



Technology is essential but not sufficient for its adoption evidence from fodder Innovation Project

S V N RAO¹, K NATCHIMUTHU², S RAMKUMAR³, V RASHEED SULAIMAN⁴ and RANJITHA PUSKUR⁵

Rajiv Gandhi Institute of Veterinary Education and Research, Puducherry 605 009 India

Received: 6 February 2013; Accepted: 18 July 2014

ABSTRACT

The aim of the paper is to better understand how various social and policy issues constrain the adoption of innovations among dairy farmers and presents the observations of the relationship between the adoption of green fodder feeding to dairy cattle and marketing of milk in Puducherry. Though there are some isolated successes of promoting fodder entrepreneurs by the development departments in Puducherry, these approaches could not be sustained due to lack of complementary or supportive institutional arrangements. Adoption of an innovation (fodder transaction) is more constrained by social, economic and policy issues, which include transportation of fodder, relations between the fodder growers, buyers, secretary, Milk Cooperative Society, leaders of Women Self Help Groups, government policy on milk pricing, urbanization and, industrialization, rather than technological issues. The insights offered in this paper could be useful in the design of policies to address complex economic and social issues associated with fodder usage by the dairy farmers in general and landless dairy farmers in particular.

Key words: Adoption, Evidence, Fodder Innovation Project, Technology

Technology generation and its use by farmers is *sine qua non* for global agricultural development. It is well known that there is a huge gap between the technology generated and used (Rao *et al.* 1992). This gap is usually attributed to the ignorance of farmers and/or poor performance of extension agency. Of late, it is very well realized that technology *per se* is not scale-neutral and every technology has limitations. This realization led to the inclusion of farmers in all the stages of technology generation, testing, refinement, and use in agriculturally developed countries (van den ban and Hawkins 1996) and the same is being experimented in India by various agencies. For instance the Indian Council of Agricultural Research (ICAR) modified the mandate of Krishi Vigyan Kendras (KVK) to include on-farm testing, refining and documenting of technologies in collaboration with the researchers and extension personnel.

In many countries low agricultural production has been attributed to ineffective technology delivery system, including poor information packaging, inadequate systems and poor methodologies (Del Castello and Braun 2006). Rogers (2003) explained that the technology with relative

advantages, simple to understand and use and compatible with the local values, beliefs and situation has high rate of adoption. The spread of one particular innovation was often embodied in an input that has a complementary relationship to other inputs. Technical complementary is a stronger concept than compatibility (Feder *et al.* 1985).

Now it is increasingly realized that technology as such is not an issue but the way it is positioned, reinvented and commercialized to suit to the local situation and organize various input support required for its adoption and extension policy need to go beyond transfer of technology (Sulaiman and Hall 2003). Several approaches (RRA, problem identification, analysis and solutions, transect analysis, factors influencing technologies) were tried in transferring livestock production technologies in selected locations in India (Singh and Schiere 1995). These experiments proved that innovative methods/ processes to introduce a technology are more important than the technology itself. In this context an action research project was undertaken with feeding green fodder as a technology to improve the livelihoods of the dairy cattle dependent poor people in Puducherry and the lessons learnt are presented in this paper. This may help the researchers and extension practitioners in learning from our experiences thereby refining their approaches or *modus operandi* in planning and implementing similar projects.

MATERIALS AND METHODS

The project, 'Enhancing livelihoods of livestock dependent poor people through increasing use of fodder

Present address: ¹Professor and Head (svnrao1953@gmail.com), ²Associate Professor, Veterinary and Animal Husbandry Extension Education (natchimuthuka@gmail.com), RIVER, Kurumbapet, Puducherry. ³Director (Entrepreneurship) KVASU, Waynad, Kerala (suku.ramkumar@gmail.com). ⁴Director, CRISP, Banjara Hills, Hyderabad (rasheed.sulaiman@gmail.com). ⁵Senior Scientist, Policy, Economics and Social Science, WorldFish, Penang, Malaysia (r.puskur@cgiar.org).

commonly termed as Fodder Innovation Project (FIP-II)', in participation with International Livestock Research Institute (ILRI) and the United Nations University—Maastricht Economic and Social Research Institute on Innovation and Technology and (UNU-merit) at RIVER, Puducherry: The project is aimed to address the question of fodder shortage not from the perspective of information and technological scarcity in fodder production, but from that of capacity scarcity in relation to bringing about technical and other changes in fodder usage practices — this is referred to as fodder innovation (Hall *et al.* 2007). The project understands innovation capacity to be a function of the networks of different players related to livestock fodder and their collective capacity to bring new ideas into use.

Action research characterized by cyclic, participative, qualitative and reflective processes (Kemmis and McTaggart 1988) were used to address the issue of fodder scarcity in Puducherry region. In a significant departure from the traditional perspective, the FIP looked at capacity scarcity in relation to bringing about technical and other changes in fodder practices, and explored ways of strengthening this capacity to increase the use of green fodder and help enhance the livelihoods of livestock dependant poor people. The entire processes and various steps the stakeholders have gone through under this project with lessons learnt are discussed in the subsequent sections.

Context: Cattle rearing is an important occupation for resource poor and landless families in rural and peri-urban areas of Puducherry. Studies showed that majority of landless cattle owners in peri-urban regions of Puducherry (81%) are women (Natchimuthu 2002, Ramkumar *et al.* 2003, Natchimuthu *et al.* 2005). Cattle are the only asset for the landless poor and their contribution to the family income is quite substantial. Majority of the new generation livestock farmers are agricultural labour forced to take up dairying due to subsidized loans provided by the government to buy cattle. Urbanization has led to conversion of farmlands for other purposes and this has led to reduced availability and high cost of fodder grass. Food crops (paddy) are being substituted by non-food crops (casuarinas) which require less labour and need less supervision. There was a shortage of green fodder to the tune of 94 % in Puducherry (Sastry *et al.* 1993). There is almost no practice of growing green fodder crops in Puducherry and the area under fodder cultivation is less than 90 acres (PONLAIT Report 2011). With increasing costs of fodder (especially paddy straw) and the low price for milk, farmers do not have adequate incentives to feed their cattle with purchased fodder. Unless green fodder is produced locally and is made accessible to the landless livestock keepers, the fodder situation in Puducherry is unlikely to improve.

Innovation system diagnosis: A diagnosis workshop was organized with the active participation of several stakeholders which include officials from line departments, a local NGO as well as the representatives from Women

Self Help Groups (WSHGs) and land owners.

Though productivity enhancement of livestock and fodder development are important priorities for the Government of Puducherry (as indicated in the *Pondicherry Vision 2020*), the experience on the ground suggested that the fodder development approaches are not successful. While several organisations are trying to address the problem of fodder, these efforts remained isolated and all of them focus on distributing fodder seeds/slips and financial incentives (subsidies) for purchasing/cultivating fodder. Though every development, research and training organization in the state has at least one programme on fodder yet fodder promotion has been the last priority. Owing to a number of reasons associated with the way these organizations operate (funded and evaluated), there has not been any joint discussion on how each of these organizations could contribute towards addressing fodder shortages. Moreover, every government programme has a subsidy element and the farmers have become accustomed to the subsidy culture and do not venture into doing anything without government subsidies. Though there are some isolated successes of promoting fodder entrepreneurs, these approaches could not be sustained due to lack of complementary or supportive institutional arrangements.

With more and more crop and common lands expected to be diverted for real estate and industrial activities, ensuring supply of more fodder seeds or slips is not going to realistically address the fodder shortages. Unless fodder is grown as a commercial crop and mechanisms for its sale or buy-back is ensured as an entrepreneurial opportunity, the state may not be able to address the fodder shortages meaningfully. This would necessitate interaction and collaboration among the different agencies who are currently working in isolation.

Lack of a platform: The major challenge in addressing fodder issue at Puducherry is in bringing better cohesion among the various agencies. There is no platform or forum where the different agencies can come together to address an issue like fodder that cuts across different organizational domains. This has constrained exchange of information on the ongoing programmes of different departments and has also prevented these organizations from exploring complementarities. Much of the interaction that happens is *ad hoc*, informal, need-based and weak and this is constraining the emergence of capacity or collective wisdom to deal with problems such as fodder scarcity. Lack of a common platform has also prevented the emergence of a state level policy or programme direction for addressing the issue of fodder shortage. Though the state government has highlighted fodder shortage as a critical constraint in enhancing livestock production, there is no clear articulation of what each organization should be doing to improve access to fodder. This has led to a situation where different organizations work independently, sometimes exacerbating the fodder crisis.

The Project team decided to focus its attention on measures for improving fodder innovation capacity through

organizing a platform comprising fodder relevant stakeholders to discuss, plan, implement and evaluate the outcomes of action research on a pilot initiative that can potentially addresses fodder shortage.

Multi-stakeholder platform: A platform with the active involvement of stakeholders of fodder development in Puducherry comprising officials or representatives of different development departments, farmers, WSHGs was established to implement the project activities. The multi-stakeholder platform identified a cluster of villages to implement this project. Initially 7 villages were identified and later narrowed down to 1, Sorapet based on secondary information as well as the experience of the officials working in the area. This fodder forum met on several occasions depending upon the need and finalised the action research plan. It also served as a monitoring and learning platform that facilitated learning from the action research and also helped promote joint working relationships on other programmes outside this project.

Identification of potential fodder growers: Prospective fodder entrepreneurs were identified by the different agencies as the potential way forward for addressing fodder shortage. The arrangements had been worked out with potential fodder buyers so that the fodder growers are assured of a market once they harvest fodder. Though all the agencies have some interventions on fodder usage, promotion of fodder growers under this project envisaged participation of all these agencies.

Fodder production: The participatory approaches led to the idea of linking potential fodder growers with milk producers. Hybrid Napier (CO₃), being multi-cut high yield perennial fodder crop, was preferred by the stakeholders. Few land owners came forward to cultivate Hybrid Napier, mainly for selling it to the milk producers in the village. Economics of fodder production in comparison to paddy cultivation were estimated and shared with the farmers, who were convinced with the relative returns. Four farmers agreed to raise fodder for selling it to landless cattle owners.

RESULTS AND DISCUSSION

The issues which were identified by the stakeholders

included urbanization, decreasing area under crops, low milk prices, induction of cattle without concomitant increase in the inputs (especially feed and fodder) and services, high demand for milk in the town (Puducherry has 90 % urban population). Free delivery of services like artificial insemination (AI), veterinary treatment, and vaccinations coupled with subsidies on cattle purchase, cattle feed purchase and green fodder utilization are key characteristics of the dairy economy of Puducherry.

Three types of households are associated with fodder production / utilization in Sorapet (Table 1). The characteristics of potential fodder growers (farmers with and without cattle) and potential fodder buyers (landless cattle owners) were analysed. The landless cattle owners have negligible scope to grow fodder.

The area under fodder cultivation was negligible in Puducherry (0.3 % of the cropped area of 13,176 ha) in the year 2008 (Government of Puducherry 2009), and the cattle owners especially the landless were not habituated to feeding their cattle with cultivated green fodder regularly. It was a common practice for the cattle owners to allow their animals to graze (on private lands or public property areas) in addition to feeding them with purchased paddy straw and concentrate feed.

Fodder transaction through MCS: The stakeholder platform discussed the issue of how to make fodder accessible to the landless dairy farmers. In the process of deliberations the idea of involving Milk Cooperative Society (MCS) as a nodal point for fodder transaction emerged. The logic behind this was that fodder as an input and milk as an out put can be conveniently routed through MCS, a hub for both fodder buyers as well as the fodder growers. Almost all the fodder growers were also members of MCS. Accordingly, based on several rounds of discussions and interactions with farmers and milk producers, fodder was grown on 2 acres of land in the selected village and the same was harvested and supplied through MCS to milk pourers on credit basis. The payment for fodder was to be recovered from the payments due to them and paid to the fodder growers (Fig.1). Initially there was a component of subsidy from the Department of Animal Husbandry (DAH)

Table 1. Characteristics of households associated with fodder production / utilisation

Characteristics	Land owners with cattle	Landless cattle owners	Land owners without cattle
Characteristics	Land owners with cattle	Landless cattle owners	Land owners without cattle
Number of households	Low	Substantial	Very few
Dependency on cattle rearing	To some extent	To a great extent	Nil
Utility of fodder	Milk production sale, if excess	Milk production	For sale
Potentiality	Potential as surplus fodder producer need to be explored	Potential buyer of fodder	Potential seller of fodder if a reliable market for fodder exists
Purpose of cattle rearing	To meet the domestic milk requirement	To earn income through sale of milk; Asset building	Not relevant

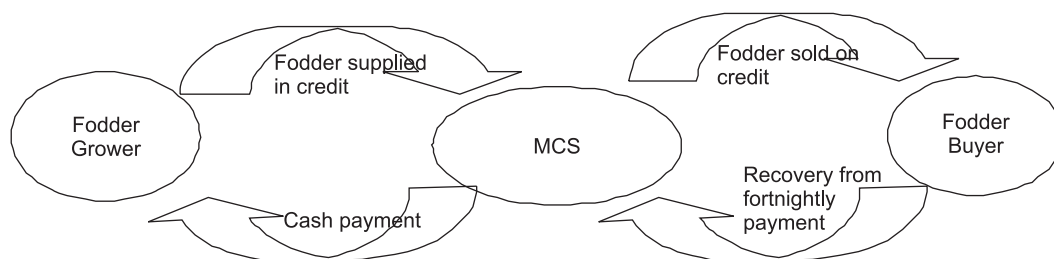


Fig. 1. MCS in fodder transaction network.

which was later withdrawn due to paucity of funds.

Fodder sale was good initially and later declined gradually. The average fodder sales started with about 200 kg / day and reached a maximum of 600 kg owing to the subsidy pull. The reasons for decrease in fodder sales include irregular payments to the fodder growers, labour and transport problems faced by fodder growers and availability of alternative feed/ fodder resources to landless cattle owners in addition to their experience that feeding of green fodder to cows did not result in increased income. Allowing animals for grazing or feeding green grasses from bunds or weeds free of cost was practiced traditionally in the study area. Hence, buying green fodder @ ₹ 10/bundle of 10 kg was not compatible with their existing traditional practice. There were instances of wastage of fodder due to late arrival of fodder at MCS, thick stems of the Napier grass and also due to poor sales of fodder. The MCS secretary found it difficult to sell fodder to members with dry cows (non pourers of milk to the society) for cash instead of credit. Despite the efforts to absorb the cost of transportation by the project, this system of routing fodder through MCS did not work.

Fodder transaction through WSHG: This issue was discussed in a stakeholder meeting, and the WSHG leaders came forward to accept the responsibility of fodder distribution and collection of money from the fodder buyers with a resolution passed in their group meeting. The resolution was based on the credibility they had on the

officials and their recommendations. The fodder was accordingly delivered by the fodder grower at the doorsteps of the WSHG leader (Fig. 2). This system had solved two problems – one, even if the fodder was supplied late in the evening, the leader was able to distribute to the buyers (group members); second, fodder was supplied to any buyer (irrespective whether he / she is a member of the MCS or not) for cash. This system did work for a few months to the satisfaction of all the stakeholders. The fodder buyers especially the landless cattle owners had a grouse that feeding green fodder to cows was expensive and it should be subsidized. In all the meetings the issue of “low milk procurement prices” did come up as it appeared to be a stumbling block for milk production enhancement programmes.

This system worked well as long as the WSHG leaders took active part in receiving and distributing fodder and also collected the money from the buyers. Later, it suffered a serious setback when these leaders were engaged in some other activities (elected to local bodies) and could not devote time for fodder transactions. Their involvement in fodder transactions in a way catapulted them to the political arena. Since WSHG members (lower stratum) and MCS secretary (upper stratum) were belonging to different communities the cooperation between them on fodder transaction was not up to the expected level. The fodder growers in both the experiments did suffer due to delayed payments and sometimes wastage of fodder due to poor sales.

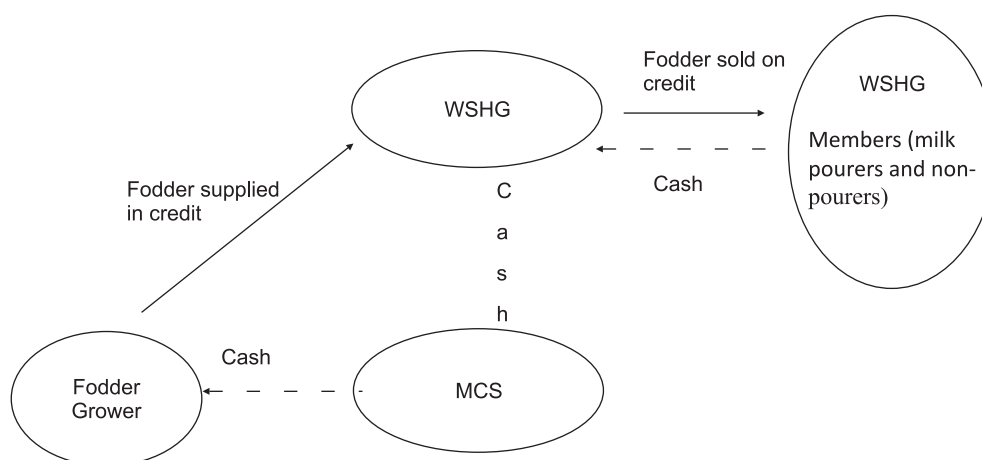


Fig. 2. WSHG in fodder transaction network.

Perceptions of WSHG members on feeding green fodder to their cattle: The WSHG members perceived the importance of feeding green fodder to their cattle for increasing milk production (500 ml / day), improving the conception as well as the health of the animals as reflected by shining skin coat. Initially, when the fodder was sold at subsidized prices, the milk producers were feeding their cows with purchased green fodder and later the sales declined with the withdrawal of subsidy. The milk producers, especially the WSHG members, expected that the milk production increases (both in quantity and quality) with increase in feeding of Hybrid Napier or reduce the cost on concentrate feeding. However, the milk producers after feeding green fodder continuously for 2 months to their cows perceived that the income through sale of milk to the MCS did not increase and they attribute it to the faulty testing of the milk in the MCS. A survey among 18 selected fodder buyers revealed that the average income through the sale of milk (for a fortnightly period) did not vary much before (Rs 1,252) and after (Rs 1,272) feeding Hybrid Napier to their cows. On the other hand reduction in expenditure on feeding was also not observed by the members. Most of the landless cattle owners perceived that ultimately there was no relative advantage over the existing practice of allowing animals for grazing and feeding bund grasses and weeds. They were unhappy with the milk testing as it is neither transparent nor done on a regular basis.

In addition, the WSHG members were not interested in feeding their pregnant and dry cows with purchased green fodder as the adoption of this innovation had poor observability and also not getting any income from the dry cows. However, this project had its positive impact on fodder growers. One fodder grower who raised fodder on one acre of land had realised the potentiality of feeding green fodder to cattle and discontinued selling green fodder to the MCS/WSHGs as it is economical for him to feed his cattle with *ad lib.* green fodder rather than feeding with paddy straw which is costlier than green fodder. Similarly, one farmer having 3 repeat breeding cows felt happy with feeding green fodder (grown on 30 cents of leased land) to cows as all these repeat breeding cows were conceived.

Constraints and challenges: In the process of implementing this project the stakeholders encountered the following constraints which challenged the achievement of the objectives.

- (i) Everyone associated with the project realized that it is a challenge to enable resource poor landless cattle owners in Puducherry feed their cattle with green fodder on a regular basis. The representatives of various departments were sensitized to the complexity of making available the green fodder to the landless cattle owners, which itself is one of the significant achievements of the project.
- (ii) Milk procurement price has been a contentious issue on which none of the stakeholders had any say. In almost all the stakeholder meetings the issue of low

milk procurement price was discussed but without any feasible solution. Although, the Milk Union is empowered to fix the milk prices, in practice the Government will fix the prices, which will be in favour of the urban milk consumers (more in number) rather than few scattered rural milk producers or members of the MCSs. Not a single MCS out of the 93 functional MCSs in Puducherry has an automatic milk collection unit which is considered as transparent and foolproof method of weighing and testing the milk regularly. Testing of milk in these MCSs is never done on a regular basis. In most of the MCSs the milk tester was out of order, a conducive situation for malpractices.

The trends are indicative of decreasing interest of the farmers for cattle rearing. It was reported that the average herd size and milk production are showing declining trends in Puducherry (Athilakshmy *et al.* 2011). This might be due to the decrease in the availability of feed and fodder which ultimately led to high cost of feed, coupled with low milk procurement price in Puducherry (Natchimuthu *et al.* 2005).

The Government of Puducherry is, implementing several schemes which include milch animal purchase, subsidies for green fodder production, calf feed, cattle feed, green fodder purchase etc. However, these schemes did not help in increasing the milk production in Puducherry. The gradual decrease in milk procurement by the MCSs (decreased from an average of about 50,000 litres per day in 2001–02 to 29,000 litres per day in 2010–11 and outsourcing has gone up from zero to 73,000 litres during the same period) is an indication of decrease in milk production which reflects upon the negative impact of subsidies on milk production in Puducherry, (PONLAIT Report 2011). However, the argument that decrease in milk procurement need not necessarily because of decrease in milk production could be countered by the fact that PONLAIT is still the major milk procurement agency in rural areas of Puducherry and private milk procurement agencies are not operating in these areas.

Cultivating green fodder (main input to reduce cost of milk production) by the land owners and making it available to the landless cattle owners is a complex issue. Evidence showed that none of the farmers completely adopted the practice of feeding nutritious green fodder to their dairy animals (Rezvanfar 2007) despite the fact that the researchers consider it as vital to feed the dairy animals with green fodder to reduce cost of production. Although the focus of the project was on fodder production and its use by the landless cattle owners (technology adoption), the lessons learnt could be extrapolated to any livestock production technologies.

It is easy to produce green fodder and fodder growers could realize the benefit of feeding the cultivated green fodder to their cattle (due to the minimum cost of labor and transportation) whereas, landless fodder buyers could not realize the same because of the indifferent attitude towards

the purchase of green fodder. The mind set of resource poor plays an important role in technology adoption and they prefer low quality or subsidized inputs over the good quality purchased inputs. They preferred allowing their animals to graze on public or private lands (non cash cost) rather than spending ₹ 20 (cash cost) every day to feed one cow on purchased green fodder, however superior the latter may be in terms of quality. Their mindsets might have changed if their incomes have increased significantly by feeding green fodder.

The dry fodder (paddy straw) is preferred over cultivated green fodder, although the latter is superior in terms of TDN, DCP and palatability. Green fodder, a scarce commodity, is cheaper than dry fodder due to its poor demand in Puducherry. The reasons for their preference to paddy straw are that they can stock and use it for about 4 to 6 months depending upon the season. Purchasing (during harvest season), transportation and stocking it could be completed in one day whereas the cultivated green fodder (heavier) needs to be obtained from the fodder producer or MCS on a daily basis which is laborious.

The scientific recommendation is that *ad lib.* green fodder feeding without concentrates is enough for a crossbred cow to sustain the milk production up to 8 litre/day. The average milk production per crossbred cow in Puducherry is about 5 to 6 litre per day, and green fodder feeding alone will meet both maintenance and production requirements of the cow. However, the landless cattle owners perceived that it is easy to purchase concentrate feed (@ ₹ 12 / kg) on credit (from MCS), transport and stock it (once in a week or fortnight) rather than spending time on green fodder (Re 1/ kg) feeding every day as the latter cannot be stocked.

Labour and transportation costs are vital for adoption of dairy production technologies, which hitherto were not considered important by the technology promoters. Labour costs are increasing with increase in opportunity cost owing to the implementation of MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act) coupled with distribution of free or subsidized rice to the BPL families. Labour wages for agricultural operations including fodder harvesting have gone up and the farmers in the entire country are experiencing this serious constraint and Puducherry is no exception to this (The Economic Times 2007). Increasing labour costs is one of the important reasons for the land owners shifting from food crops (Paddy) to less labour intensive non food crops (casuarinas) cultivation thus reducing drastically the area under food crops in Puducherry. The area under land put to non agricultural uses in UT of Puducherry over the years has gone up from 15,251 ha in 1998–99 to 18,466 ha in 2009–10 (*Government of Puducherry Report 2011*) adding to the shortage of agricultural byproducts.

The adoption of any technology must result in increased incomes for the farmers and this depends upon the market structure, pricing policies, transparency in measuring, pricing and payment schedules etc. Feeding of cultivated

green fodder (purchased inputs) by the landless cattle owners did not result in increased incomes primarily because of the unscrupulous practices followed in testing of milk by the MCS. Unfortunately the milk producers/ MCS members have no say in “testing of milk” and in “price fixation” although theoretically they own the MCS and the PONLAIT (Rao *et al.* 2009).

Better price for milk encourages the producers to enhance milk production provided the input costs are not rising with output prices. The average price of compound cattle feed supplied by the milk union was ₹ 12/ kg and the average milk procurement price for milk was ₹ 17.00 in the year 2011. The milk and feed price ratios are decreasing over the years, indicating thereby that the prices of feed are increasing at an increasing rate than the prices of milk (Tamizhkumaran *et al.* 2012).

Adoption of technologies depends directly on the market outlet of the produce and the policies of the marketing institution. PONLAIT has become innovative in reducing losses by procuring milk from outside, process and sell as value added products (may be easier to purchase milk even at higher price rather than to increase procurement through its own societies). This activity revealed that the PONLAIT was interested to safeguard its position through purchasing milk from outside rather than protecting the interest of milk producers in this region. This indicates the thrust of PONLAIT is on milk processing and marketing (especially milk products) with little or negligible concern for production and it may prove fatal to PONLAIT in the long run as it increases the risk of its dependency on outside agencies on which it has limited or no control. In addition, this policy is detrimental to implementation of all the milk production enhancement programmes with the technological interventions which include fodder development programmes.

Technologies are not scale-neutral. There was very wide variation in the expectations of fodder producers, buyers and facilitating agencies and many of these expectations conflict with others. The fodder growers were interested in harvesting a fixed quantity of green fodder everyday that too not less than 500 kg (labour and transport charges do not vary with the quantity up to 1,000 kg) which is conflicting with the expectation of the fodder buyers who wish to have flexibility in purchasing green fodder from the MCS as the latter have not realized the potentiality of feeding green fodder to cows on a regular basis.

Technology adoption hinges on the interest and enthusiasm of the technology promoting institutions and the key players involved in the process. The secretary of the society, who is a key player in the fodder transaction, was not sufficiently interested in this. However, he projected himself as a leader of the village and wanted to distribute freebies to build his political future.

Subsidies have a negative impact on production. It confirmed the conclusion of Rogers (2003) that adopter incentives lead to adoption of an innovation by the individuals different from those who would otherwise adopt.

It clearly indicated that the practice of feeding the cultivated green fodder by the landless dairy farmers was intended to receive subsidies and not for the sustainable milk production. It is well known that subsidies if not properly directed may result in negative impact. The implementation of several schemes with subsidy component did not result in enhanced milk production, rather they had the opposite effect. The Government controls the prices of milk procurement as well as consumer prices and most of the unions are incurring losses as the processing costs are increasing and the consumer prices are not raised to cover the costs. Hence the challenge of increasing the fodder availability and its utilization is becoming insurmountable as the policy is not favourable in the region.

The weak interpersonal relationships between the fodder growers, fodder buyers and fodder transaction agency might be one of the reasons for the failure of the innovative fodder transaction process introduced through this project. There was no culture of taking responsibility to resolve the issue(s) amicably at their level. All issues raised during the processes indicated that everyone was interested to get an individual benefit (field level) by participating in this project implementation.

Rasheed (2012) opined that the 'debate should move beyond technology dissemination and research-extension linkages to ways of promoting innovation and enhancing capacity for innovation' is quite relevant in this context.

This research clearly indicated the problem of green fodder cultivation lies not in fodder technology availability or access *per se* but has several ramifications which are not in the purview of the individual stakeholders.

Adoption of an innovation (fodder transaction) is constrained by social, economic and policy issues rather than technological issues and include transportation of fodder, relations between the fodder growers, buyers, market facilitators or intermediaries, government policy on milk pricing, urbanization, industrialization etc. This project has provided evidence that milk prices hold the key to increasing the production, which becomes a prerequisite for demand of technologies. This calls for appropriate policies and institutional arrangements at both state and national levels for making inputs, especially fodder, accessible to the poor livestock owners so as to enable them to thrive on livestock rearing.

REFERENCES

- Athilakshmy S, Sunitha P and Rao S V N 2011. Temporal changes in the dairy farming scenario in Puducherry. Paper presented in national seminar on 'Innovations in Farming Systems Research and Extension for Inclusive Development'. TANUVAS, Chennai.
- Del Castello, Riccardo and Braun Paul Mathias. 2006. *Effective Rural Communication for Development*. FAO and GTZ, Rome.
- Feder Gershon, Just Richard E and Zilberman David. 1985. Adoption of Agricultural innovations in developing countries. *Economic Development and Cultural Change* 33: 255–98.
- Government of Puducherry. 2009. Directorate of Economics and Statistics, Pondicherry .
- Government of Puducherry. 2011. Directorate of Economics and Statistics, Pondicherry
- Hall A J, Rasheed Sulaiman V and Peter Bezkorowajnyj. 2007. Reframing Technical Change: Livestock Fodder Scarcity Revisited as Innovation Capacity Scarcity- A Conceptual Framework. FIP Conceptual Framework. International Livestock Research Institute http://www.crispindia.org/docs/FIPConceptual_Framework.pdf
- Kemmis Stephen and McTaggart Robin. 1988. *The Action Research Planner*. Victoria, Australia: Deakin University Press.
- Natchimuthu K 2002. 'Socio-economic and technological impact of animal husbandry programme in Pondicherry.' Ph.D. thesis, NDRI, Karnal.
- Natchimuthu K, Ramkumar S and Rao S V N. 2005. Constraints and Challenges of Dairy Development: Field Evidence of Pondicherry. *Journal of Rural Development* 24 (4) 501–20.
- Pondicherry Vision. 2020. *Madras School of Economics, Chennai*. Puducherry.gov.in /publication/v2020.
- PONLAIT 2011. *Annual Report 2010–11*. The Pondicherry Cooperative Milk Producers' Union Limited, Puducherry.
- Ramkumar, S, Rao, S V N, Garforth, C and Ganesan R 2003. Cattle rearing by landless in the periurban regions of Pondicherry. *Cattle Health Issues in Peri-Urban Regions: Potentials of Information in Coping with Poverty*. (Eds) Rao S V N and Ramkumar S. 2003. Proceedings of the workshop held on 20 and 21 March, 2003 at RAGACOVAS, Pondicherry.
- Rao, S V N, Kherde R L and Tyagi K C. 1992. Why delay in farmer's adoption of dairy technologies. *Indian Dairyman* 44: 288–301.
- Rao S V N, Natchimuthu K and Ramkumar S. 2009. Milk Producers pay for all. *Indian Dairyman* July 2009: 61–66.
- Rao S V N, Patil B R, Rangnekar D V, Dey R A and Van Den Ban A W. 1995. Farmers' perceptions of innovations. *Handbook for Straw Feeding Systems – Principles and Applications with Emphasis on Indian Livestock Production*. (Eds) Singh Kiran and Schiere J B . Indo Dutch Project on Bio conversion of Crop Residues, ICAR, New Delhi and DTAP, Agricultural University, The Netherlands.
- Rao, S V N, Ramkumar, S, Natchimuthu, K and Peter Bezkorowajnyj. 2009. Dairy cattle feeding – evidence based pro-poor institutional approach. *Proceedings of the Animal Nutrition World Conference 2009*. Vol II, Lead Papers, pp 157–62.
- Rasheed Sulaiman V. 2012. Agricultural extension in India: current status and ways forward. *Roundtable Consultation on Agricultural Extension*. 15–17 March 2012. Beijing.
- Rasheed Sulaiman V and Hall J Andy. 2006. Extension Policy Analysis in Asian Nations. *Changing roles of Agricultural Extension in Asian Nations*. (Eds) van den Ban A W and Samanta R K. BR publishing Corporation, Delhi.
- Rasheed Sulaiman V, Andy Hall, Vamsidhar Reddy, T S and Kumuda Dorai. 2010. Studying rural innovation management: a framework and early findings from RIU in south Asia, *Discussion paper Series* 11, RIU.
- Rezvanfar A. 2007. Communication and socio-personal factors influencing adoption of dairy farming technologies amongst livestock farmers. *Livestock Research for Rural Development*. Volume 19, Article #33. Retrieved April 6, 2012, from <http://www.lrrd.org/lrrd19/3/rezv19033.htm>
- Rogers E M. 2003. *Diffusion of Innovations*. 5th edn, Free Press, New York.

- Sastry N S R, Reddy D P R and Hermon R R 1993. *Planning for development of Animal Husbandry sector: a study in Pondicherry*. NIRD and Booklinks Corporation, Hyderabad.
- Singh Kiran and Schiere J B. 1995. *Handbook for Straw Feeding Systems – Principles and Applications with Emphasis on Indian Livestock Production*. (Eds). Indo Dutch Project on Bio conversion of Crop Residues, ICAR, New Delhi and DTAP, Agricultural University, The Netherlands.
- The Economic Times*. 2007. *NREGA may be Adversely Affecting Agriculture in Economy*. Aug 19, 2007
- Tamizhkumaran J, Rao S V N and Natchimuthu K. 2012. Prospects of livestock rearing in Puducherry. *Proceedings on Kerala Veterinary Science Congress*. 10th and 11th Nov 2012. Pp.165–175.
- Van den Ban A W and Hawkins H S. 1996. *Agricultural Extension*. 2nd edn. Blackwell Science, London.