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Participatory Varietal Selection to Multiple Actor Orientation – Case study of groundnut in Anantapur, Andhra Pradesh

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As part of a 3-year project focusing on improving the livelihoods of poor livestock keepers by improving availability of fodder, testing of new groundnut varieties incorporated Participatory Rural Appraisal (PRA), Rapid Rural Appraisal (RRA), Focus Group Discussions (FGDs) and Field Days as platforms of learning. The approaches were limited in attempting to address the complexity of the groundnut system and therefore constraints to uptake of improved varieties continued to be elusive. Evolution of the project approach recognized the potential of multi-stakeholder approaches to take a broader view of how novelty in a system and innovation occur. Interactions between a range of actors including traders, oil-seed merchants, private seed companies, etc. were facilitated and a process of action and reflective learning explored. As a result a new set of constraints and opportunities were identified that prevented innovation related to the use of new groundnut varieties. Documentation and analysis of the type and quality of the linkages between the actors within the system helped to catalogue the process, and the platform created provided the opportunity to learn from each other. Lessons and implications are discussed.

Key words: Actors, linkage, learning, fodder, poverty and innovation.

Introduction

Groundnut (*Arachis hypogaea L.*) haulms are an important fodder for cattle in mixed farming systems in the semi-arid zones of Andhra Pradesh and other states in India. Cattle production in the southwest zone of Andhra Pradesh, which includes Anantapur district, depends on groundnut haulms as the main source of fodder (ISPA 1997). Groundnut is also grown as a food-feed crop in other developing countries

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providing pods for human consumption and haulms for livestock feeding (Larbi *et. al.* 1999; Omokanye et al. 2001). India ranks first in the extent of cultivation of groundnut with 6.7 million hectares followed by China, Nigeria and US, while in total production it stands second with 5 million metric tons trailing behind China, which produces 10 million tons (Talwar, 2004). Across the states in India, Gujarat tops the list with over a million tons closely followed by Tamil Nadu and Andhra Pradesh (AP) with a production of slightly less than million tones (AP Oil Fed., 2005).

Within AP, Anantapur district is the highest producer with 0.28 million tons which is about 34% of the groundnut production in the state. However, in terms of productivity, it is low with 0.27 tons per hectare. The mean rainfall of the district is about 550 mm, which is erratic both in space and time. The monthly potential evapo-transpiration is more than the monthly normal rainfall, which reduces the soil moisture and makes agriculture a risky proposition in the district, year after year (Statistical Abstracts of Andhra Pradesh, 2004).

Results from dual-purpose usage, groundnut crop improvement and livestock nutrition programs of ICRISAT/ILRI have shown that choice of appropriate cultivars could improve the food and fodder situation in mixed crop–livestock systems substantially (Ramakrishna Reddy et al. 2004; Blummel et al., 2005a). Significant differences for organic matter digestibility, organic matter intake and live weight gains were reported in sheep fed with 13 different cultivars of groundnut. There was a three-fold variation in live weights across cultivars. It was concluded from the findings that livestock productivity could be improved substantially through provision of superior dual-purpose cultivars to mixed crop-livestock systems (Vellaikumar *et. al*., 2004) The relationships between haulm fodder quality traits and pod and haulm yields in 860 genotypes suggested that high pod yield and superior haulm quality were compatible traits (Blummel *et. al.,* 2005b). Participatory varietal evaluation trials conducted with nine improved varieties and a local control during 2002 and 2003 rainy seasons in two villages of Anantapur district indicated that of the new varieties, ICGV 91114, gave increased fodder yields of 7.7 and 12% respectively and increased pod yields of 0 and 17% respectively. Other benefits observed included greater disease resistance, shorter maturation times and higher shelling percentage (ICRISAT, 2002-2004; Nigam et al. 2005; SAT Trends, 2005). It is well known that about 70% of rural households in India keep livestock and that income from livestock accounts for 15-40% total farm household incomes (World Bank, 1999). It follows that improved cultivars of groundnut that promise higher yields of pod and haulms are likely to be adopted by farmers as they would be supportive of livestock based livelihoods.

The DFID-supported project *Enhancing livelihoods of poor livestock keepers through increasing use of fodder* started in September 2002 in India. The main objective of the project is to improve livelihoods of poor livestock keepers by increasing the

productivity of their livestock and sustainability of their farming systems through adoption of fodder innovations. In partnership with civil and public sector organisations the project started with diagnostic surveys and Participatory Varietal Selection (PVS) which included focus group discussions followed by Researcher designed farmer managed on-farm trials.

In the initial design of the project, scaling-up of the most promising farm-tested varieties was planned using a transfer of technology mode. However, the constraints for scaling-up became clearer and it was realised that there was a greater need to consider the roles that a broader range of actors play within the local cluster. The paper is an attempt to present the change-of-learning approach adopted by the initiative and is organised into five sections. Section 1 summarises the sample survey on the characterisation of the crop-livestock farming system. Section 2 contains information obtained through PVS and outlines the limitations of the approach. Section 3 is about lessons learnt from a multi-stakeholder workshop that was conducted as preparation for scale-up. Impact pathways for groundnut scale-up based on the Innovation Systems method and approach is presented in Section 4. A strong case for the Innovation Systems approach is presented in Section 5.

Section 1. Diagnostic survey

A sample survey was conducted with 60 farming households participating from three villages in the Uravakonda *mandal* (sub-district) of Anantapur district. The purpose was to understand and characterise the livestock-livelihoods-fodder scenario in a farming systems perspective. Another objective was to explore how far the prevailing crops and cropping systems support the fodder requirement of cattle across different seasons of the year. The three villages of Sivapuram, Veligonda and Yerraborepalli, are representative of several typical features: red loamy soils, predominantly rainfed agriculture, and groundnut based cropping. They also have a majority of poor households.

Farmers were drawn randomly from a stratified sample where caste, land-holding size and access to irrigation water and cattle holding sizes were used as criteria for stratification. Trained field investigators canvassed a structured questionnaire to the respondents, which included both men and women. The sample represents 10% of the households in the three villages.

The survey showed that cattle are kept for multiple purposes: to meet draft requirements of groundnut farming; as a source of cash income by hiring out draft services to others; production of milk for home consumption; to serve banking and insurance functions through sale of animals in times of emergencies such as defraying medical expenses and/ or to tide over the crop failures in droughts. It was also learnt that shortage of fodder is so acute that a majority of farmers, including the poor, buy

crop residues to feed their animals particularly during April and June (Table 1). There was a meagre 0.75 tonne of stall-fed fodder per livestock of which 79% was contributed by groundnut haulm. Seventy percent of the farmers purchased dry fodder and of these two-thirds purchased paddy straw, while the remaining bought groundnut haulms to cope with the shortage of home grown fodder. In addition to being used as a fodder source, paddy straw acts to stabilise the haulms when stacked, as well as a shelter from the rain. The survey indicated that given the low rainfall and virtual mono-cropping of groundnut in Anantapur, an improved variety of groundnut, which can yield more pods and haulms and with higher haulm quality compared to the prevailing local variety, would enhance the livelihoods of crop–livestock farmers.

Table 1. Cattle holding and fodder situations of farmers belonging to various strata with respect to landholding, caste and irrigation (N=60).

Farmer category		No of households	Mean land holding (ha)	**Number of cattle per household (average)	Mean total stall-fed fodder (tonnes)	Groundnut in total stall fed fodder (%)	Purchased fodder (%)	Farmers that purchased fodder (%)
Landholding (ha)	Up to 1	4	0.7	1.3	0.2	95	73.3	50
	1.1 - 2.0	15	1.7	2.2	1.5	91	36.8	73
	2.1 - 4.0	15	3.6	3.2	2.2	88	19	66.7
	4.1 - 8.0	14	6	4	3	78	19.2	64.3
	> 8	12	15.2	6.8	5.1	71	21.2	83.3
Irrigation status	Rainfed	38	5.8	3.3	2.2	81	31.4	81.6
	Irrigated*	22	5.8	5	3.5	80	13.3	72.7
Caste groups	SC[1]	16	2.5	2.7	1.1	94	29.3	62.5
	BC[2]	38	6.1	4.2	2.9	83	22.5	68.4
	OC[3]	6	12.4	5	5.4	69	19.6	100
Overall		60	5.8	3.9	3	79	22.6	70.0

Note: [1]Scheduled Castes (SC) [2] Backward Castes (BC) [3]Other Castes (OC)
** Includes buffaloes and cattle of all age groups
* Indicates only the presence of a well or borehole whose recharge is highly dependent on rainfall

Section 2. Participatory Varietal Selection

In the light of the findings of the survey, focus group discussions were held mainly with farmers practising rainfed agriculture from the three sample villages to elicit relevant options for improving livestock- and fodder-related livelihoods. Farmers

indicated that supply of seed of improved dual-purpose groundnut varieties would be the best-bet solution to address the problems of fodder shortage. Accordingly 75 farmers, the majority smallholder farmers practising rainfed agriculture, were provided with groundnut seeds of ICGV 91114, a variety specially bred by ICRISAT for low rainfall areas. Farmers grew half acre each of the improved and their local variety in a contiguous comparable patch of land. Farmers used their own practices to cultivate both the varieties. Field days conducted just before harvesting and simple household level questionnaires (HLQ) after harvesting were used as learning platforms to see how farmers perceived the performance of the new variety.

Test farmers and visiting farmers at the field day ranked the test cultivar superior to their local counterpart based on their own criteria (Table 2). Analysis of the questionnaires provided a similar picture.

Table 2. Ranking of the two groundnut varieties by farmers[1] (N=45)

Farmer identified traits	Indicators spelt out by farmers	Test cultivar (ICGV 91114)	Control (TMV 2)
Flowering performance	By 40 days, uniformly thick yellow coloured flowers which do not turn red or fall off	8	4
Heavy pods	Heaviness of pods signifying kernels inside	8	5
Rounded heavy kernel	Not misshapen, shrivelled or shrunken	6	5
Taste of kernel	Tasty and not bitter	7	7
Branches and leaves	More branches and dark green leaves without pests	9	6
Empty pods	Not more than 5%	9	4
Pests and diseases	Should be free from *aggitegulu* and *gudamategulu* (Sclerotia rot)	8	7
Duration of crop	Less than 90 days	8	6
Pods per plant	Not less than 25 pods	8	5
Height of plants	About a foot height, not more and not less	5	6
	Total Score	76	55
	Rank	1	2

[1] Scored on a scale of 1 to 10, with from worst (1) to best (10) in 2004

Section 3. Preparations for scale-up

A multi-stakeholder workshop was conducted in the district to streamline and organise the scale up and scale out of the improved cultivar of the groundnut that were tested in the participatory varietal selection studies. Participants included representatives from government departments, public and private seed sector companies, NGOs, researchers, representatives of Krishi Vigyan Kendra (KVK) and other civil sector actors including farmers from the project villages.

The workshop highlighted the fact that seed systems, formal or informal, are not yet in place to adequately support the envisaged scale-up. While farmers' own saved seed was the primary source in meeting seed requirements, smallholder farmers in particular have serious problems in retaining seed, owing to financial problems and debt servicing pressures at the time of harvest. Fear of spoilage of seed during storage (6-7 months) is another challenge in maintaining seed sustainability. The government is a key player in seed supply but government supplies are fraught with problems such as restrictions of seed per farmer (only 120 kg), lack of purity in terms of variety supplied and enormous expenditure involved in logistics due to the bulky nature of pods. Other problems pertain to middlemen and traders who supply part of the seed requirement at the onset of the season and procure groundnut at the harvest time as well. Farmers perceive that the traders are unfair in weighing, pricing and quality-related aspects at both buying and selling stages. The contrasting preferences of different actors is also problematic; for example, millers prefer groundnut with higher oil content as against the smallholder farmers' preference for smaller kernel varieties because of their drought tolerance.

The workshop deliberations were an eye opener, in that the project learned that scale-up of a new technology cannot be taken for granted. Instead it has to ensure certain processes in terms of actors and factors that may be within or outside the control of a research initiative such as improved groundnut germplasm. The project then felt the need for a more comprehensive learning approach that is not merely preoccupied with the demand aspects at the farmers' level but with the mandates and needs of all the concerned actors at supply, demand, trade and other support services.

Section 4. Analysis of the Groundnut Innovation System

The Innovation Systems Analysis (ISA) was built up in a series of key informant interviews with different actors and resulted in actor analysis, actor linkage analysis and problem analysis broadly following the tools of Actor Linkage Matrix (ALM) developed by Biggs and Matsaert (2004) and RAAKS or the Rapid (or Relaxed) Appraisal of Agricultural Knowledge Systems developed by Engel and Salomon (1997). The information base for the ISA comprised individual interviews; group discussions with public sector personnel from the AP Oil Federation and the Department of Agriculture; discussions with private sector actors such as three millers, two decorticating unit owners, one trade intermediary (Siddeswar & Co.,

Anantapur) and two village level traders; and 40 farmers from two villages, Sivapuram and West Narasapuram. The actors' views were also captured in a multi stakeholder workshop where the project personnel facilitated the actors to air their views on problems and opportunities in groundnut-based livelihoods.

Actors in the groundnut system

Actors represent public, private and civil sectors as well as Members of the Legislative Assembly (MLA) and Members of Parliament (MP) and the Press (Table 3). Apart from farmers, who are the principal stakeholders, the other actors include the district administration represented by the Collector and a number functionaries working at the district and sub-district level; the AP Oil Federation and two other seed distribution agencies; the Joint Director of Agriculture and his team; and a vast chain of private sector traders dealing with chemicals, procurement and sale of groundnut. A leading NGO, Rural Development Trust Accion Fraterna (RDT-AF) with its network of functionaries across the district is also closely involved with improving groundnut-based livelihoods.

Table 3. Broad categories of actors related to groundnut and their mandates.

Actors	Mandate/mission
Smallholder farmers	To make a living from groundnut, wage labour and livestock
Medium and large-scale farmers	To make a living from diversified farm and non-farm sources such as services and business
District administration	Preparing overall plan and implementing it, with focus on seed distribution
AP Oil Federation	Mainly concerned with groundnut seed distribution for rainy season; seed procurement and formulation of minimum support price
Department of Agriculture (Joint Director and others)	Assisting the government with seed distribution; providing technical advice and extension to farmers; implementing other agricultural programs in the district
DWMA (District Water Management Association)	Developing watersheds, enhancing productivity of agriculture and enhancing income from livelihoods
Private dealers of seed, fertilizer, pesticide and agricultural implements	To provide support services, extension, counselling; also often to provide credit
Wholesale traders from Tamil Nadu and other states	To buy groundnut on large scale as pod/kernel
Local and intermediary traders	To procure at the village level and sell to decorticating units/ millers/exporters
Credit institutions	To provide timely credit to farmers

RDT-AF and other NGOs	Watershed development, technical advice and crop demonstrations

Actor linkages

Strength of linkage indicates how well an actor is connected with others. Strong linkages are those that facilitate and enable actors to communicate and work together and may involve exchange of resources such as information, labour or other materials that promote goodwill. By and large, the actors within the government framework are well connected. These are formal, hierarchal-oriented linkages as in the case of District Collector with the AP Oil Federation, the Department of Agriculture and the *mandal* (sub-district) level staff. These linkages reflect the hierarchical, functional relations that ensure a unified line of command. These are very effective in ensuring functions such as seed distribution, which have to be executed with strict deadlines to ensure delivery in time. However, when it comes to linkages with smallholder farmers, the public sector actors in general do not have strong linkages. The Agricultural Officer who is concerned with technical advice and extension does not have adequate linkages with farmers. Apparently this is due to inadequate outreach given the vast number of farmers and their spatial spread. However, the weaker interactions and linkages are also due to ineffective institutional arrangements in the form of formalised forum where farmers would get a chance to air their problems, views and perceptions. Traders associated with sale of fertilizers and pesticides – dealers and retailers –have strong linkages with farmers and vice versa. Farmers often seek technical advice from them. While functioning as an important source for communication and extension, these input suppliers operate at different levels in league with the village level traders who procure groundnut. Between these actors they also offer credit to farmers. However, strong linkages do not necessarily mean a win-win situation. Credit, material supplies, technical advice and procurement of groundnut get interlinked often to the greatest disadvantage of smallholder farmers. This is where the institutional and policy matters need to be looked to for improving the innovation process.

Linkages between traders and government are weak and almost non-existent. There is no formal regulative mechanism at the market level and no regulated market exists for groundnut kernels at Anantapur. As a result, traders rule the roost and exploit farmers in pricing and in weighing the produce. Linkages among smallholder farmers are strong but are limited to informal interactions. Formalised interactions at the level of village organisation or watershed association leading to the interface with the government or trade related actors are non-existent.

Prime mover hexagram

Prime mover or stakeholder analysis indicates which actor(s) have more power or are more influential in driving change for better or worse. Coalitions are usually seen around actors with influence. A prime mover hexagram was developed through

facilitation of a group of actors, which included personnel from the AP Oil Federation, Department of Agriculture, private traders and farmers. These respondents first identified the actors and scored the influence of individual actors on a scale of 1 to 10 (Figure 1). Subsequently the actors were grouped on a functional basis and a score was assigned to the group.

Market related actors (mainly those from the neighbouring state of Tamil Nadu) who buy the bulk of groundnut from Anantapur have the greatest influence. They operate through a long chain of village level traders, brokers, commission agents, decorticating unit owners etc. The other lead actors are government agencies like AP Oil Federation and District administration that are associated with subsidised seed supply. Large-scale farmers, associated with trade, credit and political power – are also lead players. Research and extension do not play a dominant role. The smallholder farmers who are perhaps most important from the development and equity point of view are obviously the least powerful. The village organisations and watershed associations are not influential enough to effectively access and establish links to alternative, and in some cases more appropriate services to meet their needs.

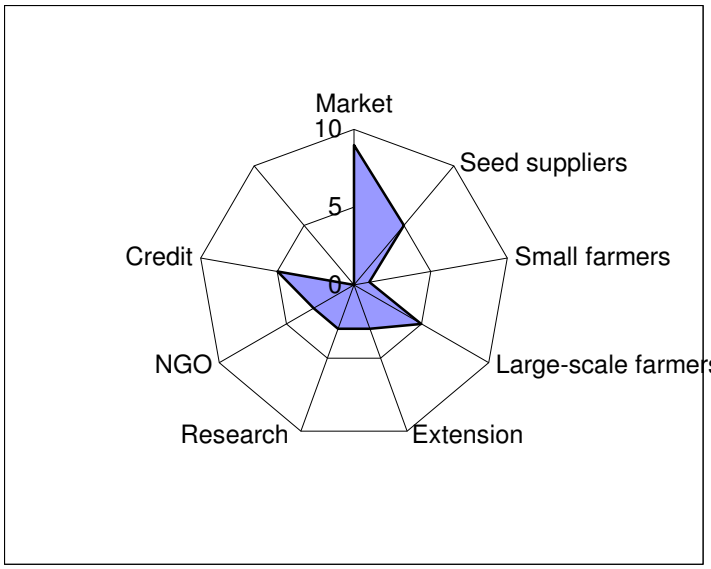

Figure 1. Prime mover hexagram

Actor-factor interactions and problem analysis

Farmers and other actors representing input suppliers, technical advice and trade separately listed and ranked the problems from their viewpoint and subsequently ranked them as one group and discussed the actor-factor interactions for each issue. The results of this analysis included overall ranking of the problems, the importance

of the concerned actors in addressing those problems and the factors responsible for the problems (Table 4).

Next to drought, the absence of organised market yards seemed to be the major problem. Other trade-related issues are allied to this problem. The presence of a yard would facilitate constituting a marketing committee manned by all the stakeholders; putting in place a framework of rules related to buyers and sellers; making available required physical infrastructure; making arrangements for scrupulous weighing and measurements; instituting and implementing price premiums and penalties vis-à-vis quality of groundnut; widely communicating and displaying information on market intelligence.

The problem of overemphasis on subsidised seed supply, according to the actors themselves, is due to populist policies. Instead of indiscriminate increasing the quantities of subsidised seed supply, the government decision should be based on objective estimations with special reference to prevalence of drought in the previous season, which is an important criteria for assessment for the seed requirement

Table 4. Problem Ranking along with factors and actors concerned[1]

External factors			**Internal factors**	**Problems**	**Actors**							
Weather/Climate	**Policy**	**Market**			**Government**	**Collector**	**AP Oil Fed.**	**Dept of Agriculture**	**Press**	**NGO**	**MLA/MP**	**CBO**
+				1. Drought								
	+ +	+ + +		2. No regulated market	+ +	+ +	+				+	
		+ + +	+ +	3. Announcement of minimum support price (MSP) is delayed by several weeks		+	+ + +					
		+ + +		4. Traders do not pay price premiums		+						

	+++		++	5. Farmers poorly informed on market information	+							
	+++			6. Credit from non-exploitative sources unavailable		++				+		++
				7. Over emphasis on seed distribution	+++	++			+		+++	
			++	8. Timely advice on pest management				+++		+		++
				9.Spoilage of seed at storage								

[1]Number of '+' markings indicate extent of responsibility.

In general farmers save seed for the next season. However, debt burden and fear of spoilage of seed force them to do away with saving part of the crop for seed. Similarly farmers who grow groundnut on leased lands may not save seed because of the uncertainties regarding future lease agreements. In any case, many concerned actors suggested a drastic reduction of the quantity of subsidised seed supplied to about 20% or 10% of the present supplies depending on the prevalence of drought in the previous season. The actors felt that overemphasis on seed distribution not only drains the resources, which otherwise could have been used for organising more effective support services, such as pest management, but in fact increases the pest menace as farmers use greater quantities of seed brought from outside. By taking into account the processes that can be controlled by researchers and those that cannot – the orientation of research towards impact is improved.

Configuration of the groundnut innovation system

Configuration refers to a particular arrangement of actors. The groundnut Innovation System in Anantapur reflects collective competence, not individual. While actors are inter-dependent, they are also guided by their own objectives, which might be complementary or competitive with other actors. Well-coordinated services resource coalition available in the Anantapur system where the District Collector oversees the seed distribution led by the AP Oil Federation, personnel of district administration and those of the Agriculture Department deployed for the purpose. Personnel from different disciplines share the objectives and tasks, execute activities and achieve outputs as laid out in the circular specially issued for the purpose by the District Collector. The standardisation of norms helps effective coordination of this time bound activity. Strong political will is another facilitating factor. However the present government dominated seed supply has not been sensitive to the varietal requirements of farmers in different agro ecological contexts within Ananthapur district besides being a deterrent to entry of private sector in to this area. It would

therefore augur well to have a public-private-civil sector partnership based arrangement for the seed supply. It is now for the actors themselves to enhance the resource coalition, convergence and coordinating mechanisms to address other problems of trade, pest management at farm level, credit, seed storage etc. An organised, regulated market may be the mechanism to bring about public-private partnership by way of improving the innovation performance and by having market committees manning all the concerned actors such as farmers, traders, government personnel and NGO/CBO representatives. The policy makers (actors by themselves) might put in place the necessary conditions to improve the innovation process. The non-actors, the students of innovation system, may, however facilitate the actors to try and design the way they can act and interact to this end. This may mean a series of changes at different levels.

Section 5. Implications for Research

The change in the learning approach from farmer participatory varietal selection and a farmer-biased survey to a multi-stakeholder perspective is instructive. The learning approach has important implications for scale-up of the improved groundnut technology on the one hand and on the research process *per se*, on the other. The spread of innovation from farmer to farmer, community to community, from village to village is referred to as scale out. The concept has geographical and spatial connotations. The term scale-up, however, pertains to the institutional expansion from grassroots organisations to policy makers, donors, development institutions, and other stakeholders and arrangements, which are key to supporting and building an enabling environment for change. Both scale-up and scale out are inter-related because as a change spreads further geographically, the greater the chances of influencing those at higher levels, and vice versa, that as one reaches higher institutional levels then the chances for horizontal spread increase. The scale-up approach predicates that solutions to complex problems cannot be solved on-station only but need to be built up *in situ* in farmers' fields, taking full advantage of farmer's knowledge and innovative abilities. Farmers usually make certain changes in their own systems to adapt to new technological interventions and similarly modify technology packages to adapt them to their systems (Douthwaite *et. Al.* 2003b). Also implicit in the concept of scale-up is that technological change is brought about by the formation and actions of networks of stakeholders/actors. The actors may belong to the public sector (government/ banks), private sector (seed companies or private individuals/money lenders/traders) and/or the civil sector (NGO/CBO). So whatever *in situ* modifications and improvisations farmers achieve on the best-bet technologies provided to them have to be understood in the light of the processes. In doing this, the researcher or the development practitioner will be able to target other new areas where the farmers' innovations can be introduced. In other words scale up replicates the social and organisational processes associated with technical change rather than technology *per* se. Appreciating farmers' adaptations in

the light of associated processes is also required to be supportive of farmers and to create an enabling environment.

By implication this means that on-farm trials are not one-off attempts to validate station-bred technologies but are to be taken as learning grounds that provide space for farmers to construct their technologies in the 'learning-by-doing' mode. Farmers also communicate what they learnt to other farmers with whom they share or pass on the seeds or planting material. The resource endowment, agro-ecological context in which farmers live and the linkages with other actors dictate the type of adaptations farmers make before a large-scale adoption of technologies takes place. For example, in the context of the groundnut variety in Anantapur, farmers' perceptions and ranking of the improved variety are based on just one season's experience on 0.2 ha of land. With a majority of farmers having more than 2 ha, there is a need for more iterative experiential learning between and among the input suppliers, traders, farmers and others before the change to the improved variety takes place. In the first place farmers should be convinced on the availability of seed in time and that traders will pay well for the improved variety when produced in larger quantities. The traders, on their part, need to be ensured that quantity of the improved kernel reaching the market is large enough for them to make necessary modifications in their machinery like sieve sizes etc. The way out of this 'tautological' situation is that linkages among actors are enhanced to provide for knowledge and information flows. Innovation is created within a network of actors that co-evolve with the technologies they generate (Nelson 1993; OECD 1999; Rycroft and Kash 1999). The co-evolution occurs as a result of iterative experiential learning between the actors involved (Rosenberg 1982) that is intrinsically random (Kauffman 1995). Fostering scaling out and up is best done by first identifying who the key stakeholders are – the people who will ultimately benefit from the innovations and the people responsible for their promulgation – and then working with these stakeholders in a participatory way to encourage them to take over ownership. If this happens then the key stakeholders will tend to promote it to each other and lobby for political support for the work, even if there are setbacks and funding cuts. Successful innovations result from strong interactions and knowledge flows within these networks (Douthwaite *et. al.* 2003a).

Of late, research funders have been asking for more concrete evidence of the impacts of agricultural research. Their concern is reflected in the term 'impact orientation', a normative concept that is being increasingly used to characterise an organisation that has managed to achieve outcomes and impacts and not mere outputs (GTZ 2000; Smith and Sutherland 2002). Hence impact orientation refers to client-oriented research methods, responsiveness and linkages to farmers and other stakeholders in pursuit of the development goals (Springer-Heinz et al. 2003). The impact pathway so built is unlikely to comprise a single chain of events leading, in a deterministic mode, to the inevitable impact. Instead, the pathway will simulate multiple chains of events with 'influencing and dependent' events occurring with certain probabilities

underlying the uncertainties and risks. In other words there would be social and organisational processes associated with each stage – from activities through outputs, outcome and impact – each of which entail the next stage only after satisfying 'if-then' conditions. Similarly while there are factors that are controlled by activities, actions planned and implemented, there are also factors that are outside the control of the plan-act arena of any research/development initiative. These could be climatic, market-related aspects or policy changes. They might influence the planned initiative either positively or negatively. Therefore an impact orientation for the organisation concerned is an imperative to take into its stride the host of events required to be facilitated, monitored and measured. More important than using the pathway as a road map for monitoring the progress, it should be seen as a tacit knowledge management tool which is built by reconstructing the reality proactively. It would help in accounting for the smaller bits of 'change' that are likely to occur due to the actor-factor interaction processes at each stage. Building such a plausible bridge at the beginning of the project will help identify scale-up and out pathways and predict the likelihood of the success of the project.

In the PVS and technology transfer mode the ex-ante analysis of farmers' context (captured through surveys, focus group discussions and on-farm trials) was considered adequate for the scale-up of the test variety. However in the real world situation it was not to be. There were no suitable seed systems in the district to backstop the scale-up process. Presently the produce of farmers is being recycled for seed and no certified seed development process has been initiated. The seed spoilage problems of smallholder farmers have to be addressed to ensure the sustainability of groundnut farming and trade regulations have to be in place so that farmers get their due in the market. The Innovation Systems framework of analysis brought out many issues pertaining to the groundnut Innovation System while the PVS approaches highlighted the importance of germplasm at the neglect of others. The next step is to explore ways of building the capacity of the system so that it is better able to access and adapt new technology. This may mean facilitating new coalitions of actors that formerly did not interact; building capacity of individuals and organisations to understand the nature of the problems faced beyond the technological problem.

The importance of recognising the existence of the large number of actors involved in technology development, adaptation, transfer and use is drawing attention at present as is the need to promote better information flow among them to improve the performance of the wider innovation system. The current interest in trying to understand the innovation systems around particular technical interventions emerges from the work of a number of scholars. Notable among them are the Agricultural Knowledge and Information System (AKIS) ideas proposed by Roling (1994); Multiple Sources of Innovation model of agricultural research and technology promotion by Biggs (1990) and the National Systems of Innovation approaches articulated by Freeman (1987) and Lundvall (1992). One of the major contributions of

the Innovation Systems Framework (ISF) is that it explicitly recognises the wide range of actors – both research and non-research – who are involved in innovation and the institutional context that underpins the way these actors interact. The ISF also emphasizes the importance of linkages, partnerships, alliances or coalition among the various actors, the value of technological and institutional innovations and the role of learning in promoting better innovation systems (Hall *et. al*., 2000).

References

AP Oil Federation Limited. 2005. *Groundnut Crop: Tips for improving Productivity;* Report from the Managing Director, A P Oil Federation. Basheerbagh, Hyderabad, India.

Biggs, S. and **Matseart, H.** 2004. Strengthening poverty reduction programmes using an actor-oriented approach: Examples from Natural Resources Innovation Systems. *AgREN Network Paper No. 134*. ODI Agricultural and Research Network.

Biggs, S. 1990. A multiple source of Innovation Model of Agricultural Research and Technology Promotion. *World development.* Vol. 18(11):1481-1499.

Blummel, M., Ramakrishna Reddy, Ch., Ravi, D., Nigam, S.N. and **Upadhyaya, H.D.** 2005a. Food-fodder traits in Groundnut. *International Arachis Newsletter*. Vol. 25: 52-54.

Blummel, M., Vellaikumar, S., Devulapalli, R., Nigam, S.N., Upadhyaya, H.D. and **Khan, A.** 2005b. Preliminary observations on livestock productivity in sheep fed exclusively on haulms from eleven cultivars of groundnut. *International Arachis Newsletter.* Vol. 25:54 –57.

Douthwaite, B., Kubyb, T., Elske van de Fliertc. and **Steffen, S**. 2003a. Impact pathway evaluation: an approach for achieving and attributing impact in complex systems. *Agricultural Systems*, 78:243-265

Douthwaite, B., Delve, R., Ekboir, J. and **Twomlow, S.** 2003b. Contending with complexity: The role of evaluation in implementing sustainable natural resource management. *International Journal of Agricultural Sustainability*. Vol. 1(1): 51-66.

Engel, P.G.H. and **Solomon, M.L.** 1997. *Networking for innovation: A participatory actor-oriented methodology*. Royal Tropical Institute: The Netherlands.

Freeman, C. 1987. *Technology and Economic performance: Lessons from Japan*. London, UK: Pinter.

G.T.Z. 2000. *ECART/ASARECA/CTA workshop on impact assessment of agricultural research in Eastern and Central Africa*, Entebbe, Uganda. 16-19 November 1999. Eschborn, Germany.

Hall, A.J., Clark, N.G., Sulaiman, R.V., Sivamohan, M.V.K. and **Yoganand, B.** 2000. New agendas for agricultural research in developing countries: Policy analysis and institutional implications. *Knowledge, Policy and Technology*, Vol. 13:70–91.

ICRISAT. 2002-2004. *Program for farmer participatory improvement of grain legumes in rain fed Asia.* Progress Reports: IFAD Technical Assistance Grant No. 532, ICRISAT. Patancheru, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. (Limited distribution).

ISPA. 1997. *Livestock feeding situation in Andhra Pradesh – options for improvement*. Indo-Swiss Project, Andhra Pradesh. VBRI premises, Shantinagar, Hyderabad, India.

Kaufman, S. 1995. *At home in the universe: The search for the laws of self-organization and complexity*. New York: Oxford University Press.

Labri, A., Dung, D.D., Olorunju, P.E., Smith, J.W., Tanko, R.J., Muhammad, I.R. and **Adekunle, I.O.** 1999. Groundnut (*Arachis hypogea*) for food and fodder in crop-livestock systems: Forage and seed yields, chemical composition and rumen degradation of leaf and stem fractions of 38 cultivars. *Animal Feed Science and Technology*. Vol. 77:33 - 47.

Lundvall, B.A. (ed.). 1992. *National systems of innovation and interactive learning*. London, UK: Pinter. 161 pp.

Nelson, R. (ed.). 1993. *National innovation system: A comparative analysis*. New York: Oxford University Press.

Nigam, S.N., Aruna, R., Yadagiri, D., Reddy, T.Y., Subramanyam, K., Reddy, B.R.R. and **Kareem, K.A. 2005.** Farmer Participatory Varietal selection in Groundnut – A success story in Ananthapur, Andhra Pradesh, India. *International Arachis Newsletter,* Vol. 25: 13-15.

OECD. 1999. *Managing national innovation systems*. Paris: OECD.

Omokanye, A.T., Onifade, O.S., Olorunju, P.E., Adamu, A.M., Tanko, R.J. and **Balogun, R.O.** 2001. The evaluation of dual-purpose groundnut varieties for fodder and seed production in Shika, Nigeria. *Journal of Agricultural Science*. Vol. 136:75 - 79.

Ramakrishnareddy, Ch., Ravi, D., Nigam, S.N., Upadhyay, H.N. and **Blummel, M.** 2004. Observations on food and fodder traits in a wide range of cultivars of groundnut. *In New dimensions of animal feeding to sustain development and competitiveness*; Proceedings of V Biennial Conference of Animal Nutrition Association. NIAN&P, Bangalore.

Roling, N. 1994. *Agricultural knowledge and information systems*. Pages 56-67 *in*

Extension handbook: Processes and practices (Blackburn D, ed.). Toronto, Canada. Thompson Educational Publishing.

Rosenberg, N. 1982. *Inside the block box: Technology and Economics*. Cambridge: Cambridge University Press.

Rycroft, R.W. and **Kash, D.E.** 1999. *The complexity challenge: Technological innovation for the 21st century*. Science, Technology and the International Political Economy series. New York: Cassell.

SAT Trends. 2005. ICGV-91114: a winner in Anantapur. SAT Trends-ICRISAT monthly e-news letter, 60. (http://www.icrisat.org/satrends/Nov2005/Nov2005.htm)

Smith, D.R. and **Sutherland, A.** 2002. *Institutionalising impact orientation: Building a performance management approach that enhances the impact orientation of research organization*. Natural Resources Institute: Catham, UK.

Springer-Heinze, A., Hartwich, F., Henderson, J.S., Horton, D. and **Minde, I.** 2003. Impact pathway analysis: An approach to strengthening the impact orientation of agricultural research. *Agricultural Systems*. Vol. 78: 267-285.

Statistical Abstracts of Andhra Pradesh. 2004**.** Table- 4.11-Oil seeds: area and out-turn, district-wise, 2002-03. *Directorate of Economics and Statistics*, government of Andhra Pradesh, Hyderabad

Talwar, S. 2004. *Peanut in India: History, Production and Utilization; Peanut in local and global food systems series, Report No. 5*. Department of Anthropology, University of Georgia.

Vellaikumar, S., Waliar, F., Nigam, S.N., Upadhyay, H.N. and Blummel, M. 2004. Effects of cultivars-dependant groundnut haulms on live weight gain and Nitrogen retention. In '*New dimensions of Animal Feeding to Sustain Development and Competitiveness'*, Proceedings of V Biennial Conference of Animal Nutrition Association held at NIAN&P, Bangalore

World Bank. 1999. *India livestock sector review: Enhancing growth and development*. The World Bank, Washington DC.