5. SUMMARY AND CONCLUSION

AKIS (Agricultural Knowledge and Information System) is the most recent concept based on systems’ perspectives in policy and information management. It differed from the conventional extension theories in its approach of looking at all elements of the agriculture system like research, technology development, extension, policy makers and farmers not as separate entities but as equal partners. In a typical AKIS the functions of knowledge generation, dissemination and use could be carried out by any one of the partners. AKIS performance required, balance of bottom-up and top-down approach, directed action for the resource poor through proper target group categorization, differentiation to cope with diversity, synergy between the roles of constituent actors and a conducive environment. A typical AKIS does not serve agriculture in general, but specific domains.

In the present study AKIS was included in the domain of dairying and hence it was suitably named as DKIS i.e. Dairy Knowledge Information System. It is already established that linkage between research and extension is weakest which leaves research in production of unwanted technologies and extension in disrupted and irrelevant response to farmers’ needs. The interfaces between each of the systems’ major actors became faulty due to conflicting domains, heterophylly gaps and ineffective linkage mechanisms. Faulty interfaces led to failure to transform knowledge and information appropriately and hence to a system that could not operate synergically. The management of AKIS interfaces thus emerged as the most important aspect of DKIS.
To get a comprehensive view of the DKIS in India mapping of links among actors in the system was needed. It was necessary to understand the hierarchical levels in multi-tiered systems and the roles of different institutes and actors in the DKIS. The extent of linkages among various actors of DKIS and the content area of linkages also needed investigation.

The present research demanded to look into the aspects of technology development transformations, integration synergy and user control to analyse the process of information management related to specific technologies. The study focused whether the technologies addressed the needs of dairy farmers within the diverse and complex condition in which they strive to achieve maximum milk production. It was also important to know whether the technologies were science driven or demand driven.

A series of transformations occur between communicators and users while information is transferred from research findings to farmers. On a typical DKIS situation, the movement of information from generators to users existed, irrespective of the status of the actors in the system. Therefore, it was imperative to study sources of information and information flow from various actors of DKIS like researchers, extensionists, marketing agents, input suppliers etc. to farmers and vice versa. It was also necessary to understand how and where the information stagnation occurred.

A unique characteristic of the DKIS which differentiated it from the conventional extension models was its synergy. Synergy is the system state where the combined contribution of the actors is more than the sum of their individual contribution. It was seen necessary that research, extension, farmers and other
actors had to be more valuable in their combined contribution than as separate entities. The basic requirement for synergy emerged as the functional differentiation between roles and integration of various roles through adequate linkages. In their context, the present study looked into how the different actors in the DKIS perceived their roles in the whole system. This in turn gave insight into the perceptions of the system by those involved. In view of the above points following objectives were developed and studied under the present research work:

i) To analyse the linkages in the Dairy Knowledge Information System (DKIS).

ii) To study the information management in relation to improve practices and innovations in sustainable dairy production.

iii) To study the constraints in the information flow.

iv) To study the role perception of various actors (researchers, extensionist, input suppliers, marketing agency and farmers) in the DKIS.

5.1 SALIENT FINDINGS

Analysis of linkage in DKIS

The present study helped to analyse the information management in the DKIS and the disorders in it leading to stagnation of information. The analysis of the linkages in the DKIS contributed towards interface management to ensure the smooth passage of information through various actors of the system. The case studies in the information management in relation to various technologies compared the DKIS model and the existing ones of the problem situation. It showed what could be done in terms of knowledge management and intervention to achieve
sustainable dairy production. The study on the constraints in the information flow and role perception of various actors in the DKIS helped in interface information management and in sustaining synergy in the system. The results of this study will provide valuable data and direction to the policy makers, administrators, researchers, and extension personnel for information management. Being the pioneer study on DKIS in India, this gave insight into how DKIS function in diverse, risk prone, low external input and complicated rain-fed farming systems of developing countries.

The information management in DKIS was studied using qualitative research methods in order to have clear knowledge and vision of the system. The most recent tool in participatory research, PRA, was used in this study. This is the first attempt to study DKIS in India using PRA methods as revealed by the literature surveyed. By doing PRA the following observations were made in the villages under Karnal DKIS.

Mapping of DKIS

In the present study mapping of DKIS in Karnal was carried out in the following manner. The DKIS map was drawn keeping in mind the Indian scenario specifically pertaining to the study area of Karnal. This place is one of the most renowned areas of dairy farming in the country. The location of National Dairy Research Institute, further, strengthened the value of the maps as an effective tool to study the DKIS. This map could very well represent DKIS in any other part of the country as basic pattern of the information system was same. It showed the overall view of the system, direction and character of the links between actors and the strength of the links.
Policy making related to agriculture in a broad sense is responsibility of the Central Government mostly based on recommendations of various committees constituted from time to time for studying field situation and problems. The policy decisions are conveyed to Indian Council of Agricultural Research (ICAR) the apex body of agricultural research in India and to the State Departments of Animal Husbandry/Dairying. The main functions of various institutes under ICAR are research and technology development. The other responsibilities are education for human resource development, training for farmers, extension personnel and industrialists and dissemination of technologies using printed and electronic media. The research institutes are also directly connected with farmers through IVLP and KVK. The technologies developed by the National and Central Research Institutes are transferred through the Extension Research wing to the State Departments and SAUs through education, training and media. The technologies having main concern for industries are transferred directly to them. The State Departments and SAUs are having specific programmers for training and extension for dairy farmers. They give limited resources too. Industry approaches dairy farmers through input suppliers. In short, dairy farmers and industry are the users of technology generated by researchers. The dairy farmers were also found to store wealthy indigenous knowledge and expertise based on their own experimentations. However, the information movement from farmers to research and extension system was observed to be weak. The feedback to the industry through input suppliers was good enough may be because of the market researches and development activities of the industries. The input suppliers were having contact with research institutes and state departments often for procurement of research formulated products, vaccines and semen, occasionally sold through such institutes (Fig. 4). Even though, the NGOs played a critical role in dairy extension in many parts of India, there was no NGOs operating in Karnal DKIS.
To study the extent of linkages among the various actors of DKIS, two matrices were formed. The first matrix showed the extent of contact between various actors in the DKIS (Fig. 5). The cells indicated the subject matter area related to which contacts were made. Farmers contacted village based extension agents for assistance, mainly in the area of health care. Breeding and feeding required less of contact. The contact of farmer with scientist was negligible in all the areas.

Another matrix explained the direction of information movement and showed the type of information exchange existing between two actors. This matrix also revealed the strength of various linkages. Columns in Fig. 6 showed from whom the various actors received information and the rows showed to whom they gave information. The cells indicated the subject matter area, on which information was transferred and the strength of the link. The subject matter area were health management, breeding and feeding. It is evident from the matrix that information flow was linear in majority of the cases. The feedback got blocked with some of the actors as there was no proper information management mechanism for the upward movement. The matrix showed that very weak feedback was reaching at the level of dairy scientist, extension scientist, print media and electronic media. The matrix showed the inability of the print media to articulate in the village information system consisting of the dairy farmers alongwith his neighbours, relatives, friends, the stockman, input suppliers, marketing agents and extension personnel operating in the village. The unavailability of the farm journals in the village information system was major constraints. Maximum linkage in information dissemination of scientist were with print media which never reached the other actors of DKIS.
Links between extension scientists and researchers

Weak linkages were observed between the extension scientists and other scientists working in the same institute, NDRI, Karnal. The activities where some sort of linkage among the extension and other scientists existed were staff research council meetings (SRC) and through Institute publications like Annual reports, research highlights, other technical publications and through print and electronic media. The Extension council where policy makers, scientists, research managers and field extension officers discussed the activities related to dairy extension and its management was the only body in the Institute where some sort of liaison between research and extension was existing.

Research-Extension liaison

For successful functioning co-ordination units or research-extension liaison units other than the existing direct supervision of Director of the Institute and Heads of Division are necessary, to ensure proper links in the functional level. The advantages are that there would be closely knitted information management between research and extension and it would be easy to allocate time and resources for integration and liaison in coordinated work of the researchers and extensionists under one unit. It will help for treatment of research findings to develop proper extension messages. This type of units would also be beneficial for publication of extension literature in which the extension scientists and other researchers will have combined contribution and the research 'jargons' could be made clear for extensionists. Research-extension liaison units can also be used for directing the technologies to the specific target groups and recommendations in this context would be helpful to field level extension workers who engaged in wider technology transfer among farmers.
Village information system

In the lower half of the matrix a closely knitted village information system was spotted. It also consisted of the out village informal information systems (OVIIS) and out village formal information system (OVFIS) operating inside or in the periphery of the village. OVIIS consisted of input suppliers and milk marketing agents locally called milk vendors. OVIIS included stockmen, veterinary officers and extension workers. In this cluster, dairy farmers were seen having strong links with actors of VIS. This meant that they were receiving information from almost all the formal and informal agents operating inside the system or along its periphery. This finding emphasized the role of stockman, milk vendor, input suppliers who were hitherto unrecognised as strong information agents.

The matrix also revealed that there was weak up-stream flow of information from VIS. Even though dairy farmers received information from all actors who operated inside the village the up-stream flow was very weak. This seems to be the reason for poor user control over technology development. Participation of farmers in technology development or having control over the research system through collaborative or collegiate participation was lacking in Karnal DKIS.

The intensive participation of farmers in research was difficult to institutionalize, especially in Indian conditions where illiteracy exists among majority of the farmers. In such conditions the participation may be limited to the passive mode, where the needs, priorities and problems of farmers are conveyed to the researchers through the extension workers and extension researchers.
The matrix also suggested poor links between extension workers and dairy researchers as well as extension scientists. The analysis revealed lack of institutionalization of links between these researchers and extension workers as one of the reasons for poor information management. Another reason was the 'terophyly gap' between researchers and extension workers. As the present research clearly showed stagnation of up-stream information at the level of extension workers, there is an urgent need for a comprehensive policy for information management and institutionalization of information flow between field extension workers and scientists.

The knowledge areas where the various actors concentrated were mainly on health care followed by breeding and least was in feeding. For health care farmers were closely linked with stockman and veterinary officers. Feeding was carried out based on their working knowledge, traditional knowledge and management of locally available resources. The matrix revealed very poor information feedback from farmers to research information system and OVIS (outage information system).

The linkage problems in the DKIS stemmed from the lack of interface of information management between the village information system and the scientific information system. Both the systems were having articulation of information but wide gap existed between the systems. Weak links between extension department in research system and that of the state government department was observed as one of the reasons for this information gap. A ruling of the whole setup and institutionalization of the information flow is needed to facilitate information management based on systems' perspectives.
It is inferred that capacity building and empowerment of farmers during the period of adoption should be undertaken instead of making it a process of delivering services and inputs. The adoption of a village may be withdrawn only when the local capacity to handle the services are strong enough to sustain.

**Information management in feeding of dairy animals**

Case studies were conducted on specific feeding technologies with reference to management of information. The study also examined the concept of participatory technology development as an alternative to attain sustainable feeding practices. For this the empirical evidence related to the dynamics of traditional feeding systems and farmers experimentations in the process of sustainable feeding of dairy cattle were collected. The nutrition technologies were studied using secondary sources of information and discussion with concerned scientists. It was found that the farmers of adopted villages were aware of the technology of silage making. The focus groups were also able to describe the details of making and filling the silage pit, recollecting the demonstrations they had seen. However, the farmers were no more interested in adopting this technology, no need for silage due to availability of green fodder, because it was a cumbersome technique, high cost of operations and had less palatability.

Regarding urea treatment of straw, the awareness among farmers in selected villages was complete. But the knowledge possessed by them pertaining to the operational details of technology was found inadequate. The abundant availability of green fodder in the Karnal DKIS, further lessened the interest of farmers. Despite the claim of scientists that urea treatment of straw will bring an increase in milk production (one litre/day/animal) in actual field conditions, negligible increase
in milk yield was observed. The farmers opined that even though intake of straw increased after urea treatment, it did not help them in reducing the amount of concentrate mixture as promised by the technologists. Feeding of treated straw made the dung loose and sticky which could not be used for making dung cake for fuel purposes. Other constraints perceived by farmers in adoption of this technology were cost of urea and inability to divert the labourers who were already busy with various agricultural operations.

Farmers were found aware of degure mixture, this was found as a technology appreciated and wanted by all sections of dairy farmers. This problem solving technology was helping them to utilize the locally available paddy straw profitably.

Discussion with feed companies operating in Karnal DKIS revealed that the concept of By-pass protein has been accepted by feed industries and feeds are being produced claiming to have By-pass protein incorporated. But neither the farmers nor extensionists were aware of this concept and also the By-pass protein content in any of the locally available feeds. This showed the necessity of developing this technology into proper extension message which could be understood by farmers and extensionists. Research on by-pass protein content of all locally used feed resources would prove helpful to farmers and for extensionists to develop proper extension messages. Even though considerable research output on single cell protein exists, it was found that much of treatments required to make it an adoptable technology by feed manufacturers and farmers.

Investigations were conducted in detail to understand how farmers evaluate feeds, how scientists evaluate feeds and the information management issues related
to the linkage interfaces. Nutrition scientists were found using proximate analysis
to study the characteristics of various feeds. Field observations during the PRA
revealed that farmers were using their own criteria for evaluation and selection of
feeds. Their criteria were firm on the practical experience and age old beliefs. They
were not aware of any type of feeding standards or scientific feeding practices.
They were evaluating feeds using criteria like local availability, increased milk
production, increased fat percentage, cost and high palatability. Their adoption was
depending upon factors such as availability of feed resources, labour requirements,
land, capital and services of extension agencies. Hence, research approaches should
be to encourage understanding traditional system of feeding and building upon
indigenous knowledge of farmers.

As the farmers of Karnal DKIS were not adopting the so called scientific
feeding practices, it was not found apt to label them as laggards in this respect.
Empirical evidence from all parts of the world shows that the 'central source of
innovation model' does not conform with reality.

It was identified that the real problem lies in the information management in
the interface links between the evaluation of feeds by scientists and that of farmers.
Scientists were found not paying attention to the visual methods of assessment of
feeds followed by farmers and of their feeding objectives. Even resource rich
farmers were not interested in knowing about scientific feeding. They were feeding
few kg. of compound feed to high milk producing animals other than the daily
ration containing green fodder, concentrates and straw. Adoption of compound feed
(CF) was mainly due to the efforts of the feed companies rather than the extension
mechanism.
To correct the problems in this interface management, the study suggested that the nutrition research should primarily be based on farmers priorities and objectives. The researches should be based on experience of local farmers and indigenous technologies of the area. The research findings or technologies should be transformed into understandable extension messages through integration of knowledge from different sources. During this study it was noted that synergy was totally lacking in the Karnal DKIS related to feeding. The study observed lack of systems perspective in information management related to feeding. The whole system was found moving according to the transfer of technology model where farmers were meant to be the receivers of technology developed by researchers. For the effective information management and success in high milk production, the study suggested the knowledge and information system approach, where all actors, whether researches, extensionist, farmer, marketing agencies or input supplies have equal role in the system i.e. knowledge could be produced by any actor of the system and information could pass from any actor to another, in any direction. This perspective assigns equally important role to farmers as researcher and points towards the importance of farmers experimentation and farmer first (FF) approaches, the basic principle behind participatory technology development.

In practice, this seeks the reasons for non-adoption of new technology by farmers, not because he has lack of information but deficiencies in the technology itself and the process that generated it. The significance of the reversal for learning is that researchers and extension workers learn from farmers. What options the farmers set aside for various aspects of nutrition technologies was also analysed. The technologies which were matching with the needs were found obtaining better options according to the assessment of farmers. The options assessment chart showed that farmer considered the technology of 'Degure' having the best options.
a terms of sustainability, stability, productivity and having best technical feasibility. Although nutritionists do lot of research on enrichment of straw and bypass nutrients, these technologies were not facilitating adoption. It was observed that what farmer wanted was not package of practices devised by the formal research and extension services, but a basket of options from which he could make active choices. Extension may then be able to supplement the needs of farmers (demand activated process) by facilitating various functions such as skill development and specialized training. This gives a new role for extension services as "facilitators of information options".

This study investigated the general feeding practices followed by farmers of Karnal DKIS with special emphasis to farmers experimentations where so ever observed, using PRA method. It was observed in all villages under study that cattle were fed using the age old practices of feeding with locally available feeds. Due to the abundance of green fodder in this area, feeding was not observed as a limiting factor in milk production. Cattle owners were not following the scientific feeding schedule recommended by research institutes. Discussion with extension personnel revealed that farmers rely on indigenous knowledge for feeding and were never ready to adopt scientific feeding practices.

Many of the farmers formerly termed laggards have shown to be ideal managers of their own situations. They were found in a constant process of analysing, choosing, experimenting and adopting. PRA experiments showed that the main concern of farmers was of local availability of the feed. Priority was given to feeds which provide the high milk productions. They were ready to analyze and choose from the research recommendations but were not ready to accept any technology involving complicated methods or which does not provide substantial
increase in milk output. Dairy farmer were found to have complete knowledge of how their farming systems function and he would integrate only those alternatives which complement resource management and production goals. And before integrating them it will undergo farmers' own experimentation and decision-making cycle where the technologies will be analysed, the best options chosen, experimented and adapted.

Whenever they became aware of any new feeding practice, small scale experimentation were carried out by farmers to know about the pros and cons of technology. Information regarding any technology that showed specific increase in milk production was found spreading through the informal farmer's network quickly. They were searching to find "meanings" for it in their own context. Most of the farmers were found formulating own rations for their cattle based on their own knowledge.

Before adopting any practice it was found undergoing a series of different processes and changes. Farmers experience and working knowledge were having major roles in this process. The farmers did experimentation with different concentrates and compound feeds and feed combinations. The PRA exercise brought into light that when compound feed was introduced into this particular information system, how they did own experimentation and decided to which type of animals the compound feed should be fed and at which rate. Applying their own criteria, the farmers decided to give compound feed only to high milk yielding animals. The present investigation urges the need to study the farmer formulated rations and rationality behind their feeding schedule. The farmer formulated rations may be scientifically validated and modifications which permit him to adopt in his particular farming system may be suggested.
Information management in breeding

A farmer aspires for a particular breed of cattle depending on what objectives he has for dairy farming. His priorities may differ from what a researcher or extensionist perceive to be the objectives of dairy farming. In the present study, direct matrix ranking was used to understand the preference of farmers, researchers and extensionists on the objectives of dairy farming.

While scientists and extensionists viewed dairy development in the light of increased milk production, whether it is for consumption or for sale, farmers had many other equally important objectives like fuel, manure, transport and draught animals. Neither the researchers nor the extensionists bothered about whom the technology is intended to and for which category of dairy farmers what technology has to be developed and transferred. These type of perceptual differences were found leading to unwanted and irrelevant breeding technologies. High cost and low adaptability of crossbred animals to the extreme climatic conditions were deriving forces for resource poor farmer to keep buffalo mainly. Moreover, high fat content of buffalo milk is another factor for preference of buffalo over crossbred cattle. Buffalo population in the villages under the study constituted by Murrah group i.e. Murrah, Nili-Rabi and their grades.

As the researchers and extensionists did not set proper and timely objective of maintaining healthy herd of good indigenous breeds suitable for low external input agriculture systems, good breeds of indigenous cattle became a rare commodity to find. Moreover, breeding policies lacking proper planning and objectives were found resulting in unknown, mixed and high percentage of exotic blood in our breeds which often led to reproduction and disease problems. The present study revealed that even though dairy farmers preferred crossbred for their
high production capacity they were unsatisfied with recurrent health related problems and infertility. During the transect walks in the village some cattle were observed to be non-descriptive crossbreds which showed a clear lacuna in breeding policy and objectives. It was found that no record was maintained regarding the pedigree, insemination schedule and type of semen used for each insemination etc. Lack of this kind of records were mainly responsible for all the negative impact of crossbreeding programme in field conditions. Thus, this study showed poor interface management leading to distortion of information between various actors involved in breeding system.

Depending on the animal husbandry system, farmers were found looking for particular traits in the animals they selected for breeding. The traits which farmers perceived to have in crossbreds underwent change with respect to priority through years. This shift in priority was an output of farmer's rationality, experimentation and decision making, it explained how they explored possibilities and integrated knowledge from different sources over time to make their own options. Farmers were initially keen to have Holstein Friesian (HF) crossbred cows and were pleased with their high milk production were found slowly changing their priority on this particular breed. Systematic observation by the farmers and based on experience information on different breeds passing down farmers' communication networks has made them prefer Jersey breed to HF. The reason attributed by them for the change was high milk production along with other traits such as disease resistance, docile temperament and less feed requirement. Inspite of having high milk production the overall expenditure for maintaining HF crosses was high due to cost of proper housing, feeding and treatment diseases and infertility problems.
This case study analysed the ongoing work on induction of lactation in barren animals in the field conditions and tested whether the technology is actor oriented and contributions of various actors in relation to this technology. The crossbred cattle and buffaloes which were either repeat breeders, anestrous or suffering with disorders like cystic ovariies leaving them barren and hence no milk production were included in the field trial. After hormone treatment of oestrogen and progesterone combination the animals those were not giving any milk started giving 100 ml to 500 ml of milk which gradually increased to 4-5 kg. On the face value the technology seemed to be fit for field condition. However, farmers’ reservation for keeping a non-productive animal was a big constraint. Moreover, unpredicted production of milk after the treatment would also instigate the farmer to get rid of such animal.

On the other hand the practice of giving oxytocin injection to the animals for milk led down was found very common in all types of animals in field condition. It was observed that dairy farmers or even ladies were trained to give this injection to the animal before milking. The technology found to be very popular as it stimulated animal to give milk which otherwise would have been retained by the animal and would have caused problems like mastitis. Farmers opined that there was no harm either to animals or to the consumers due to oxytocin injections. As the technology is highly need based and brings very good returns (i.e. 3-5 kg of milk by one injection costing hardly Rs. 1/-), farmers have adopted it completely and feel at ease while using the technology. In such technologies efficient information management played a key role.
Constraints in information flow

Stockmen of village were the most reliable source of information, followed by neighbours, extension worker, input suppliers, marketing agent and radio. Once the information is acquired for confirmation and evaluation of it they were depending on neighbours. The input suppliers and marketing agents who visit the village from outside were also assumed as cosmopolite sources of information. The mass media played only a marginal role as source of information. Dairy Samachar which is an extension publication of NDRI, meant to be read by dairy farmers were not reaching them. The main source of information for extensionists regarding the dairy farmers was stockmen. Hardly any leaflets or pamphlets released by research institutes for extension personnel were reaching them.

It was observed that researchers were totally alienated from extensionists as well as farmers except a few concerned with IVLP or FSR. The main priority for selection of research problems were the mandate of the institute reflected in the practical utility of research project. There was no mechanism for researchers to be knowledgable about indigenous technology (IT) and build upon their research on it. There were no joint problem diagnosis with extensionists or farmers. Few researchers were interested in farm related programmes of television and radio. However, they were found reading newspaper articles related to dairying, whenever published.

No structural mechanism existed in NDRI for the co-ordination of Research and Extension. Even in programmes like Institute village linkage programme (IVLP) where extension had a major role to play, were mainly handled by subject matter specialists. NDRI being an apex body of dairying in India is not having any
functional linkages with departments of animal husbandry/dairying. A proper strategy for structural and functional linkages has to be planned for the successful implementation of such programmes.

Marketing agencies such as HAFED was found dealing with Dairying mainly in feeding aspects. Their linkage with extensionists and researchers was found very weak especially related to extension aspects. Milk vendors and medical agents were also having close linkage with farmers and extensionists. In many instances they were found giving advice on recent technologies and on the ways of achieving high milk production.

Attention should be given to the responses of the changing trends and involve different actors and linkage mechanisms for different types of technology. The findings on the study of the technology triangle also emphasised the need that research managers to monitor and evaluate links and to introduce measures or adjustments which accommodate the changes. This was seen requiring considerable time and energy as well as flexibility and creativity in the design and management of linkage mechanisms.

Role perception of various actors in DKIS

The role perception of researchers, extensionists, input suppliers, marketing agency, stockmen and farmer were critically studied based on personal interviews and discussions. The researchers perceive their role as generator of information in this DKIS. They did not believe it their duty to transfer the research findings or technologies to extensionists or to farmers.
None of the researchers perceived it their role to discuss with extension personnel neither for priority setting of research agenda nor for decision making on which technologies were to be transferred. It was observed that the perception of researchers in the Karnal DKIS was continuing with the TOT model - this might be one of the reasons for ineffective research-extension linkage in this DKIS. The researchers need to develop clear perceptions related to indigenous knowledge and farmers experimentation. Formal research and extension could be made more effective by collaborating with experimenting farmers, improving two-way transfer of knowledge between scientists and farmers and linking into farmers' communication networks.

Extensionists perceived their role as the disseminator of information and farmers as users. They were aware of their role in feedback of the responses from field to the researchers, but felt constraints in doing so because of improper linkages. Diagnosis of constraints in adoption of various innovations were also perceived to be one of their important function. Extensionists did not perceive it their role to seek appropriate technologies from researchers. They did not visualise any role in assigning priorities for research agents. They did not assign themselves any role in capacity building or in empowerment of farmers. The field extension workers did not perceive any role in tapping of indigenous knowledge and analysing the priorities of farmers.

Extension agents must understand farming as a whole, be able to communicate effectively with farmers to identify appropriate options and effectively draw on different sources of information or assistance (often farmers themselves), and not just be conveyors of messages. In short, they must move beyond the simple liner, unidirectional transfer of technology notion. The new role for extension is
not merely a disseminator of information but emphasise on activities such as skill
development and specialized training. It was observed that in the present setup of
the extension system there was hardly any distinction made between the
recommendations and extension messages. Extensionists have to be made aware
of their role in transformation of research recommendation into proper extension
messages. Because of improper perceptions of extensionists regarding the role of
women in dairy production. They are out of the target of many of the dairy
extension programmes. In such cases technical intervention remain inappropriate
and unused because they do not meet women's needs and priorities.

Dairy farmers did not perceive their role as a user of technology produced
by scientist and transferred by extensionists. Most of them felt that often they were
used by research-extension system to test their technologies. They perceived their
role only to the extent of milk producer and expected the government agencies to
provide them all facilities required for dairying like good quality semen, personnel
for insemination at their door steps, veterinary doctor for health care, good seeds of
fodder crops and good quality compound feed for high yielding animals. Their
perception regarding achieving the above mentioned needs through own efforts or
through co-operatives was very poor. It was observed that the women who really
work in the field, rare cattle and make dung cakes for fuel never realized that they
were doing something extra ordinary. They perceived their role as simply fulfilling
their part of the household. Thus, this study emphasise the need to make farmers
aware of their role equally important as a research or extensionist in the systems
perspectives of the dairy knowledge information system.

The milk vendor moves around the village from farmer to farmer for
collection of milk, he often perceived his role as disseminator of information in the
local farmers' information system, he perceived his role also as a contacting agency with veterinary doctors and input agencies. The milk vendor has no perception of any role in relation with researcher, extension scientists and extension agencies. Another unique role played by milk vendor was giving financial assistance to dairy farmers. However, being a non-formal commercial agency, the milk vendor has not been included in the dairying system up to now. Still it could be thought of assigning him a role of informal information disseminator and receiver.

The main input agents operating in the village had concern with cattle feeds, fodder seeds and recently the private A.I. agents. They all perceived their role only to the commercial limits. However, they believed in having contact with researcher and veterinary doctor to know about advanced health care practices, breeding and feeding related knowledge. Input agencies perceived it their duty to have regular contact with extension workers of the village to sustain and promote their activities. In the DKIS perspective input agencies are recognised as actors who could influence the knowledge system in its various interfaces, acting with in their commercial operations.

5.2 INFORMATION MANAGEMENT IN DKIS -
A MODEL FOR DEVELOPING COUNTRIES

The present research identified that the real problem in successful and sustainable dairy development was in the information management in the interfaces of links between the various actors in the DKIS. For the effective information management the knowledge and information system perspectives emerged as the best approach where all the actors, whether researchers, extensionists, farmers, marketing agencies or input suppliers had equal role in the system i.e. knowledge

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could be produced by any actor of the system and information could pass from any actor to another in any direction. This outlook assigned equally important role to farmer as researcher and pointed towards the importance of farmers' experimentation and farmers first approaches. The importance of user control on research was also emphasized by Roling (1989). Empirical evidences from effective AKIS clearly demonstrated that user control in some form was an essential ingredient.

A careful examination of the present study, where information management in Dairy Knowledge and Information System (DKIS) is systematically analysed, suggested that in Indian conditions where majority of farmers were illiterate and living in remote villages, the direct user control and intensive participation of farmers in research was difficult to achieve. The model evolved out of this study pointed out that the social dimensions of farmers, policy decisions, heterophylly gaps and strength of linkages came into play in the context of user control on research. Wherever these factors were not favourable direct user control was difficult to operationalize and participation was limited to the passive mode, where the needs, priorities and problems of farmers were conveyed to the researchers through the extensionists. The difficulty in institutionalizing farmers participation in research was reported by others workers also (Nagel, 1979; Merrill-Sands and Kaimowitz, 1997). Yet Ashby (1990) argued that the full benefits of participation could be gained only when farmers has active role in setting the course of research.

The present research clearly emphasized the importance of science based innovation for dairy development not because farmer initiated innovation was not important by its' operationalization was difficult in developing countries. The importance of science based innovations was also elaborated by some of the earlier
studies (Nagel, 1979; Lionberger and Chang, 1981; Swanson, 1986; McDermott, 1988). According to Kaimowitz et al., (1989) innovations which were policy driven were equally, if not more, important than science based technical innovations. In the proposed DKIS model (Fig. 19) the user control attained a very important role in its passive mode. The model suggested the role of extensionists to bring in effective user control through the role of a facilitator, catalyst, intervener, who worked jointly with farmers and researchers. At the farmers level the role of extensionist involved diagnosis of the existing problems interventions, review of responses which in turn were conveyed to researchers.

This model perceived Interface Information Management (IIM) as a crucial factor in between the various actors of the DKIS. In IIM between researcher and farmers and in reciprocal linkages between farmers and researcher, research-extension liaison units were suggested. These units sorted out joint programmes for learning farmers priorities, working knowledge and experiences which were communicated to researchers for development of farmer based technologies. It further transformed the technologies into recommendations, integrated in with farmers working knowledge and experiences and assessed the technologies in the light of their priorities. Maintaining the synergy of the system, the recommendations based on the technologies were translated into understandable extension messages which could be merged into the ongoing farm practices. Extensionists had a vital role in testing facilitating and adaptation of the technologies. In this DKIS model, extensionist had the additional responsibility of capacity building and empowerment of farmers to sustain the developmental activities.
Fig. 19 Model of Information Management in DKIS for Developing Countries
The feedback by extensionists thus attained more significance than direct user control of farmers. This concept may prove true in the context of most of the developing countries. The active user control on research as suggested by Roling (1989) may be apt for developed countries. Connection of human need with human knowledge attained more significance in context of developing countries (Nagel, 1979; Jones et al., 1987; McDermott, 1988). The case studies in the present research, on information management of various dairy production technologies in DKIS substantiated the concept of connection of human need with human knowledge.

This model outstands the comments by Roling (1989) about the INTERPAKS model as a one-way linear system, because of the strong reciprocal links depicted in the model linking farmers and researchers through research-extension liaison units and through extensionists, operating in the research-farmer interfaces. The model also assigned important roles to all the actors and was based on systems approach where generation, dissemination and using of information was done by all actors in the DKIS.