in strengthen over time and then maybe switch to organic fertilizer when energy price increase because of an unpredicted development in international politics. Obviously this evolving treatments scenario presents all sorts of problems for measuring welfare outcomes of an approach that is based on the idea of nurturing institutional changes in a dynamic environment with strong local to global connections. Again, a sufficiently large sample size and sophisticated modelling approaches may be able to deal with this, but these lay beyond the reach of most of us.

Lagged outcomes from failure-based learning.

Of course we are interested in tangible welfare outcomes of creating capacity and it would be nice to be able to conclusively measure these. But, because institutional change – and thus capacity development -- can occur through failure of activities as well as successes, there can (and usually is) a long lag time before welfare outcomes become apparent. Take for example a project that tries to use participatory plant breeding to improve the nutritive value of crop residues fed to animals. The project produces excellent varieties that farmers and their animals like and which have high nutritive value. But the technology doesn't spread because the scientists didn't work closely enough with companies in the private sector-led seed delivery system. The welfare outcome of the initiative is limited, but the scientists have learnt to work in a different way -- i.e. to include the private sector as well as farmers in their work. This has strengthened the capacity to innovate and will underpin future welfare impacts. This means that conventional approaches will either miss key outcomes as they will be institutional in nature or will a least grossly underestimate changes as these will only be viewed in short term tangible welfare terms. Is this amenable to mathematical modelling? Give enough time and data its not inconceivable that this can be dealt with but, but its not a widely understood approach.

A pragmatic solution – plausible causal connections

Rather than wasting huge amounts of time and resources in trying to construct an elaborate experimental design to test a counterfactual, a more pragmatic approach to assessing the impact of an innovation capacity approach is to devise a way of benchmarking this capacity and monitoring changes in it over time(a before and after comparison). This is really a question of tracking institutional change overtime and relating this change to likely and actual welfare changes. We have typologies of desirable institutional changes. Socioeconomic benchmarking and the qualitative documentation of episodes of institutional and technical change and consequent socio-economic outcomes (episode analysis) would be a way of tackling this (This is discussed in further detail in section three of this paper).

Such an approach relying on multiple sources and types of information can be used to build up plausible causal connections[8] between particular types of institutional change and the welfare impacts that are desired. Discussion with biometricians likens this to the way evidence on climate change has been amassed (pers. Com. Dr Richard Coe). There is no counterfactual for climate change, N=1! Different pieces of evidence have been gathered over time to make the case. Lets just hope that it doesn't take so long to convince people that we need to building innovation capacity rather than carry on transferring technology.

Its easy to understand the discomfort some may have with an approach that focuses on institutional change with welfare impacts lagged and mediated through long term and unpredictable patterns of capacity development. But when it comes to addressing fodder scarcity in a way that could help poor people, what viable alternatives are there? Currently, very few!

[8] I am grateful to Ravi Prabhu for introducing me to this idea.

9. Conclusion

Understanding how to develop fodder innovation capacity requires an analytical framework that can explore the patterns of interaction that lead to innovation and institutional and policy settings that shape this process. The innovation systems framework can guide the exploration of these issues as it gives specific focus to institutional change. This, in turn, raises methodological questions about how institutional change can be tracked during an action research project. The third of these three companion papers will focus on tools for operationalising this research.

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