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Fodder Research Embedded in a System of Innovation

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A 3-year project implemented in India and Nigeria addressed the issue of improving livelihoods of poor livestock keepers by improving availability of fodder. The original approach focused on testing of new crop varieties to be scaled up through partners using mechanisms such as farmer-to-farmer exchange and field days. As the project evolved, it became clearer that the systems were much more complex than originally thought with a wide range of actors involved. Although fodder technology is obviously a requirement to reduce fodder shortages, many of the problems are embedded in the institutions and policies that determine how technology is developed and delivered. To help address these issues, an innovation systems approach is proposed with a focus on building capacity within the system.

Key Words: Innovation, capacity building, actors, fodder, institutions

Introduction

According to the task force on Science, Technology and Innovation commissioned by the UN Millennium Project, strategies to scaling up investments in infrastructure and human capital while promoting gender equality and environmental sustainability are to be in place to eradicate poverty (Millennium Project, 2005). To help construct these strategies, the development process must make way for experimentation and learning largely though local initiatives and partnerships while relying heavily on local ownership and champions to access and use available and new knowledge to improve livelihoods, particularly of the rural poor.

Conventional research may not be adequate to address the constraints and opportunities faced by poor people within an ever-changing socio-economic environment. Production and application of knowledge from research, and how it

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relates to the process of agricultural development and poverty reduction must adapt to the context in which it is required. Availability and the effective use of this sort of knowledge in new ways is important if poverty is to be addressed. This process of how knowledge is produced and used, in this case to help address issues of poverty reduction constitutes innovation.

More than a simple process of transferring knowledge from producer of knowledge to user of knowledge, innovation is a process of interaction and learning where knowledge from a variety of sources is shared and integrated in ways that allow its use in new ways. This broader perspective does not focus on the research component and the associated actors as the centre of a knowledge system, but as a part of a larger and more diverse group of actors in a wider network of constantly changing relationships.

This paper introduces the innovation systems concept and using case studies, both from inside and outside of a DFID funded fodder project, highlights components of the innovation systems framework and draws lessons that help to direct research activities within an innovation systems framework.

Innovation Systems Approach

The Innovation Systems Approach explicitly recognises the wide range of actors – both research and non-research – who are involved in innovation and the context that underpins the way these actors interact. The capacity to innovate and use knowledge productively is therefore a function of patterns of these interactions and the factors – culture and practices – that influence the behaviour of the interacting entities. At the heart of the Innovation Systems Framework is the contention that research and development is always embedded in social, political and institutional contexts and that unless the influence of this environment is accounted for by decision makers, the evaluation and impact of research will be incomplete. (Hall et al, 2000).

Key properties are applicable to agricultural development particularly in the generation and use of knowledge, within which research can be embedded. These key concepts are:

A process orientation

Unlike many of the research and development frameworks that focus on generation of information leading to production outputs, the innovation systems framework focuses on the process of how to generate, disseminate and apply knowledge from a variety of sources in order to achieve beneficial social and economic outcomes. Learning itself is an interactive process of exchanges of knowledge. The greater the number or better quality of the source, the more accessible actors are to relevant knowledge, and the better chance that new

knowledge acquired is translated into action – in other words innovation. How this is done - the process - is important.

Multi-stakeholder involvement

Inclusion of many stakeholders provides a social network that can contribute a wide range of knowledge. Important is sensitivity to the agendas and mechanisms that stimulate innovation through, for instance, policy measures that create incentives for adopting practices – important especially for the poor who have limited access to resources.

Importance of institutions

Within the innovation systems concept, 'organisations' are bodies such as research institutes, cooperatives, NGOs and seed companies, where as 'institutions' are the sets of common habits, routines, practices, rules or laws that regulate the relationships and interactions between individuals and groups (Edquist, 1997). When identifying how things are done, institutional settings play the central role in shaping the process for knowledge sharing.

Adapting to change

As a result of external or internal changes, a successful innovation system allows for access to new knowledge that allows for new ways of doing things to help cope with shocks. This is usually in the form of developing different ways of interacting with others in the system. To help facilitate this process, it is important that mechanisms are in place to allow partners to link with those that could provide the necessary knowledge required in response to any future changes that may affect the way things are done.

Emphasis on capacity development

As mentioned above, the innovation systems concept focuses on the process of change, more than the inputs such as technology needed to bring about change. This has a very important implication, because in terms of intervention it shifts emphasis toward improving processes rather than increasing inputs and is therefore much more concerned with capacity development (Hall, 2005). The logic here being that building the capacity of an innovation system would strengthen both the process by which inputs such as technology are produced and as well as the processes involved in making these inputs available and ensuring that they are used. But capacity development in relationship to innovation does not just mean training – although it includes that. Instead is also places great emphasis on developing networks that support interaction and learning. Equally important is the development of institutional setting - norms that pattern behaviour – that play such an important role in innovation, shaping patterns of interaction and learning.

Experiences Pointing to an Innovations Systems Approach

Following are summaries of cases in which components of an innovation systems perspective can easily be identified. The first two cases are drawn from activities in the DFID-funded Fodder Innovations Project implemented in India and Nigeria that started as fodder technology transfer activities. In both cases, constraints relating to the lack of fodder were first addressed through participatory selection of fodder options that were liked by farmers with an emphasis on genetically improved germplasm. Scaling-up and out of the technologies was envisaged as taking place through farmer to farmer exchange facilitated by development organisations partnering with the project. However, in reality, the processes involved were much more complex and to scale up fodder technologies it was realized that there was a need to understand and identify the range of stakeholders involved in the system and the types and quality of linkages between the actors. Partnerships with a much wider network of actors were important in order for change to take place and the lack of coordination and interaction between them was common in both cases.

The third case illustrates that change is an on-going process that is influenced by both internal and external factors and that the adoption of single interventions are dependant on the environment – economic, social and political in which they are presented. The final case uses the example of a government development scheme, to emphasis the complexity of the system and the difficulty of coordinating interactions between actors, particularly to solve 'second generation' type problems within the systems. It shows how important it is to consider the habits and practices and other institutional factors of all the actors within the system.

Case 1. Groundnut Adoption - requires more than a superior variety

Testing new groundnut varieties in India in the first part of the Fodder Innovations Project confirmed a preference for a new variety ICGV 91114 in on-farm trials resulting in higher yields of both grain and haulm - an important fodder source for livestock keepers in India. Despite the apparent success of the variety, deliberations from a series of individual and group discussions highlighted a number of issues reflecting the complexities involved in scaling up the variety.

While farmers' own saved seed is the primary source in meeting seed requirements, small farmers in particular have serious problems in retaining seed, particularly due to financial problems and debt servicing pressures at the time of harvest. The government is a key player in supplying seed but this is not without problems. Inadequate amounts of seed allocated to farmers, lack of purity in terms of variety supplied and the costs involved in storage and transport due to the bulky nature of pods are just some of the issues that were raised at stakeholder meetings. Other issues pertain to middlemen and traders who supply part of the

seed requirement at the onset of the season and buy-back groundnut at the time of harvest. As well, farmers claim unfair compensation by traders who are perceived to bias transactions when buying or selling seed. Issues also arise from the contrasting preferences of different actors e.g. millers prefer groundnut with higher oil content where as small farmers prefer smaller kernel varieties for their drought tolerance and the ease in which the seed flows during planting with mechanical planters. The interaction and flow of knowledge between each of the actors was found to be somewhat restricted.

From the groundnut experiences, the project concluded that there is a need for interaction in the system where issues could be discussed with a focus on generating new ideas for change, between the various actors i.e. input suppliers, traders and farmers, to help facilitate not only scaling up of improved varieties – assuming that there was a demand indicated by the other actors in the system, but to discuss many other issues that may arise from 'second generation' types of issues resulting from the initial changes due to interventions. Key constraints such as timely availability of seed and assured markets for the farmers must be linked to the needs of other actors in the system such as the traders who need to be assured that the quantity of seed reaching the market is adequate to justify technical and operational modifications. The network of actors that can potentially co-evolve will benefit not only from promotion of knowledge and information flows, but from building their capacities as a result of iterative experiential learning as situations arise. As such, the quality and type of linkages between actors play an important role in providing a platform to interact and learn- an important consideration in this case for scale-up and out.

Case 2. Cowpea in Nigeria – the need to explore new partnerships

In Nigeria, on-farm trials of improved food-feed crops such as the cowpea varieties IT93K-452-1, IT90K-277-2 and IT89KD-288, and groundnut varieties UGA2 and M572-80I stimulated demand over the project period (Annual Report 2004). In the third year of the project the demand for seeds of these improved varieties increased beyond the very limited supply that was available. The main reasons identified for this was due to inadequately small amounts of seed produced by farmers, the inability of the decentralised state government agricultural development projects (ADPs) to (despite the national policies mandating them to do so) adjust their production process to meet the change in demand for seed, and the non-interest of the private seed sector in non-hybrid maize and other crops. Planning and information exchange workshops facilitated by the project exposed that traditionally communication channels have been limited to the benefit of only a few key organizations and individuals. It was clear that there were several other potential communication links that could be explored and that if strengthened would possibly facilitate enhancement of the seed system.

One such link was explored between the farmers and the private seed companies. The seed companies clearly indicated that because of the risks

involved, they were hesitant to produce seeds of new crops. Ninety five percent of the companies' business is related to production and marketing of hybrid maize seeds, which has a large and guaranteed market demand each year. In contrast new cowpea and groundnut varieties did not have a guaranteed market. They are risky to handle since if the new seed varieties could not be sold the following year, storage would reduce viability of the seed making them not saleable. A key component to this risk avoidance behaviour was identified simply as insufficient knowledge about the new varieties and the uncertainty of how they would be accepted within the system. This included: information on demand for the seed and who the clients were, where they were located geographically and the quantities of seed required for the beginning of the planting season.

As a first step to investigate how the knowledge flow could be improved, the project initiated an intervention to explore strengthening the link between the farmers and the seed companies. An agreement was signed between ILRI and a private seed company where in the company would produce a tonne of the new variety of seed and ILRI would absorb the cost of production if the seeds were not sold in the 2006 growing season. Although this was a useful exercise aimed to trigger diversity of commercial seed production, what would enhance the sustainability of the system would be to address the key constraint identified - that is to strengthen the flow of knowledge. Activities to identify mechanisms that could be developed and the processes to use them would contribute significantly to enhancing the capacity of the system to adopt new ideas or approaches to a much greater extent.

Whether private seed companies are interested in production and distribution of non-hybrid seeds of promising technologies in Nigeria is debatable. However, facilitating meetings between the actors did help to provide a platform where interaction and exchange of knowledge helped provide better insights into the system. The joint planning meetings held in the project provided not only reflections on linkages and seed delivery issues, but also uncovered more tacit types of knowledge such as a culture of mutual suspicion between some public institutions and seed companies. If the system is to be strengthened, then issues like these types of habits and perceptions will have to be addressed. How this can be achieved is not only a key consideration, it is an empirical and researchable question.

Case 3. Hybrid maize - a case in change management

In two villages in the Nalgonda district in Andhra Pradesh, India where sorghum has traditionally been a food-feed crop, two improved sorghum varieties CSH 15 and CSH 16 were tested in the first year in on-farm trials at the request of the implementing agencies. Farmers preferred the improved varieties over the local for both grain yield and stover quality. Despite this, there continued to be a gradual increase in the uptake of hybrid maize by farmers working in both rain-

fed and irrigated systems. The increase in the area under maize was mainly at the expense of sorghum, as well as paddy and to some extent cotton.

Change to cope with the change The farming systems in the test villages have been continually evolving as a result of the need to cope with change. For example, in the 1970s the study villages grew predominantly local sorghum, pigeon pea, groundnut and tobacco along with other minor crops like sesame. Tobacco and groundnut were the major source of cash income and rain-fed sorghum followed by white sorghum were the major food-feed crop. Cattle rearing predominantly based on stall-feeding sorghum straw and grazing grasses from fallow lands and village commons was popular. Sorghum grain was the households' staple diet and farmers were able to maintain relatively large herds of buffalo and cattle owing to larger amounts of good quality straw from sorghum. Open wells were the main source of irrigation and a limited number of households grew paddy as part of the farming system. Over the following ten to fifteen years, there was a significant increase in the number of households that had access to bore wells, primarily as a result of government subsidies, resulting in an increase in the area planted under paddy. Also during this period, continuous dry spells resulted in hard soils and difficulty in plucking groundnut at harvest time. At the same time, the government initiated distribution of rice from the Public Distribution System (PDS) resulting in a reduction in demand for the sorghum grain thus a reduced area used for sorghum cultivation.

In the 1990's, cotton prevailed as the major cash crop while paddy straw, pigeon pea and a limited amount of sorghum stover continued to be the major sources of crop residues for cattle feeding. From the late nineties onwards, however, climatic factors such as early/late drought, and excessive rains during harvest have become triggers of change. Another factor included bore holes with inadequate recharge of water at the onset of the planting season and consequently the area under paddy was reduced particularly between the years of 1999 to 2004. It is during this time that farmers increased adoption of hybrid maize serving to some degree as a fodder yielding commercial crop.

In-situ changes in maize growing At the outset, farmers in the area continue to believe that food-feed sorghum stover is an excellent source of cattle feed, both in terms of quality and quantity. Paddy straw was the alternative particularly for those having dairy animals. However, having increasingly adopted maize as a cash crop, it was necessary for farmers to adjust their system and implement practices that would make up for the loss of sorghum fodder. Included in the changes were:

- Increasing the seeding rate by 25 to 50 per cent of the recommended rate. Farmers strongly perceived that increase in density makes the stem of the plant thinner and fodder more palatable to animals without reduction to grain yield or quality. Thick stems lead to more wastage as animals tend to leave the stem portion if too thick after eating only leaf portion.

- In addition to the increased seed rate farmers also realized that harvesting of the maize crop was easier than harvesting sorghum. This had a direct result on reducing the labor demands during harvest, particularly for women.

In-situ changes in cattle herds Farmers responded to changes in the management of the cattle herds as well. Presently the average number of cattle per household is six (across a range of land holding sizes). This is only 75% of what was held prior to 1999. In addition, the majority of the improved buffalo after 2002 were replaced with more efficient cross-bred cows. The replacement of graded buffalos with crossbred cows reduced the demand for feed while at the same time not affecting milk yield.

Multiple service Providers The area is exceptionally well served by service providers from public, private and civil sector actors. The Deccan Development NGO Network (DDNN), a consortium of NGOs working as Project Implementation Agencies (PIA) in watershed development and other agricultural development programs have been active in extension and advisory activities. BAIF, the government veterinary department and the dairy union are actively involved with multiplication and distribution of feed and fodder, as well as providing AI and animal health services. Farmers identified specific actors i.e. their neighboring farmers, retail seed and fertiliser suppliers in the nearby town, NGOs and government personnel in decreasing order of importance as sources of information. Government and private marketing outlets are well connected to local traders so marketing of maize is not a problem. Unlike crops like groundnut pod, the risk of maize spoilage is minimal. Maize seed is less bulky than groundnut, consequently transportation cost is less, and unlike sorghum the market risks associated with grain mold is significantly less.

It is clear that external and internal changes in the system had significant influence on testing the coping strategies for the livelihoods of the farmers despite the perceptions recorded by the farmers about the new sorghum varieties. Although it is uncertain what allowed the farmers (and the associate actors) to adjust to the changes, it is suspected that the ability of the various actors to link to others in the system played a significant role. If the fodder issue is to be better addressed under these changing conditions, then a focus on developing mechanisms to help actors adapt to future changes will have to be considered. A more in depth study of the processes involved in the actors adjusting to change may provide key lessons on how to more effectively respond to change. These types of insights would help to formulate a research methodology to address empirical questions embedded within the System.

Case 4. Velegu Dairy intervention in Adilabad, Andhra Pradesh: a case of multi-agency collaboration for livestock-based livelihood promotion

This case documents the way a rural development project, after choosing livestock as an entry point had to deal with a large number of second generation challenges that arose from this. After having introduced large numbers of high yielding buffaloes, vet services, fodder supply, and credit all became limiting to the effectiveness of the intervention. Although there was no forward planning to cope with these unforeseen difficulties, the project formed partnerships with different government departments and NGO's in order to access the resources and assistance needed to make high yielding buffaloes a viable livelihood option.

The case is of a micro-credit based livelihood promotion project (Velugu Project) implemented in Adilabad district by the govt of Andhra Pradesh. The Project disbursed a total loan of Rs.3.55 crores towards induction of 4000 high yielding buffaloes to promote dairy as a livelihood option for poorest of the poor rural women. As a forward linkage to the intervention, the Project also invested in the installation of Bulk Milk Cooling Units (BMCUs) with a combined capacity of 22,000 litres per day. Chilled milk was sold to a private dairy in Maharashtra on ex-unit basis.

Project Linkages Collaborating with other line departments in the district has been fundamental to the successful implementation of the Project e.g. in order to accommodate the Project's need for a large number of milch animals, the local Animal Husbandry Department (AHD) modified their standard animal purchase procedures to accommodate. They invited approved animal sellers to set up shanties in the villages thereby saving the farmers' travel and transportation costs, and also provided them the advantage of observing the animals in their own setting. Other districts are also following the same purchase system now. To keep the animals productive and in good health, the department supplied medicines through Project funds and health camps were sponsored by another government program. The DRDA ensured the required logistics.

Fodder requirements were addressed through three distinct arrangements - a) By promoting cultivation by individual farmers on 10-15 % of their arable land, b) By forming Common Interest Groups of landless farmers and leasing land from big farmers and soliciting SSG and cowpea seed at subsidised rates from the Project/Bulk Cooler Units, and c) By providing subsidy to 'not-so-poor' farmers with land and irrigation to produce and sell fodder.

The Project provided loans for only one animal and in most cases it was the first/only animal owned by the beneficiary. This resulted in a breeding gap and at present the milk procurement has dropped significantly. Though the Project does not have provision for advancing second loan, almost 70% of the beneficiaries have approached BASIX – a micro-finance company operating in the district -for second animal loans. After loaning BASIX conducts camps in collaboration with the AHD and also provide livestock insurance and healthcare services for a fee. The Project revived the dairy activity as an additional livelihood opportunity for the rural poor. Milk producers were organised to form cooperative societies with

paid secretaries appointed to procure and test the milk, and make payments regularly. The Project hopes to streamline its procurement and has invited the National Dairy Board to provide technical expertise to help set up input delivery and related support systems needed for increasing the procurement. To address the breeding gap, the dairy approached reputed NGOs such as JK Trust and BAIF to make AI services available to the farmers, at their doorsteps.

How Innovation took place The Adilabad Velugu Project initiated dairy activities by providing loans for high yielding animals. Upgraded animals needed better management, i.e., regular healthcare, better/ more nutritive feeding, and also a more reliable market linkage. This led to collaborative arrangements with the AHD for veterinary services, with the district administration to permit use of revenue wastelands, and with NDDB to streamline dairy operations. It is therefore evident that one action (micro-credit) led to a whole series of new problems and the evolving nature of problems generated a new set of partners. These partnerships have resulted in increased accountability on part of some of the partners such as the AHD, whereas association with NDDB might help raise Velugu's credibility in the case of dairy enterprise management. In case of the relationship with BASIX as well as with NDDB, it is evident that the differences in the institutional context need to be managed, and substantial time and resources will have to be invested if they are to contribute to strengthening of the innovation system.

Simultaneous to the micro-credit intervention there was a parallel need to make linkages to organise producers, make services and inputs available and to market the milk. Velugu teams coordinated the inputs of the various agencies involved. The anchoring role played by the Project facilitated convergence between their respective programs and the Project at the implementing level. As Project funds became scarce there was need to source funds from other government programs. Merging of the Project into DRDA in the 4th year thus proved useful at this juncture.

What have we learnt?

Our innovations conceptual framework suggests that it is important to consider the habits and practices and other institutional factors of all the actors within the system. This is clearly so in the groundnut and cowpea cases where it is unlikely that lack of fodder can simply be addressed through farmer participatory selection of fodder options with an emphasis on genetically improved germplasm. Fundamentally the interactions between actors are important. With in the government, linkages based on the hierarchical system function effectively like that of the government officials overseeing the task of seed distribution that entails the role of multiple government functionaries at different levels. However, many of the public sector linkages with smallholder farmers do not function very effectively simply because of the demands on field level actors such as the Agricultural Officers who are under resourced to

adequately address the issues of the vast numbers of farmers. Inadequate attention has been paid to the need for developing and facilitating a forum for small farmers where views and issues can be raised and discussed and knowledge such as market demands can be accessed. As a result, small farmers are less able to interact and provide feedback into the system resulting in a miss-match between the production enhancement strategies of government, and the demands of poor crop-livestock farmers and the market.

The framework also indicates that different types of partnerships are important and that new partners may be necessary for addressing evolving constraints within the system. The intervention that was initiated to create a link directly between the farmers and the private seed producers in the Nigeria shows how an empirical question can be addressed through action research – in this case by providing a monetary incentive to allow the seed company to experiment with a new strategy of multiplying seed of an improved variety that they otherwise would have found to be too risky to provide. Preliminary results indicate that the demand for seed for the 2006 planting season is overwhelming. However, what is important is not the sustainability of such an intervention (this is obviously only a one-off initiative), but the research approach that was used to test new institutional arrangements, and the process involved to establish a new link. Further initiatives following a process approach would focus more on ways of building linkages so that the seed suppliers can respond to changes or opportunities in the future.

Our innovation framework also suggests that being able to adapt or cope with changes is an important feature of a successful innovations system. This is clearly illustrated in the case of maize. Government subsidies for construction of bore wells resulted in an increase in the number of households that had access to water that subsequently resulted in an increase in paddy, and later other interventions such as distribution of rice through the Public Distribution System, and opened the door to adoption of hybrid maize caused a reduction in area for sorghum and availability of sorghum stover traditionally used for livestock fodder. The reduction in available fodder forced farmers to replace their local herds with improved buffalo and later cross-bred cows thus reducing the demand for feed but maintaining the milk yields. Without the ability to adjust to the changing conditions, this transition would not be possible.

Finally the need for emphasis on capacity development is illustrated in our fourth case. The Adilabad Velugu case illustrates just how messy the process of livestock innovation can be. Once one problem is solved new problems reveal themselves. And these are not just technical problems, but often administrative and institutional problems. Developing new partnerships is a good way to deal with this. However one lesson from this case is that the habits and practices or institutional context of some partners makes it difficult, at least initially, to form workable relationships. Institutional change would therefore seem to be an important element of the capacity of groups of partners to innovate.

Clearly there is a much wider range of actors needed to be involved in order for knowledge flow and change to take place. Even if we address a specific problem of introduction of a particular technology (e.g. underwriting seed production) this would not strengthen the capacity of the system as a whole to adopt technologies such as new varieties in the future since the interaction between actors remains unchanged. To do so we have to consider how to address the institutions that make the system more responsive. Can we establish systems by which information on demand is fed back to seed companies – or to the private sector. How can we enlighten, for example the public sector in India to realize that by providing subsidized seed they affect the ability of the system to change.

If mechanisms and associated processes were put in place to provide a forum for such interaction, then there would be an opportunity to interact and benefit from the knowledge of the various actors in the system. A shift towards a focus on the institutional capacity required to facilitate change and create novelty within the system in order to address issues of fodder scarcity would help address development issues and contribute to alleviating poverty. It is clear that the lessons learnt from the project so far highlight the importance of addressing the key components from the innovation systems conceptual framework as a way forward. That is to say:

- Focusing on the process – not what is done but how thing are done
- Involving various actors from a variety of knowledge bases within the system
- Consider institutions - not organisations – as the habits and practices or rules of the game
- Relate ability to cope with change with the ability to access relevant sources of knowledge
- Building capacity within the system is achieved by developing effective networks that support interaction and learning

The implication of these cases is not just that partnerships and linkages can be an essential strategy for coping with an evolving set of problems – although it has been central in moving these examples forward. More importantly, the cases suggest that ways of bringing about innovation needs to be approached experimentally in different locations and that ways of bringing about institutional change need to be found. In each case emergent problems will define how these same problems need to be dealt with and this cannot be predicted in advance. Developing principles about how to bring about change, create innovation capacity and the process of institutional change that supports this could make a valuable contribution to livestock related rural development practice.

Conclusions

The paper shows the complexity of the systems within which research is conducted and supports the supposition that research should be conducted within an innovation systems

framework and a capacity development is the way forward. This project has in fact taken these ideas on board and readjusted its approach by focusing on the actors of the innovation system and directing research toward the processes responsible for influencing institutional change. Research to identify principles on how to build capacity in a fodder innovation system and not just technology per se will be key to helping provide knowledge that will help to improve the livelihoods particularly of the poor.

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