Paper presented at Innovation Africa Symposium 20th-23rd November 2006 Kampala, Uganda

Scale-Up of Napier Fodder
A Case Of Institutional Innovation In Small Farmer Dairying

VL Prasad[1], PG Bezkorowajnyj[2], K Gurava Reddy[1], VK Mahesh[3] and D Romney[4]

[1]International Crops Research in Semi-Arid Tropics, Patancheru, India
[2]International Livestock Research Institute, Patancheru, India
[3] National Dairy Development Board, Vijayawada, AP, India
[4]Formerly International Livestock Research Institute, currently CABI-Africa Nairobi, Kenya

Abstract

Based on a formal diagnostic survey and subsequent focus group discussions (FGD) with farmers an improved variety of hybrid Napier sourced from the Agricultural university was provided to select farmers as part of a 3-year project aiming at enhancing the livelihoods of poor livestock keepers by improving availability of fodder. The original assumption was that the recipient farmers would demonstrate the improved fodder technology and share the planting material with other farmers. However, in practice an institutional innovation in the form of a fodder market emerged between resource farmers and other small farmers and the landless. Seller farmers, buyer farmers and the milk union anchored the scale-up of Napier because it addressed their interests and needs. The paper discusses the importance of coalitions of actors in generation and application of knowledge towards enhancement of livelihoods and poverty reduction.

The background

In India where the bulk of the livestock are in the holdings of small and marginal farmers having less than 2 hectares of land, livestock development offers a potential pathway out of poverty (Birthal and Singh, 1995; Birthal et al. 2002). Feed is singularly the most important constraint in smallholder dairy (World Bank, 1999). With less than 3% of livestock feed coming from grains and concentrates (Tikku, 2002) fodder becomes increasingly important (National commission on farmers, 2004). Fodder is sourced in a variety of ways and includes material collected or grazed from own or communal land, crop residues and planted fodder. Many of these resources are sold to farmers or exchanged for goods and/or services. Crop residues are the mainstay for livestock feeding in India (Parthasarathy Rao et al 2004) and planted fodder less common, although over 25% of farmers in irrigated tracts of coastal Andhra Pradesh in south India feed green grass cultivated traditionally (Subrahmanyam et al.1995).

The DFID-supported Fodder Innovation Project (FIP) started in September 2002 in India with the aim of improving livelihoods of poor livestock keepers by increasing the productivity of their livestock and sustainability of their farming systems through

adoption of fodder technologies. In the early stages participatory varietal selection trials were implemented to test a range of fodders in the field with the assumption that promising varieties would diffuse through farmer-to-farmer exchange and the efforts of partners running the trials in the field. However, the project gradually realized that the original farmer focused approach did not allow consideration of the constraints to wide-scale adoption, many of which were determined by the behavior and influence of other actors in the system (Prasad etal.2006). The project concluded that fodder constraints of poor livestock keepers are embedded in a complex system and therefore generation of knowledge and applying solutions to solve some of the constraints requires more than just technical interventions (Bezkorowajnyj et al 2006a; 2006b).

In 2004 the project embarked on a series of activities in which the focus switched to building alliances with partners to capitalize on some of their on-going activities and contribute by introducing learning activities that allowed both project and partners to reflect on ways of doing things. The project considered a range of different options including the potential of planted fodders to contribute to dairy production where farmers had access to irrigation. Activities commenced in the coastal district of Krishna district in Andhra Pradesh in South India, named after the river Krishna and well known for fertile soils and crop agriculture and for smallholder dairying based on buffalos. Upland areas cover about half of the District and represent a rain shadow region that has been reeling under drought for the last 5-6 years (Andhra Pradesh Drought report, 2002; World bank, 2005). Climatic vagaries after 1999 resulted in severe depletion of water in major, medium irrigation reservoirs and minor irrigation sources in the upland villages and have led to a shortage of fodder that is severely affecting livelihoods of small dairy producers. Exacerbating the problem is the replacement of sunhemp (*Crotalaria juncea*) and pillipesara (*Phaseolus trilocus*), which were grown by small farmers on residual moisture after paddy harvesting, with commercial crops like black gram (*Vigna mungo*) the residue of which is not fed to cattle (Situational Analysis, 2004). Only large farmers with ensured supplementary irrigation are in a position to take up planted forages for feeding buffalos. With common grazing areas having drastically declined in the District small farmers and the landless have no other alternative left than buying green fodder from other farmers.

The project partnered with the Dairy Union in Krishna and national dairy development Board (NDDB), a parastatal that supports cooperative dairy activities in India. Organized Dairying modeled on the ANAND pattern co-operative structure was initiated in the District in 1981 with the formation of the Krishna Milk Union. The Dairy has 510 organized dairy co-operative Societies with over 100,000 member producers spread across 800 villages in both upland and delta areas (Krishna Milk Union, 2005). Initially the Project along with the Union and NDDB staff visited the villages of upland Krishna and held discussions with the farmers on the feed and fodder constraints of small dairy producers. As a result 15 villages were selected to work closely with the Union and the project on crop-livestock livelihoods. The criterion for selecting the villages was the presence of significant numbers of farmers practicing dairy with land holdings of only 1-2 ha, considered as 'small' farmers in Indian context (Birthal and Parthasarathy Rao 2002)

This paper presents the cultivated fodder market in upland Krishna district as an institutional innovation observed in an activity involving FIP, NDDB, Dairy Union and the farmers who are members of primary dairy cooperative societies in the District. Presented in three sections the paper argues that as actors see clear benefits they become creative in finding new ways of doing things that contribute to scaling up even though not originally planned. Section I deals with a diagnostic survey and Focus group Discussions (FGD) and section II with the on-farm trials of hybrid Napier. The lessons, implications and conclusions are presented in section III.

Section I

Diagnostic Survey

A sample survey of 49 farming households from three representative villages from among the 15 selected - Kothagudem, velagaleru and Chinnagiripalli was conducted to characterize the livestock-livelihoods-fodder scenario in a farming systems perspective to assist in identifying the constraints and opportunities. To explore how far the prevailing crops and cropping systems are supportive of the fodder requirement of cattle across different seasons of the year was another objective of the study. The three villages were considered by Union staff familiar with the area to be typical of the diversifying crop, livestock and off-farm based livelihoods in a partly irrigated agriculture scenario. Paddy along with mango and many other cash crops are grown by a vast majority of the households. The villages are also known for dairying and the dairy societies are well linked to Krishna union. Farmers were drawn from a stratified sample where caste group, land-holding size and access to irrigation water were used as criteria for stratification. Trained field investigators administered a structured questionnaire schedule to 49 respondents that represented 3 % of the households in the three villages.

The majority of households across all land holding categories hold livestock and buffalo for milk production. There is a diversified cropping pattern with paddy, Pigeon pea, black gram, cotton and horticultural crops like Mango along with many other minor crops. Dry fodder fed to animals is invariably the rice straw. In addition, farmers feed rice bran, dairy concentrate and coconut cake to the buffalos. Though no regression analysis was done to establish the causality, households with access to cultivated green fodder were associated with 59% more milk production annually compared to others. In particular, those with a supplementary irrigation source accessing cultivated green fodder produced 72% more milk than households that depend on canal irrigation, which was available for only for kharif season. The cultivated green fodders included para grass, hybrid Napier (co 1), sweet sudan grass, *Pilli pesara* (Phaseolus trilocus) and to a limited extent Guinea grass (Table 1).

Table 1. Landholding, cattle holding and milk production of sampled households N= 49

Strata of farmers according to		No of households	Mean landholding (ha)	Mean cattle holding per household [6]	Mean stall-fed dry fodder[7] (tons/ LSU)	Mean annual milk production per household (liters)	
						With access to cultivated green fodder[4]	With out access to cultivated green fodder [4]
Landholding (ha)[5]	No land	3	0.00	3.67	0.23	NA	807
	Up to 1	21	0.64	4.71	0.64	2776	981
	1.1 - 2.0	12	1.56	5.08	0.80	1992	1952
	2.1 - 4.0	9	3.04	6.22	0.87	1615	2002
	4.1 - 8.0	4	6.07	5.25	1.13	1952	1477
Irrigation status	Canal irrigation only	13	1.2	4.85	0.62	1306	1407
	Canal +supplemental irrigation[8]	33	1.9	5.14	0.88	2262	1314
Caste groups	SC[1]	6	0.45	3.00	0.38	1197	904
	BC[2]	24	1.97	6.04	0.98	2484	1781
	OC[3]	19	1.87	4.47	0.65	1594	1245
Overall		49	1.71	5.06	0.75	2147	1353

Note: [1]Scheduled Castes (SC) [2]Backward Castes (BC) [3]Other Castes (OC)
[4] refers to farm-grown, purchased or grown on leased-in land
[5] broadly following Indian classification of land holding
[6]Includes buffaloes and cattle of all age groups
[7]Livestock Units (LSU) derived by giving weightage of 1.5 to graded buffalo, 1 to other adult animals and 0.5 to calves
[8]Indicates only the availability of the source while the recharge is uncertain and erratic

Eliciting Best-bet option

Thirty farmers (including 10 women) from two villages, Chinnagiripalli and Kotha gudem, who had experience with different planted forages, evaluated the fodders using their own criteria. The objective of this exercise was to arrive at the best-bet option with regard to cultivated forages. Two facilitators assisted farmers with large brown sheets and markers for performing the exercise. To start with farmers were encouraged to list criteria for a good fodder crop. Accordingly, after a thorough discussion, they identified 11 criteria, 6 related to crop characteristics and 5 to the animal response. Criteria were ranked and animal health, milk yield and milk fat % were considered as the three most important criteria for ranking fodders. Farmers selected 7 fodders with which they were

familiar and compared them on the basis of the eleven criteria, scoring on a scale of 1 to 10, with 10 as best and 1for the lowest. The results are presented in table 2.

Table 2. Scoring of different cultivated fodders varieties by farmers (N=30) [1]

Criteria/Crops	paragrass (Bracheria mutica)	Stylo Stylosanthes hamata)	Hybrid Napier[2]	Johnsons grass (Sorghum halepense L)	Hybrid Sorghum Sudan Grass	*Pillipesara* (Vigna trylobytus)	Sunhemp (Crotalaria) juncea
Positive Impact on Animal health (1)	7	8	9	7	8	6	8
Milk yield (2)	5	10	8	4	7	5	10
Impact on milk fat% enhancement (3)	7	8	6	4	6	3	8
Low Cutting interval of biomass (4)	6	4	8	4	6	2	2
Low Water requirement (4)	4	8	6	5	4	9	9
Acceptability (5)	4	8	9	6	7	6	8
Tillering (6)	6	9	10	5	7	7	5
Forage crop height (6)	4	3	10	8	10	3	7
Seed germination (6)	4	4	7	4	8	4	9
Impact on Calf growth (7)	4	7	8	6	8	7	6
Perennial nature (8)	9	10	10	6	7	4	4
Total Score	**60**	**79**	**91**	**59**	**78**	**56**	**76**
Overall Rank	**5**	**2**	**1**	**6**	**3**	**7**	**4**

[1]Figures in parenthesis in first column indicate the rank of the criteria
[2] Hybrid Napier referred to was the Co 1 variety with which farmers are familiar for over 10 years

The numbers in parenthesis indicate the rank given to different criteria in order of Priority by the framers. While different fodders have been shown to differ from one another on the basis of individual criteria the overall rating was done by the farmers keeping in view both the quality and yield potential of fodder. Accordingly Hybrid Napier, Stylo and Sudan Sorghum grass have been ranked 1, 2 and 3 respectively.

Section II

Demonstration trials with Improved fodder germplasm

The survey and FGD with farmers on potential options were supportive of the work already undertaken by the union on the introduction of improved variety of hybrid Napier. The Dairy union had been distributing the improved Napier germplasm from 2001 across the District with the objective of promoting the livelihoods of small dairy farmers with access to irrigation at least for some part of the year. However, the project

and the union felt that it would be better to organise a demonstration in a group of close-knit villages in upland Krishna so that impact would be more tangible and monitoring further scale-up would be easier for the field staff. Accordingly the Union sourced planting material of an improved cultivar of hybrid Napier called CO3 from an Agricultural university to organise a demonstration trial in the Project villages. One hundred farmers from the 15 villages who had not only ensured irrigation status but showed interest and aptitude to grow planted forages and demonstrate to others were selected. Planting material adequate for an area of 200m^2 and a loan of Rupees 500 were given to each of the selected farmers. The loan was provided by the union at the request of the farmers to defray part of the land preparation and fencing costs, which were estimated at Rs 1000 for 200 sq m area. Dairy union field supervisors working in the 15 demonstration villages were trained by FIP project staff on the trial layout and in eliciting information from the farmers through open-ended communication. The dairy union insisted that farmers who were provided with the improved germplasm had to part with the first cut/harvest to supply planting materials to other farmers free of cost. The demo farmers have been specially instructed not to harvest the crop before 60 days with the idea that the resulting Napier slips would be fit for replanting. In practice it worked well and in about 3 months of time the recipient farmers shared the planting material with many other farmers who, in turn, have been instructed to use 2-node slips for re-planting with one node below the ground and one node above.

Fodder market Arrangements

The original objective of the demonstration of Napier was the propagation of improved germplasm as an intervention in the context of dairy farmers having irrigation facilities. However it was found that some farmers, in addition to feeding Napier to their animals started leasing out small areas of land with Napier to others. Because of high demand the buyer-seller interface became well established in terms of price of fodder and mutual responsibilities. It was negotiated that buyers would pay Rs 300 for the fresh grass harvested from each area of one cent (40 sq. m) for a period of one year. Seller farmers allowed the buyers to pay the lease amount in two instalments but within 6 months from the start of the agreement. The lease arrangements also specified clearly the responsibilities, in that, the buyer would use his/her own labour for harvesting and application of fertilizer and would purchase the fertilizer. The seller would make available a supply of water and a standing crop of Napier while labour needed to use the water to irrigate the crop is also the buyer's duty. As is typical of the land-market transactions in the countryside in India, the terms of the lease remain verbal but honoured in detail.

Monitoring Scale-up of Napier

The Project monitored the scale-up along with NDDB and the field staff of Dairy Union till September 2006. The field staff of the Union reported the uptake of Napier in terms of number of villages, crop areas, and numbers of sellers and buyers twice in each year to NDDB. Apart from the field reporting NDDB visited different villages at random across

23 mandals (sub-district administrative units) in 2006 July-August to gather views of contact farmers as a way of ground-truthing. Apart from this, perceptions and practices of the farmers were captured in a series of Focus Group Discussions (FGD) in nine of the Project villages both 2005 and 2006 led by both Project and NDDB personnel. The villages are: Agiripally, Chinnagiripally, Chevutur, Nunna, Velvedam, Kothagudem, G. Kondur Musthabad and velagaleru. Fifteen to twenty farmers participated in each of these villages which included both seller and buyer farmers. On two occasions in 2006, FGDs were conducted separately for buyers and sellers in Velvedam and Chevutur to appreciate the perspectives of the two groups. A broad framework of questions which included the roles of different farmers in evolving the lease arrangements, approximate quantities of feeds fed to buffalos and costs of cultivation of different cash crops, served as a guide for the conduct of FGDs. However in practice farmers were allowed to take the lead during discussions. The NDDB and the Union staff associated with Napier trial attended four action-learning workshops of 2-days each during 2004-05 conducted by the project where the status and the process aspect of scale up were discussed and documented. While the staff of NDDB and the Dairy union knew about the fodder marketing, it was only in these meetings they realized that fodder marketing was the adaptation responsible for the adoption of Napier. Accordingly the monitoring in the field focussed on the factors that helped the Napier growers and buyers continue with lease arrangements rather than on the biological aspects of the germplasm or on mere increase in numbers of farmers.

Supply of Napier slips by the Union

Apart from the materials spread by demonstration farmers in 15 Project villages the Union on its own supplied over 100, 000 Napier slips each year in August –September from 2001 onwards. While the distribution of slips was done across the District along the milk routes no records have been kept of the recipient farmers or the names of the villages. It is likely that the scale-up of Napier reported in the study was achieved by a combination of the spread from demonstration farmers and that of other farmers receiving germplasm from the Union before and during the period of study.

Scale-up of Napier

The 100 farmers originally supported by the Project and the milk union, supplied the germplasm to about 1000 farmers in as short a period as 3 months time in 100 villages. The trained field staff, with the help of demonstration farmers kept track of the names of the villages and farmers that obtained the germplasm from the demonstration. Subsequently individual records have not been kept but by 2005 June the supervisory staff of Dairy union reported that 1000 farmers in 250 villages have grown Napier in over 100 hectares and sold the fodder to 5000 farmers and by the end of 2005 another 2000 farmers from 130 more villages have been reported to have adopted the fodder crop. By June 2006 a total of 15000 farmers have been buying the fodder from 3000 farmers across 374 villages on the basis of annual lease agreement. The seller farmers have, on average, kept 10-15% of the Napier area for feeding their own stock and leased out the rest to others (Figure 1). Of the 15000 buyer farmers some previously bought para grass

and other fodders available in the market. However, leasing–in land exclusively for green fodder and accessing fodder on day-to-day basis as took place in the case of Napier did not happen in the past. The worsened drought situation that increased the demand for fodder coupled with increased losses incurred by mango and cotton farmers during the last few years was responsible for more farmers resorting to Napier. Resource farmers realized that both agronomic and market risks are far less in Napier compared with the alternative irrigated crops.

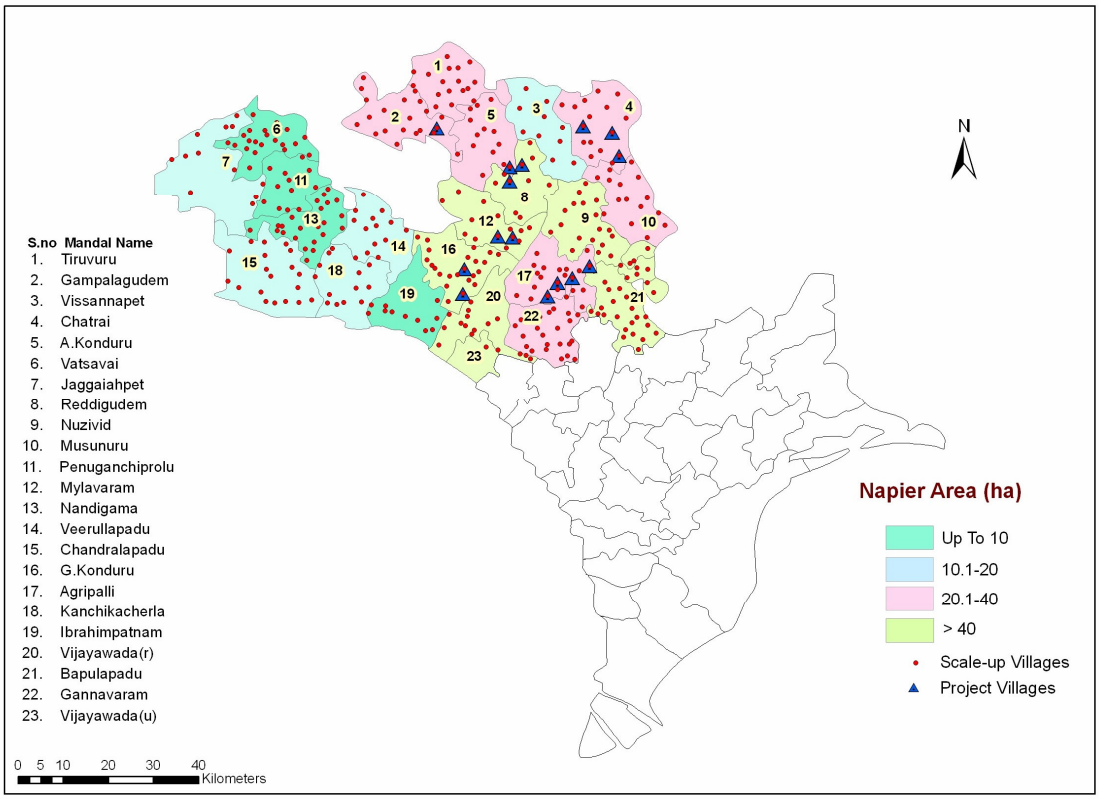
The reported scale-up is the combined effect of the regular supply of germplasm by the union and that of the demonstration farmers. As no records were kept of villages or farmers catered to by the routine supply firm conclusions cannot be drawn. However, it was noted that the mandals with larger areas of Napier grown and greater numbers of buyer farmers occurred around the demonstration villages suggesting that the demonstration activities did have a positive impact on the scale-up. Scale-up started with farmers who were growing to feed their animals. Subsequently a limited number of resource farmers allowed wage labourers working with them to harvest the surplus on payment. For this the lobourers paid the prevailing market price of green fodder to the farmers. Thanks to protracted droughts and the consequent increase in the demand for fodder the Napier market evolved to current levels. In other words the initial uptake of the Napier by the resource farmers was to promote their dairying enterprise in the light of uncertain cotton and mango markets. Subsequent scale-up of Napier took place when resource farmers started to view Napier as an alternative to other prevailing cash crops, selling the fodder to other farmers. The buyer farmers included small farmers having about ½ -1 hectare of land and the landless. Farmers who are members of milk society and acquired access to Napier grass through market arrangements reported in the study represent 15% of the total members, which might increase with time.

How did the scale-up of Napier come about?

Buyers' side of the story

An FGD with 20 buyer farmers who completed one lactation of Napier feeding was conducted in September 2006 in the village called Velvedam, which is one of the demonstration villages. The farmers were asked to indicate the change in feeding strategy and performance of the buffalos on Napier feeding. Farmers indicated that Napier harvested from 200 m^2 is adequate for one buffalo and would not like to feed more than that. According to farmers they arrived at this opinion by taking into account the milk yield, milk fat percentage and the relative prices of other feed ingredients. Also farmers felt higher amounts of Napier feeding would result in an unpleasant taste of milk which might be objectionable for both home consumption and for the market. Napier Farmers previously bought rice straw harvested from 0.8 hectare to feed one lactating buffalo for a period of one year. When Napier from their 200 m^2 plot was available the paddy straw requirement reduced to half the amount. The other change in the feeding pertained to concentrate feeds.

Figure 1. Scale-up of Napier fodder in the upland Krishna District



With Napier feeding the amount of rice bran and the dairy concentrate supplied by the Union did not change but the farmers no longer need to feed expensive protein concentrate like coconut cake. All the Napier users reported an increase in milk production of about a liter per day. Farmers clearly indicated the cost of feeding remained more or less same with and with out Napier but that the major benefit was the increased milk production of over 200 liters per buffalo in a year. Farmers were also convinced that Napier feeding was helpful in maintaining a high concentration of fat in the milk which was very important when the milk pricing was based on fat and SNF (solids not fat). The change in feeding strategy and the approximate costs involved are presented in table 3.

Farmers indicated they achieved the best Napier yields during April-June while yields were relatively lower in November-January due to frost. Farmers increased the harvesting frequency compared to the recommended, favoring the fodder quality over quantity. The harvesting intervals are adjusted to achieve or control stem thickness keeping below a thickness beyond which fodder would not be eaten by the buffalo. For this reason farmers often prefer harvesting intervals of less than 3-weeks. Farmers indicated that the total fresh fodder harvested annually from 200 m^2 area would be at least 6 tons. However

those with sandy loamy type of soils harvest fodder every two weeks and their yields are much more than 6 tons. Also, farmers indicated that harvesting of 6-7 Napier plants along with tillers daily would provide enough fodder for one buffalo.

Table 3. Feeding strategy and milk yield for one buffalo with and with out Napier[1,2,3]

	Napier (200 m^2)	No Napier	Napier (200 m^2)	No Napier
Rice bran (kg)	400	400	2800	2800
Cattle feed (kg)	240	200	1200	1100
Coconut cake (kg)	0	50		650
Napier (tonnes)	6.0	0	1550[3]	0
Paddy straw (tonnes)	1.25	2.5	1000	2000
Total feed cost (Rupees)			6550	6550
Milk yield (liters)	1520	1300		
Market value of milk (Rupees)			18240	15600

[1]Based on FGD on 25/9/06with 20 farmers who completed one lactation on Napier feeding

[2] Market prices for feeds and milk current at the time of the FGD

[3] Includes cost of leasing-in plus purchase of approx. 8 kg urea

Sellers Perspective

It was evident from the field reporting on scale-up that not only the number of seller farmers increased over a 2-year period but the areas grown by individual sellers increased. Sellers indicated that they were responding to the increased demand for more fodder from the old buyers and the prospective buyers as well. Their major motivation was that income from Napier was 55% and 230% more than that of mango and cotton respectively, which are the two popular cash crops in the area. Growing *Leucana Leucocephala* for the paper pulp industry is another lucrative activity the upland villages are known for. The returns on *Leucana* are very much comparable to Napier but farmers have to wait for 4 years before harvesting the crop for the paper industry. The differential in income apart, the market risks associated with mango and cotton are far higher than Napier. Fencing (Rs 29,000/ha) and planting material (Rs 2,500/ha) are one time costs while irrigation is the only recurring cost (Rs 5000/ha) for the sellers of Napier. By implication this would mean the longer they continue leasing out for Napier year after year, the more profitable it would be for the sellers. To this end the sellers were trying to satisfy the buyers in getting the best out of the lease arrangement. The same logic would explain why seller farmers were responding readily to demands for increased frequency of irrigation by buyers, particularly in the summer.

Dairy Union

The dairy union apart from distributing Napier slips organized disbursement of loans of Rs 500 to any farmer who grew Napier to sell to other farmers. Apart from this, the Primary Dairy Cooperative Society in a village called Nunna at the instance of the Union, leased in 1.25 hectares from two farmers, established a Napier crop and then leased out the land to over 50 small dairy producers. The lease costs at Rs 300/ 40 m^2/ year have been discounted by the society from the milk sales of the respective dairy farmers on a fortnightly basis.

Section III

Lessons from Napier Case

In the present context all three parties – buyer farmers, seller farmers and the milk union stand to gain from the Napier scale-up. The buyer farmers, who would otherwise have to buy more expensive concentrate feed and/or more paddy straw, benefit from the reduced cost of milk production and are able to take advantage of higher production and producer price particularly in summer months. For the seller farmers the income from Napier compares very well with the alternatives like cotton and mango. The milk union not only found a way out to address the demands from producers but the increased milk production is likely to improve capacity utilization of the dairy plant, making it a more viable enterprise. Small farmers who buy Napier are also happy about Union supplying slips of improved Napier variety to seller farmers as it improves their relation with them through the market arrangement. The actors have so far addressed their self-interests and specific agendas in making the Napier market a reality on the ground. Biggs and Smith (1998) argue that the emergence of a particular technology depends not only on its scientific merits but on the actions of what they term 'development coalitions'- loose groupings of actors who combine their resources to push for a particular path of technical change.

The institutional innovation in the form of fodder market through lease arrangement between selling and buying farmers was not only the driving factor for scale-up of Napier it also ensured that the innovation remained pro-small farmer. In other words it influenced the 'Reach' of the technical innovation. 'Reach', defined by the evaluation unit of International development Research Centre (IDRC) refers to the 'the groups that are touched by the results of a program' (Earl et al, 2001). In the present study, thanks to the institutional arrangements, 15,000 landless and small producers sourced green fodder, which otherwise would have been the preserve of the 3000 resource farmers. The fodder market that emerged was a negotiated arrangement among actors who by themselves decided the terms of the lease and day-to-day management of the harvesting. In these

ways farmers generated and used knowledge, and were constantly experimenting to manage risks and improve their operations.

Based on the analysis of 12 case studies Biggs et al (2005) proposed that institutional innovations always arise from the local context and that local actors and coalitions find new ways to adapt and change the old and new technologies and institutions. Douthwaite et al. 2003 distinguishes such innovation as different from in *situ* adaptations of introduced technologies. The implication is that local institutional innovations are the basis for the way actual scaling up processes takes place. The Napier market, which was responsible for the scaling up, was not in the original plan. It was due to the 'opportunistic' behaviour of farmers. It is therefore, an opportunity driven innovation rather than an orchestrated innovation (ARD, 2006). National commission on farmers (2004) noted that absence of an organized market for bulk quantities of fodder grass has been a significant deterrent to widespread commercial cultivation of fodder crops

Implications and Conclusions

The Krishna Milk Union which was founded in 1964 and considered as one of the successful dairies in India has been experiencing policy pressures to become more and more competitive. De-licensing of dairy industry from 1991 and subsequent liberalization brought in large-scale private sector players. Further, the new cooperative act of 1995 removed subsidies and other supports from the government. Also the increasing pressure from cooperative members to increase milk price has become a force to reckon with. Given these problems the Union is increasing efforts to facilitate members by helping them reduce costs of milk production rather than increasing producer prices of milk. By organizing support services that improve dairy production and profits at farm level the union will enjoy the confidence and trust of the members and build social capital which is important for integrating the primary societies with the district union. There is a good reason for the union to forge linkages with producers and get to know more about them and others by way of building functional coalitions. The Napier fodder story appears to confirm that as there can never be a final solution to natural resource problems, evolving ecological and socio-economic systems will continue to require changes in action plans and long-term goals. Within the community there will be distinct groups with each group having its own interests, objectives, values and aspirations. When such groups come together to anchor a support service with self-interest, the activity acquires a stand alone character and entail win-win relation ships.

The case also demonstrates that technology alone is not enough to provide solutions to complex problems. New institutions or ways of doing things that might involve changing the way in which different actors interact can be essential for technology to be actually used for economic advantage. Research organisations might conclude from this that an action research methodology for knowledge generation and application within an innovation systems framework will better address researchable issues to help improve the livelihoods. Within an innovation systems framework, understanding the roles of multiple actors and interactions between them, together with the habits, practices and incentives that drive those interactions is implicit. Identifying and engaging with those

actors to seek joint solutions rather than, for example, working with one category of farmers only is likely to lead to more effective research outputs.

Acknowledgements. This report is an output of a research project funded by the UK Department For International Development (DFID) for the benefit of developing countries. The views expressed are not necessarily those of DFID. The Project is a part of the CGIAR system-wide Livestock program (SLP).

References

Andhra Pradesh Drought Report 2002. A report on Management of Drought. Department of Drought Management. Government of Andhra Pradesh. India

ARD. 2006. Enhancing Agricultural Innovation: How to Go Beyond the Strengthening of Research Systems International Bank for Reconstruction and development/The World Bank. Washington DC

Bezkorowajnyj, P.G., Prasad, V.L., Dhamankar, M., Roothaert, R.L., Olufajo, O.O.,and Romney, D. 2006a. Fodder Research Embedded In A System Of Innovation. Paper presented at the International Conference on Social Science Perspectives in Agricultural Research and Development, February 15-18, 2006, Indian Council of Agricultural Research, and New Delhi

Bezkorowajnyj, P.G., Prasad, V.L., Ravinder Reddy, Ch., Reddy, K.G Hanson, J., and Romney, D. 2006b. Embedding Fodder Research In A System Of Innovation, Case Studies From India. Proceedings of the International Conference on Livestock Services Enhancing Rural Development, Beijing, China, 16 -22 April 2006. p.315

Biggs, S. D. and G. Smith. 1998. Beyond Methodologies: Coalition-Building for Participatory Technology Development. World Development. vol. 26, pp. 239-248.

Biggs, S. D., Gurung, S. M. and Messerschmidt, D. 2005. An Exploratory Study of Gender, Social Inclusion and Empowerment through Development Groups and Group-Based Organisations in Nepal: Building on the Positive. Report submitted to the Gender and Social Exclusion Assessment (GSEA) Study, National Planning Commission, World Bank and DFID, Kathmandu (Version 2, March 2005).

Birthal, P.S and Singh, M.K. 1995. Structure of Rural Income Inequality: a study of Western Uttar Pradesh. Indian journal of agricultural Economics, vol 30(2): 168-175

Birthal, P.S. Joshi, P.K. and Parthasarathy Rao. 2002. Vertical integration in Agriculture Sector Studies: dairy, poultry and fruits and vegetables. Paper presented at

the workshop on Agricultural diversification in South Asia, jointly organized by RGOB, MOA, ICAR, IFPRI, 21-23 November 2002, Paro, Bhutan.

.

Earl, S., Carden, F. and Smutylo, T.2001. Outcome Mapping. Building Learning and reflection into development Programs. International development research center (IDRC).Ottawa, Canada.

Krishna Milk Union. 2005. Back ground Document of Krishna Mutually Aided Dairy Primary Cooperative Societies Limited. pp55. Vijayawada. AP.

National Commission on Farmers. 2004 Serving Farmers And Saving Farming. *Jai Kisan*: A Draft National Policy For Farmers. Fourth Report. Government of India. New Delhi pp 433

Parthasarathy Rao, P., Birthal, P.S., Dharmendra, K., Wickramaratne, S.H.G., Shrestha, H.R., 2004. Increasing livestock productivity in mixed crop-livestock systems in South Asia. Project report. National Centre for Agricultural Economics and Policy Research & ICRISAT (International Crops Research Institute for the Semi-Arid Tropics), Patancheru, India.

Prasad, V.L., Bezkorowajnyj, P.G., Nigam, S.N., Hanson, J., and Romney, D.2006. Participatory Varietal Selection to Multiple Actor Orientation – Case study of groundnut in Anantapur, Andhra Pradesh. Paper presented at the International Conference on Social Science Perspectives in Agricultural Research and Development, February 15-18, 2006, Indian Council of Agricultural Research, and New Dehi. India.

Situational Analysis.2004. A study done by NDDB, Vijayawada in representative villages of Krishna District. NDDB, Vijayawada (Unpublished).

Subrahmanyam, S. Jagadeswar Rao, M.Ratnam,C. and Nageswar Rao,R. 1995. Bovine development in Andhra Pradesh, an analysis of regional variations. Centre for Economic and social studies and Indo-Swiss project Andhra Pradesh. Hyderabad.

Tikku, D. 2002. Indian dairy farming: evolving a sustainable model. Indian Dairyman, 54(11), 28-31

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

World bank. 2005. Drought in Andhra Pradesh. Long term impacts and adaptation strategies. Volume 1. Main report.pp 77. South asia Environment and social Development Department, World Bank.