PATTERN OF ADOPTION OF SELECTED DAIRY TECHNOLOGIES BY RURAL HOUSEHOLDS: EVIDENCE FROM TARAI AREA OF UTTARAKHAND

Thesis

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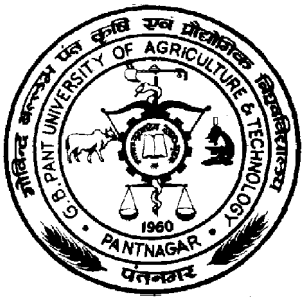

By

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CERTIFICATE

This is to certify that the thesis entitled "PATTERN OF ADOPTION OF SELECTED DAIRY TECHNOLOGIES BY RURAL HOUSEHOLDS: EVIDENCE FROM TARAI AREA OF UTTARAKHAND" submitted in partial fulfillment of the requirements for the degree of Master of Veterinary Sciences in Veterinary and Animal Husbandry Extension, of the College of Post Graduate Studies, G.B. Pant University of Agriculture and Technology, Pantnagar, is a record of bona fide research carried out by Mr. Prakash Mishra, Id. No. 34178 under my supervision, and no part of the thesis has been submitted for any other degree or diploma.

The assistance and help received during the course of this investigation have been acknowledged.

Pantnagar
2008

(D. Bardhan) May
Chairman
Advisory Committee

CERTIFICATE

We, the undersigned, members of the Advisory Committee of Mr. Prakash Mishra, Id. No. 34178, a candidate for the degree of Master of Veterinary Sciences in Veterinary and Animal Husbandry Extension, agree that the thesis entitled "PATTERN OF ADOPTION OF SELECTED DAIRY TECHNOLOGIES BY RURAL HOUSEHOLDS: EVIDENCE FROM TARAI AREA OF UTTARAKHAND" may be submitted in partial fulfillment of the requirements of the degree.

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C O N T E N T S

Chapter 1 INTRODUCTION

India is largely an agrarian economy and 70 per cent of her population is engaged in agriculture. Livestock sector is an integral part of Indian agriculture and plays a critical role in the livelihood of rural population. The contribution of livestock to total GDP was 5.36 per cent in 2004-05, which was 24.72% of the value of output from agriculture (GOI, 2006).

The livestock sector is highly livelihood intensive and provides supplementary income opportunities to millions of rural households, who are either landless agricultural labourers or marginal or small farmers. The marginal producers and smallholders, who account for about 60 per cent of all landholdings, constitute the core livestock production sector (they own about 74, 71 and 79 per cent of cattle, buffalo and sheep and goat population, respectively (CSO, 2003)). Landholding on the other hand is highly skewed in favour of semi-medium, medium and large farmers, who constitute a small proportion of rural households (10 percent), but account for a major share of total cultivable land area (56 percent) (CSO 2003). Livestock sector, therefore, has a favourable distributional impact and thus contribution of livestock to the social and economic well being of the rural poor is being increasingly recognized.

Furthermore, rising population, income growth and urbanization are fueling a world-wide change in dietary patterns in favour of livestock food products. India is also no exception to this phenomenon. Per capita consumption of poultry meat, eggs and milk in India increased at a rate of 7.5, 4 and 2.4 percent per annum, respectively, between 1970-2003. During the same period, consumption of pulses in India declined (-0.9 % per annum), while consumption growth of cereals was very limited

(0.35 % per annum) (Bardhan *et al.*, 2006). The distinct increase in the demand for livestock food products not only contribute to nutritional security, but also provide income growth opportunities for rural poor and hence accelerate the pace of poverty reduction.

Dairying is a crucial component of Indian livestock sector, as milk group alone accounted for 66.90 percent of total value of out put from livestock sector in 2004-05 (GOI, 2006). A ubiquitous aspect of any village in India is that virtually every rural household possesses 1-2 milch animals. Dairying plays a prominent role in Indian rural economy by not only supplementing the income of household, particularly the resource poor but also by providing an important source of employment. Further, for low-income households, dairy animals play multifunctional roles, as they serve as store of wealth and insurance mechanism for coping with household-related crisis and provide drought power and organic fertilizer for crop production.

Dairying in India is largely a small-holder phenomenon; there are hardly any big players in it. Over the last three decades, Indian dairy sector has progressed from a situation of scarcity to that of plenty. The fact that India now occupies the proud position of the highest milk producer in the world, can largely be attributed to millions of landless agricultural labourers, and small and marginal farmers of India who account for the bulk of the country's milk production.

An unique feature of Indian dairy sector is its low productivity. The average milk yield per cow in India was 877 kg/year/cow in 1998, which was far below the world average of 2026 kg/year/cow and other countries like Israel (8615 Kg/year/cow), USA (7767 Kg/year/cow) and Denmark (6716 Kg/year/cow) (FAO, 1998). In fact, as per a recent estimate, 5 dairy cows in India produce as much milk as 1 dairy cow in USA and 10 dairy cows in India produce the quantity of milk that is produced by a single dairy cow in New Zealand (Hemme *et al.*, 2003).

The low productivity could be attributed to, among other factors, traditional dairy husbandry practices followed by farmers. The problem of low productivity can be overcome and exploitation of the opportunities offered by dairy sector can only be fully realized, when the farmers successfully adopt new dairy technologies that are being generated in research institutes. It is well recognized that for increasing milk production and making dairy business more remunerative, it is essential to go for adoption of improved dairy technologies in the field of feeding, breeding, health care and management (Sharma and Bairathi, 1999).

Various research organizations have evolved a number of technologies for application at the field level; however, many of these technologies are not often adopted by the farmers. In fact it has been widely reported that farmers in developing countries with low literacy rates, poor extension services, and inadequate physical infrastructures have great difficulty in adopting new technologies, let alone exploiting their full potentials (Ali and Byerlee, 1991; Pingali and Heisey, 1999). As a result there is wide gap between the technology generation and their utilization by the farmers.

In case of dairy technology also, adoption have been disappointing in India. Not only have adoption rates been low, the technologies have largely failed to spread spontaneously beyond the communities in to which they were introduced by outside extension agents and also across different farmers of same community.

However, it is beyond doubt that improvement in productivity and profitability of small-holder enterprises can only occur when the farmers adopt new technologies on a sustained basis.

In this context, adoption studies assume critical importance, as they provide crucial inputs to policy makers in increasing the efficiency of dissemination process of dairy technologies, and also ensuring their

effective uptake by the farmers. Previous studies on adoption have mostly focused on ascertaining the degree of adoption, factors influencing adoption and constraints in adoption of improved dairy technologies (Arora, 2002; Singh and Sharma, 1995; Sohi and Kherde, 1980; Thorat and Kulkarni, 1994; Singh and Chauhan, 2006; Shinde *et al*, 1998; Rao, 2002; Rakshe *et al*, 1998, etc.). However, scant research attention has been given to describe characteristics of various adopter categories (for e.g. early adopter, late adopter and non adopter). If there is no information about adopter categories, extension service will need more experienced agents and resources to reach farmers. In such cases, the adoption process will probably take longer (Boz and Akbay, 2005). Thus identification of adopter categories of dairy technologies and their common characteristics constitutes an important area of research enquiry.

Research has also lagged behind in investigating the pattern of adoption of dairy technologies; how the adoption and disadoption rates have varied over time, what are the reasons for adoption and disadoption and the impact that adoption of these technologies has had on small holder dairy production system. Findings of such studies could provide crucial insights into factors influencing adoption decision of farmers and thereby furnish information relevant for informing policy makers and development agencies interested in supporting smallholder dairy production.

The present study was designed to address the above issues. The specific objectives of the study were:

1. To assess the patterns of adoption and disadoption of dairy technologies.
2. To identify the factors influencing patterns of dairy technology adoption (early adopters, late adopters and non adopters).
3. To ascertain the impact of adoption of dairy technologies.

Chapter 2 REVIEW OF LITERATURE

In any scientific research, comprehensive review of relevant literature is needed to determine the work done before and assist in the delineation of problem area. Apart from this, it provides the basic theoretical framework, insight in to the method and procedure, suggests operational definition of major concepts and provides a basis for interpretation of results. The review of relevant literature has been compiled in view of the objectives of the study and presented under following sub heads:

2.1 Socioeconomic profile of dairy farmers

2.2 Factors influencing adoption of dairy technologies

2.3 Categorization of farmers on the basis of their pattern of farm technology adoption and factors influencing such patterns

2.4 Impact of technology adoption

2.5 Constraints in adoption of dairy technologies

2.1 Socioeconomic profile of dairy farmers

Ingole *et al.* (1988) conducted a study on 120 respondents in Nagpur district and found that 39 and 42 per cent of respondents were in the age group of 21 to 35 years and 36 to 50 years, respectively. Majority of respondents (76 %) had education either up to primary or secondary level and 18 per cent of livestock owners were illiterate. According to Shinde *et el.* (1998), majority of respondents (65 %) of Udgir block of Latur districts of Maharastra were in the middle age group followed by younger age group (20%) and older age group (15%). They also stated that 46.67 percent of respondents were illiterate, 25 percent were educated up to primary school, 15.83 percent up to middle

school and 12.50 percent attended high school and higher level education.

Singh and Kushwaha (2002) carried out a study in four villages of Shivrajpur Block of Kanpur district on 80 respondents. They reported that maximum number of respondents (33.75%) had primary level of education; while only 6.25 percent of respondents had middle school level of education. About 24 percent of respondents were found illiterate. Majority of respondents (53.75%) possessed 1 to 1.5 hectares of land where as, only 25, 13.75 and 7.50 percent of them had 1.5 to 2 hectares, 2 to 2.5 hectares and 2.5 to 3 hectares land, respectively.

Shinde *et al.* (1998) in a study in Latur district of Maharashtra, observed that 26.67 per cent of the respondents possessed more than 2 hectares of land, whereas, 25.83 percent were landless, 25 percent possessed up to 1 hectare and 22.50 percent had 1 to 2 hectares of land. Seventy five percent of the respondents were involved in agriculture and dairying, while 25 per cent had labour and dairying as a source of income. Among the dairy animal owners, 80 percent had one, 15 percent had 2 and 5 percent of them had three milch animals.

Dwivedi *et al.* (2002) observed in a study in Jhansi district of Bundelkhand region on 84 dairy farmers, that average number of cattle, per household ranged from 0.50 to 1.53 and 0 to 0.13, respectively for non-descriptive and crossbred cattle. It was observed that large farmers maintained more non-descriptive cattle than crossbred cattle. Average milk yield (per day/ head) ranged from 1.1 to 1.25 liters and 5 to 5.5 liters, respectively for nondescriptive and crossbred cattle.

Manay and Farzana (2000) carried out a study on 66 rural families in Karnataka state and observed that 89.4 percent of the families were nuclear and 10.6 percent of them were joint families

having 3-7 members. Most of the families (87.8%) possessed either small or medium farm with less than 5 acres of land

Thorat and Kulkarni (1994) conducted a study in 10 villages of Shirur Tsehsil of Pune district on 117 dairy farmers. Findings revealed that majority of the farmers (61%) had 1 to 2 milch animals and 24 per cent of farmers had 3 to 4 milch animals. Most of the farmers (96%) sold milk to dairy co-operative societies and only 4 % farmers supplied their milk to the private agencies. Findings also reveled that out of the total milk produced, 89 percent of the milk was supplied to the co-operative dairy societies and only 2 per cent to the private agencies. Remaining 9 percent of the milk was used for home consumption.

Sarkar *et al.* (2006a) conducted a study in Cooch Behar district of West Bengal and found that most of the respondents (52%) belonged to age group up to 25 years; sixty percent of them followed cultivation as their main occupation. About six percent of the respondents were illiterate, while none of them were graduate, Around 14 and 2 percent of respondents could read and read and write, respectively. Forty four, 26 and 8 percent of the respondents had education upto primary, middle and high school levels respectively. Most of the dairy farmers had nuclear family (84%), while 70 percent dairy farmers had family size up to 5 members. They also concluded that 54 and 20 percent of farmers possessed land, up to 1 ha and 1-2 ha respectively. Twenty percent of the respondents, on the other hand were landless. Houses of the dairy farmers were 42% mixed type, 30 percent pucca, 26 percent kutcha and 2 percent hut.

Misra and Pal (2003) conducted a study in West Bengal and found that 64 per cent of farmers adopted dairying as subsidiary occupation. On the other hand business and agricultural labour provided subsidiary occupation to 22 and 7 per cent of respondents,

respectively. Most of the households in the study were marginal farmers who possessed less than 1 ha of land while small farmers constituted only 6 percent of total respondents. It was also observed that out of all the farmers 22 per cent were illiterate, 38 per cent were educated up to primary standard, while 40 percent and 5 percent of them had high school and secondary school level education. Average income per household per annum was Rs.26, 013. Revenue generated from dairying was Rs.6504 per household per annum which constituted 25 per cent of the total income.

Arora *et al.* (2006) carried out a study in U.S. Nagar district of Uttaranchal and found that most of the farmers belonged to middle age group (64%). The respondents were mostly less educated as 32 percent were illiterate,22, 26 and 11 percent farmers had respectively primary level, high school and intermediate level of education. Only 9 per cent of farmers were graduate farmers. The respondents mostly belonged to medium sized families (76%). Most of the farmers possessed small herd size (80%) while only 2 percent had a large herd size of 10 or more than 10 animals. Most of the respondents were low milk producers (49%) and only 20 percent were high milk producers. In regard to milk consumption, 74 percent farmers belonged to medium consumer category.

Dixit *et al.* (2006) conducted a study in four adopted villages of Central Institute for Research on Buffalo, and found that majority of the respondents (55%) belonged to middle age group. Most of them (65%) possessed low to medium level of education. About 45 percent respondents belonged to high caste while the remaining was from low to medium categories.

Bardhan *et al.* (2005) conducted a study in Rudrapur block of District Uddam Singh Nagar in Uttaranchal and found that the

maximum number of respondents selected as sample, belonged to the category of landless agricultural labourers followed by small, marginal, large and medium farmers.

Thys *et al.* (2005) carried out a study in Ouagadougou (Burkina Faso) in Western Africa and found that 26.3 percent of the households in Ouagadougou kept livestock, including all major domestic species. The main motivation for keeping livestock in an urban setting is its generation of income.

2.2 Factors influencing adoption of dairy technologies

Kumar and Sidhu (2002) conducted a study in Muzaffarpur and East Champaren district of North Bihar and found that education was positively and significantly correlated with adoption of scientific dairy farming practices.

Rahelizatovo and Gillespie (2004) conducted a study in Louisiana, USA and found that larger, more productive farms with greater financial resources were the most frequent adopters of best management practices. They also concluded that younger, more educated farmers who had been in business for a shorter time, as well as those who had a family member planning to take over the farm upon the farmer's retirement were more likely to adopt best management practices.

Ghosh *et al.* (2004) in a study in West Bengal found that socioeconomic variables like age and education of the respondents were significantly correlated with adoption of improved animal husbandry practices. Communication source and knowledge about deworming were the key variables that directly and indirectly influenced the adoption of improved animal husbandry practices.

Mahipal and Kherde (1989) conducted a study in Karnal, India and found that the farmers who possessed higher socioeconomic status, large herd size, higher knowledge of dairy innovation, higher change proneness, higher level of aspiration, and more utilization of mass media and informal sources, adopted more scientific dairy farming practices.

Chugh and Chand (1996) in a study in Karnal district of Haryana found that age, military service and knowledge of selected dairy farming practices were positively and highly significantly correlated with adoption of scientific dairy farming practices.

Verma and Sharma (2003) found that members of the dairy cooperative societies had higher adoption level of all major improved animal husbandry practices than non members. He concluded that the impact of Alwar Dairy Union Rajasthan, in the adoption of improved animal husbandry practices, was significant and positive but still there is a need to improve the adoption level of dairy members in Rajasthan. They also found that variables like age, education, landholding, income, family size, family type and herd size had significant and positive influence on adoption of major animal husbandry practices in Alwar district of Rajasthan.

Sarkar *et al.* (2006a) in a study in Cooch Behar district in West Bengal found that such attributes of dairy farmers like young age, education above primary level and belonging to agriculture caste and nuclear family exerted significant positive influence on adoption of improved animal husbandry practices.

Sarkar *et al.* (2006b) in a study in Cooch Behar district of West Bengal, found that education, urban contact, communication sources, attitude, family economic status of the Rajbanshi dairy farmers were

highly significant with adoption of improved animal husbandry practices.

Rao (2002) conducted a study in Chittoor district, Andhra Pradesh, India and found that several socioeconomic and psychological variables exerted positive and significant influence on adoption of dairy practices. Women with higher socioeconomic status, more education, higher herd size, and higher levels of aspirations and scientific orientation assisted by more extension contact and higher technical input services adopted more scientific dairy production practices.

Goswami *et al.* (2000) carried out a study in Sunderban, West Bengal and found that owners' attitude towards innovations and dairy farming, as well as their knowledge of artificial insemination and vaccination and concentrate feeding were significantly correlated with the adoption of selected animal husbandry practices.

Bheemappa *et al*. (1990) found that the personal characteristics of beneficiaries of dairy project under IRDP, such as education and extension participation were significantly associated with adoption level, whereas for age and family size, there was no significant association.

Obinne (1996) found that social participation and extension contact were significantly related to the adoption of improved livestock management practices. He concluded that Sustained farmer education programme is vital to ensure adoption of improved livestock management innovation, but there is a real need for extension agents to work with groups of farmers in Nigeria.

Singh and Sharma (1995) found that the factors which discriminated adopters from non adopters of dairy farming practices were knowledge of dairy farming and business, the number of milking animals, land holding, education, attitude towards the dairy industry, mass media exposure and extension contact.

Raut *et al.* (1989) conducted a study on 180 dairy farmers selected randomly from 10 villages of the Ahmednagar district, and found that most of the respondents were aware about improved dairy practices, such as artificial insemination and dehorning, but most of them did not adopt them for socioeconomic reasons.

Yadav and Yadav (1997) conducted a study in Haryana state to assess level of adoption of buffalo husbandry practices among farmers and concluded that social participation had highly strong association with the level of adoption of practices of housing, feeding, breeding, disease prevention and sale-purchase. Social participation was not found to have any significant association with the adoption of milking, calf rearing and calf management practices.

Sheoron and Kumar (1988) also observed that social participation had no significant relationship with adoption of different dairy practices.

Dixit *et al.* (2006) conducted a study in four villages of Central Institute for Research on Buffalo and found that caste, family education and herd size were positively and significantly associated with the adoption of artificial insemination.

Mahipal and Kherde (1989) conducted a study in Karnal and found that the dairy farmers who possessed higher socioeconomic status, large herd size, higher knowledge of dairy innovation, higher change proneness, higher level of aspiration, more economic motivation, more contact with extension agencies, more utilization of mass media and informal sources, adopted more scientific dairy farming practices.

Goswami *et al.* (2002) carried out a study in Sunderban, West Bengal and found that five factors which had largest effect on adoption of selected dairy husbandry practices were social participation,

knowledge about cultivation of green fodder, personal localite, family educational status and age. Factors like mass media communication, knowledge about deworming, communication skill, risk orientation and attitude towards dairy farming on the other hand exerted mostly indirect effect.

2.3 Categorization of farmers on the basis of their pattern of farm technology adoption and factors influencing such patterns

Alene and Manyong (2006) conducted a study in Northern Nigeria and found that there is important difference in technical efficiency between the lead farmers and the follower farmers in the farmer-to-farmer seed diffusion process. The results revealed important efficiency differences between the lead farmers who have contacts with the breeders and the follower farmers who got technology and information from the lead farmers.

Boz and Akbay (2005) carried out a study in Kahramanmaras province in Turkey to ascertain the extent to which selected socio-economic characteristics and communication behaviour variables influenced early, late and non-adopters of maize and found that adoption of maize was influenced by the educational level of farmers, income, farm size, travels to nearest town, opinion leadership, use of extension personnel, mechanization level, credit use, and agricultural investments. They found that early adopters of maize possess more such characteristics like education, income, farm size etc. than late adopters sand non-adopters.

Dixit *et al.* (2006) conducted a study in four villages of Central Institute for Research on Buffalo to assess adoption process of A.I. and found that the 80 percent of farmers selected for the study had gone for artificial insemination at least once and 55 percent of respondents

continued A.I. for second and third time while 45 per cent discontinued the practice after availing the practice only once.

Singh and Kumar (2007) conducted a study in Haryana among 200 dairy farmers who were regular members of Milk Producers Co-operative Societies and found that majority of early adopters had high level of innovativeness in accepting artificial insemination for their dairy animals. On the other hand, a large number of early majority dairy farmers had only medium level of innovativeness in accepting artificial insemination for their dairy animals. It was also observed that a large number of dairy farmers belonging to late majority category had medium level of innovativeness for timely vaccination against contagious diseases. However, almost two third of dairy farmers in late adopter category had reported to have low level of innovativeness for pregnancy diagnosis; where as, a very large number of laggards had low level of innovativeness for pregnancy diagnosis.

Nicholson *et al.* (1999) in a study in Coastal Kenya observed that 51.72 percent of households interviewed for the survey, adopted G/C cattle at some time. However these households acquired their first G/C cattle at very different times, between 1974 to 1996. About 27 percent of adopting households no longer owned a G/C animal at the time of survey. The findings also revealed that the number of households who planted Napier grass as well as total number of acres of Napier grass planted declined since 1993.

Baltenweck and Staal (2000) carried out a study in eight districts located in 3 provinces of Kenya highlands to identify the determinants of Grade or CB dairy cattle technology adoption over time. Recognizing that time plays key role in the adoption of dairy technology, the study focused on dynamics of adoption process rather than concentrating on cross sectional analysis. The findings revealed that

smallholders delay adoption because of poor credit accessibility and bad road infrastructures. It was also observed that liberalization of dairy industry (closing of some dairy cooperatives and privatization of livestock services) slowed down the speed of adoption. It was thus concluded that liberalization policies needed to be accompanied by interim support for farm services and market mechanisms to maintain technology adoption trends.

Moser and Barrett (2006) carried out a study in rural Madagascar to assess the dynamics of smallholder adoption of a high yielding, low input technology, called system of rice intensification (S R I). They observed that quite a low proportion of farmers (25%) adopted the technology during 1993-99. Moreover, only 15 percent of farmers were practicing S R I during the time of survey (1999) implying a high rate (40%) of disadoption. Proportion of farmers who were adopters increased consistently since 1993, but declined significantly during 1 year prevailing the survey. The proportion of farmers who were disadopters increased substantially during the last two years. Farmers' education, labour availability and liquidity were observed to effect decisions regarding the use pattern of technology. Seasonal family labour and liquidity constraints prevent farmers from taking advantage of S R I.

2.4 Impact of technology adoption

Nicholson *et al. (*2004) conducted a study in Coastal Kenya to ascertain the impact of dairy cow ownership and found that households owning dairy cows reported significantly higher gross cash income per month and much of the difference between these households and those without dairy cows is due to revenues from milk sales. A larger proportion of the households with dairy cows (75%) consumed milk. The

average number of labourers employed was larger for these households than for households without dairy cattle. Total payments to hired labourers are also substantially different for households with and without dairy cows.

Kumar *et al.* (2006) conducted a study at two IVLP (Institute Village Linkage Programme) centres namely; NDRI Karnal and IGFRI Jhansi and found that IVLP had made desirable impact in reducing age at first calving (AFC) of heifers, which was mainly attributed to better feeding, health care and management practices adopted by the farmers in the study area over a period. Increased awareness and economic motivation in dairying might have led them to maximize their income by reducing AFC. Similarly Verma (1993) also observed reduction in AFC due to dairy development programmes of cooperatives. The mean lactation length (LL) increased by 1.1, 0.6 and 1 month in case of local cattle, crossbred cow and buffaloes, respectively. The mean difference in LL over a period showed an increasing trend in the IVLP villages. Findings of this study are in tune with observation of Nachimuthu (2002) who reported increased lactation length because of animal husbandry programme. Several other studies also reported reduction in dry period due to dairy development programme. viz. Rao *et al.* (2000) and Nachimuthu and Kumar (2004)

Nicholson *et al.* (1999) conducted a study in coastal area of Kenya to examine the adoption of three related technologies viz. Grade or crossbred dairy animal Napier grass and ECF immunization and to assess the impacts of dairy adoption on household income, employment generation and nutritional status of pre school children. The findings revealed that average cash income per month from dairying was much higher for adopting households (Ksh. 6809/month) than non-adopting households (Ksh.321/ month). Adoption of G/C cattle also had

beneficial impact on employment generation, as 66 percent of adopting households reported employing at least one permanent labourer compared with 15 percent of non-adopting households. However adoption of G/C cattle did not have any significant influence on nutritional status of pre-school children as it was observed that the prevalence of acute malnutrition (as indicated by anthropometric measure for children) was little affected by adoption status.

Halakatt *et al.* (2007) carried out a study in Hareri district of Karnataka to understand adoption process and impact of adoption of dairy innovations on milk production, consumption, income and employment generation. The findings revealed that high adopters, medium adopters and low adopters of dairy farming technologies differed significantly among themselves with respect to all the above mentioned parameter of impact assessment. Milk production per animal per year was high for high adopters (882 litres) compared to low adopters (275.5 litres). Household milk consumption in respect of low, medium and large adopters were 77.8, 94.8 and 187.7 litres per year, respectively. Net income obtained through sales proceeds of milk in respect of low, medium and high adopters were Rs. 614.4, Rs.948.5 and Rs. 1450.4, respectively. Low, medium and high adopters generated employment of 79.8, 91.3 and 136.9 person days, respectively.

Kristjanson *et al.* (2005) in a study in dry Savannas of Nigeria observed that adoption of dual purpose cowpea by farmers exerted multiple benefits from this leguminous crop, many of which relate to fodder and soil fertility enhancing aspects rather than higher grain yields.

2.5 Constraints in adoption of dairy technologies

Singh and Chauhan (2006) carried out a study in Tonk and Jhunjhunu districts of Rajasthan and found that the major constraints in dairying in respect to breeding were poor conception rate, repeat breeding and ineffective treatment of repeater and anestrous animals followed by inadequate knowledge of A.I. As regard to feeding of animals, main constraints were the high cost of feed and fodder and poor resources for raising fodder crops. Other constraints under feeding of animals were the poor availability and high cost of compound feed, mineral mixture and fodder seeds. In respect to management and health, ill equipped veterinary hospitals, lack of facilities for treatment, vaccines and medicines, high cost of treatment, lack of veterinary dispensaries and poor knowledge of scientific management and animal health care practices were perceived as major constraints.

Dabas *et al*. (2004) carried out a study in Rudrapur block of Udham Singh Nagar and reported several constraints faced by the rural women in rearing dairy animals. They observed that 39.16 per cent of the respondents perceived constraints in the area of disease control and management practices. About 12.5 per cent, 9.16 percent and 6.67 per cent of the respondents considered high cost of treatment, inadequate housing and non availability of veterinary aid centre as their main constraints, respectively.

Podikunju *et al*. (2001) conducted a study in Girwa Panchayat Samiti of Udaipur district of Rajasthan and identified the constraints faced by tribal and non tribal farm women in dairy management and the significance of difference in constraints between tribal and non tribal women with regard to improved animal husbandry practices. He concluded that lack of improved sire was most important constraint faced by tribals in breeding while in case of non tribal, poor results of A.I. was the most important constraint faced by them. In the area of

feeding, high cost of concentrate were perceived as main constraints by the farmers of both categories.

Jain (1969) reported that the shortage of good pedigree bulls and inadequate number of A.I. centres are important constraints faced by the farmers.

Narayan and Honnappa (1987) in a study reported that one the most important constraints in adoption of A.I. was poor results with A.I.

Sohi and Kherde (1980) found in a study that the higher cost was the main reason for not providing balanced and commercial feed to the animals.

Misra and Pal (2003) conducted a study in West Bengal to identify constraints in dairying. The respondents quoted inadequacy of technical knowledge (40.3%), poor organizational support (28.6%) and lack of financial resources (20.1%) as the major constraints. Problem of repeat breeding, high cost of veterinary service and distance location of A.I. centre were also reported as some other major constraints in dairy farming.

Kavathalkar *et al.* (2007) conducted a study in Nagpur district of Maharashtra and identified the financial constraints in adoption of scientific recommendation in feeding of dairy animals. These constraints were high cost of concentrates with (88.88%), high cost of green fodder (79.25%), non remunerative price for milk (83.70%) and poor economic condition (54.07%).The other main constraints were non availability of surplus grain for feeding, lack of scientific knowledge, non availability of agro-industrial by products, lack of machinery and lack of interest in dairy business.

Palanisamy *et al.* (2003) carried out a study in Cheyyar taluk of Thiruvannmalai district of Tamilnadu and found that the major constraint perceived by the farmers was lack of awareness about the

ideal time of artificial insemination due to poor heat detection process (perceived by 90% of farmers). A major proportion of farmers (87%) perceived non-availability of green fodder as a constraint. This finding is also supported by that of Rao (1998). He also reported lack of training on modern dairy cattle management practices as a major constraint as it was reported by 81 per cent of dairy farmers. This finding is in agreement with the finding of Vyas and Patel (2000) who also reported the same constraints while adoption of modern cattle management.

Bardhan *et al.* (2005) conducted a study in Rudrapur block of District Uddam Singh Nagar and concluded that the major constraints as perceived by the farmers in rearing their dairy animals were non-remunerative price of milk, testing of milk on the basis of fat percentage only, reproductive problems, distant location of A.I. centres and high cost of feed and poor quality of concentrates. Raju *et al.* (1993) also concluded that distant location of A.I. centres was major constraint being faced by the farmers.

Singh *et al.* (1995) in their study reported that the major constraints perceived by the respondents were low animal productivity, high age at first calving in local cows and buffaloes, repeat breeding, anoestrus in buffaloes, inadequate availability of green and dry fodders, high cost of concentrates, tick infestation, high mortality in crossbred male calves, low price of crossbred cow milk, lack of milk marketing facilities and disposal of crossbred males.

Agrawal *et al.* (2007) conducted a study in Punjab, Karnataka and West Bengal and revealed that in Punjab lack of progeny testing bulls (92%), non availability of HYV seeds of different fodders (84%), low fat percent in crossbred cow milk (78%), high mortality in crossbred males (67%) and repeat breeding (65%) were major constraints as reported by majority of adopters of cross breeding technology. Among

social constraints, inability to take the animals to A.I. center (49%) was the only serious constraint in Punjab and West Bengal.

Meena and Fulzele (2006) conducted a study in Udaipur and Banswara district of Rajasthan and concluded that majority of respondents experienced the constraints such as lack of good breedable bulls, lack of A.I. centres, ill equipped A.I. centres, lack of service at A. I. centres, distant location of veterinary hospitals in regard to breeding practices. In regard to feeding practices respondents reported high cost of concentrate mixture as major constraint. As far constraints in management are concerned, these were non availability of livestock extension officers and veterinary doctors in time.

Rao (1981) carried out a study in Chittor District of Andra Pradesh and found that crossbreeding technology was rejected or its adoption discontinued by the farmers because of repeat breeding problems. Tyagi and Singh (1977) reported that crossbred males grow into inefficient bullocks and were not useful for draught purposes.

Where as Sharma (1980) found that there is no market value for male calf.

Rakshe (1998) conducted a study in Kolhapur district of Maharashtra and found that the economic constraints faced by the farmers were unavailability of capital and timely loan, high cost of feed and fodders and non-remunerative prices for the milk.

Chapter 3 METHODOLOGY

The present investigation was designed to study the pattern of adoption of selected dairy technologies, factors influencing the pattern of adoption and impact of adoption of package of selected technologies.

This chapter describes the methodology that was adopted in this study to achieve its stated objectives. The chapter is arranged as follows:

3.1 Selection of technologies

3.2 Study area

3.3 Sampling of respondents

3.4 Data collection

3.5 Variables and their measurement

3.6 Data analysis

3.1 Selection of technologies

A number of technologies in dairying have been developed. These technologies vary in regard to several parameters, viz. relevance for the farmers, intensity to which they have been disseminated, resource and knowledge intensiveness that they embody, etc. Analysis of adoption pattern of all these technologies, on equal footing, hence, might not be feasible. For this reason, the first task, thus, was selection of those technologies, the analyses of which would be meaningful and in

congruence with the objectives of this study. For this purpose, a technology identification questionnaire was developed, which consisted of a list of 10 dairy technologies, viz. Artificial Insemination (AI), Complete Feed Block (CFB), Crossbreeding, High Yielding Variety (HYV) fodder seeds, Vaccination, Deworming, Urea Mineral Molasses Brick (UMMB), Embryo Transfer Technology (ETT), Urea treatment of dry fodder and Mineral mixture. This questionnaire was presented to a panel of 10 experts, consisting of senior faculty members of College of Veterinary and Animal Sciences, Pantnagar, who have practical experience at field level in regard to technology dissemination; Veterinary Officers of Block Veterinary hospitals in Rudrapur, Gadarpur, Dineshpur and Kiccha and Chief Veterinary Officer of Udham Singh Nagar District. The objectives of this study and the questionnaire were clearly explained to the experts. They were then asked to rank the technologies in order of the relevance of these technologies for this study; the most relevant technology be given the first rank and the least relevant, the last. The criteria for this ranking also included the importance of the technology for the rural households in the study area and the duration through which the technology has been disseminated.

In order to give overall rankings to the technologies, the rankings given by the experts were converted into scores on a 10-point continuum. The technology ranked first by an expert was given a score of 10, and the one ranked last by the same expert was given a score of 1. The scores thus obtained for each technology were aggregated across all the experts and the mean score for that technology was obtained. The technologies were then ranked on the basis of their mean scores. Four technologies, which received the highest rankings were selected, viz. AI, vaccination, deworming and crossbreeding. The analyses in

regard to the adoption patterns, in this study, have thus been carried out for these four technologies.

3.2 Study area

The study was carried out in U.S. Nagar district of the newly created state of Uttarakhand. The district is one of the only two districts of the state, which are located in the plains. The district is a highly prosperous region and accounts for about 5.66 per cent and 14 per cent of the state's cattle and buffalo population, respectively. Dairy husbandry forms a source of livelihood for almost all the rural households of this region and thus, the dairy sector is considered to have high prospects to uplift the status of the rural population. The lion's share of the state's veterinary infrastructural facilities viz. animal health units, artificial insemination centers, semen banks etc. are located in this region, due to which farmers have frequent access to crucial livestock services and technologies. Out of seven blocks in the district, Rudrapur block was selected purposively as it is an agriculturally frontline region of the district. From this block a total of five villages, *viz.* Raghownagar, Anandpur, Azadnagar, Dupaharia and Bhanga was selected randomly. The villages were selected so as to ensure adequate representation of areas which vary in regard to proximity to markets, main occupation pursued, herd size and credit availability.

3.3 Sampling of respondents

Complete enumeration of all households possessing at least one milch animal, in each of the selected villages was made by interacting

with the village pradhan. Many literature on socio-economic aspects of dairying, including those on adoption of dairy technologies, are available wherein the respondents have been classified on the basis of landholdings (Kavathalkar *et al.* 2007; Sarkar *et al.* 2006a; Bardhan *et al.* 2005; Misra and Pal, 2003; etc.) or dairy herd size (Kumar *et al,* 2006). The purpose of such classification was to ascertain how the variable under measurement (say adoption) differs across different categories of landholders or herd size owners. While this is an important aspect of research analysis, given the relatively greater importance of livestock in the livelihood of rural poor than that of the richer section in India, classification of respondents according to 'wealth' status becomes a more pertinent and logical basis of classification. This assumes greater importance in adoption studies as adoption of farm technologies is crucial in increasing productivity and thus the welfare of the farmers. Classification by wealth status would thus provide critical insights into how the respondents belonging to different wealth categories differ in the adoption process. Such findings would provide crucial inputs into developing 'pro-poor' strategies in regard to technology transfer. There have been few studies with respect to dairy farmers' decision making processes, which have used the 'wealth status' basis of classification, viz. Ahuja *et al.* (2003a), Ahuja *et al.* (2003b), Irungu *et al.* (2006) etc. Some studies on adoption of agricultural technologies have also classified respondents according to wealth status, viz. Kristjanson *et al.* (2005). However scant literature is available in regard to adoption of dairy technologies, more so in the Indian context, which have adopted such basis of classification. Thus, the respondents in this analysis have been classified according to their wealth status. The wealth status variable of the respondents was measured by preparing a wealth index.

For this, a method as described in Kristjanson *et al* (2005) was adopted in this study. In each of the five villages, four individuals familiar with every household of the village were asked to conduct a wealth ranking exercise for each of the enumerated households. Three wealth ranks were used resulting into a score of 3 points for households they classified as relatively wealthy, a score of 2 for those in the middle category and a score of 1 for relatively poorer groups. The four scores were then averaged for each household and on the basis of this average score, a household was classified as poor (if the average score was less than (mean score - S.E.)), middle-class if the score was in between (mean score - S.E.) and (mean score + S.E.)) and rich (if the score was more than (mean score + S.E.)).

A sample comprising 25 percent of total number of enumerated households in each village was then randomly selected, having representation from different wealth categories on proportionate basis. Thus, a total of 80 households were selected for the study. Table 3.1 elicits wealth category wise distribution of selected households.

Table 3.1: Wealth category wise distribution of sample households

Wealth category	Total households	Households selected in sample
Rich	87	22
Middle class	153	38
Poor	79	20
Total	319	80

3.4 Data collection

A comprehensive, well structured schedule was prepared to collect relevant data for the analysis. The schedule was validated by a panel of experts. A pilot survey was carried out on two randomly selected households from each of the five villages, as a part of preliminary testing of the schedule's feasibility. Slight modifications were made in the schedule as per the inputs from the respondents to improve its reliability. This pre-tested interview schedule was than used for the final survey. Data were collected by personally interviewing the head of the household on the following specific aspects:

i. Personal characteristics (age, education, occupation, etc.);
ii. Farm-specific characteristics (herd size, land holding, farm income, share of dairying in farm income etc.) and
iii. Patterns of adoption and disadoption (year of adoption and disadoption, reasons for disadoption and non adoption and constraints in adoption, for each of the selected technologies, viz. A.I. vaccination. deworming and crossbreeding).

3.5 Variables and their measurements

There are many variables which might influence the pattern of adoption of dairy technologies. These variables may be broadly classified into the following groups:

i. Socio-economic variables:

a) Farmer and family specific variables
b) Farm specific variables

ii. Communication behaviour variables

iii. Psychological variables (Attitude and perception towards risk)

iv. Institutional variables (Access to credit, market, etc.)

Description of the variables analyzed in the study under each of the above groups is given in table 3.2. The variables were selected after extensive review of relevant literature

Table 3.2: Definition of variables used in analysis

Sl. No.	Variables	Description
i.	Socio-economic variables	
a)	Farmer and family specific variables	
1.	Age	Chronological age of head of households
2.	Education	Level of formal education of household head
3.	Member Male Female	Number of members in each household surveyed Number of members in household, gender wise
4.	Family type	Whether joint or nuclear
5.	Occupation	Both main and subsidiary sources of livelihood
6.	Membership of group	Whether belongs to a farmers' group or any other organization Yes – 1 No – 0
7.	Wealth status	Wealth status as measured by wealth index
8.	Non-farm activity of head of household	Whether head has non-farm activity

		Yes – 1 No – 0
9.	Farm owner is farm decision maker	Whether the farm owner is also the farm decision-maker Yes – 1 No – 0
b)	Farm specific variables	
1.	Landholding	Area of land under the ownership of household (acres)
2.	Herd size	Dairy herd size under the ownership of the household measured in terms of Standard Animal Units (SAU)
3.	Annual farm income	Annual income from farm – crop, livestock and any other farm enterprise
4.	Share of dairying in farm income	Contribution of dairying to total farm income (%)
5.	Annual non-farm income	Income from sources other than farm enterprises
6.	Milk production	Average milk production per day per household for last six months prior to time of survey
i.	Proportion of milk sold	Percentage of milk produced which is sold
ii	Proportion of milk consumed	Percentage of milk

		produced which is retained for home consumption
7.	Farm experience	Number of years involved in farming
ii.	Communication behaviour variables	
1.	Mass media exposure	Mass media exposure as measured by mass media exposure score
2.	Extension contact	Extension contact profile as measured by extension contact score
iii.	Institutional variables	
1.	Distance to market	Distance in Km. to nearest market
2.	Visit to market	Frequency of visit per week to market
3.	Hired labour problem	Whether non-availability of hired labour is a problem Yes – 1 No – 0
4.	Credit access	Whether access to credit is easy Yes – 1 No – 0
5.	Information access	Whether access to information is easy Yes – 1 No – 0
iv.	Psychological variables	
1.	Risk attitude	Risk averse or risk taking

		as measured by risk attitude scale
2.	Risk perception	Perception towards risk in dairy farming as measured by risk perception scale

Some of the variables mentioned above need further clarification in regard to their measurement. Following is the detailed description of such variables:

3.5.1 Socioeconomic variables

3.5.1.1 Age

It refers to the age of heads of households, selected in the sample, at the time of interview and determined by direct questioning. The data were collected and the respondents were categorized (Ram, 1994) as follows:

Lower age group : Less than (Mean- S.D.)

Middle age group : (Mean- S.D.) to (Mean+ S.D.)

Upper age group : More than (Mean + S.D.)

3.5.1.2 Education

The formal level of education taken at school or college level by the head of the household. A 6-point scale was assigned as follows:

a. Illiterate:	0
b. Up to Primary:	1
c. Up to Middle:	2
d. Up to High School	3
e. Up to Intermediate	4
f. Graduate and above	5

3.5.1.3 Family size

The number of members living together.

3.5.1.4 Family type

Type of family is either nuclear or joint. In this study a family with only husband, wife and their children was referred to as nuclear family. Family in which apart from the above members, other relations like father, mother, and brother with children, of the head of the household, lived together was referred to a joint family. The respondents were asked about his family type by direct questioning at the time of interview.

3.5.1.5 Land holding

It means the total area of land (in acres) owned by the household at the time of interview. The data were collected by asking direct questions from the household head about his land holding.

3.5.1.6 Herd size

Herd size indicates the total number of cattle and buffalo (including bulls, bullocks, calves and heifers) possessed by the household at the time of data collection. The herd size per household was calculated in term of SAU's as per specification provided by Kumbhare *et al.* (1983), which are given in table 3.3:

Table 3.3: Specifications of SAU

Sl. No.	Description	score
1.	Local cow	1.00
2.	Crossbred cow	1.40
3.	Buffalo	1.30
4.	Bullock	1.00
5.	Crossbred heifer (> 2 year)	1.00
6.	Crossbred heifer (> 1 year)	0.75
7.	Buffalo local heifer (> 2 year)	0.75
8.	Buffalo local calves (> 1 year)	0.50
9.	Other calves (< 1 year)	0.33

3.5.1.7 Milk production

It indicates the average quantity of milk produced (in litres) per household per day for the last six months prior to the time of interview.

3.5.1.8 Milk consumed

It indicates average quantity of milk (in litres) consumed by each household per day for the last six months prior to the time of interview.

3.5.1.9 Milk sold

It is defined as the average quantity of milk (in litres) sold by each household per day for the last six months prior to the time of interview.

3.5.2 Communication behaviour variables

Communication is a conscious attempt to share ideas, information and knowledge. Effective communication system plays an important role in the adoption process of improved dairy technologies. Communication profile of a respondent consists of measure of his mass media exposure and extension worker contact. Measurement of these variables would provide crucial insights in to how communication behaviour is associated with the decision making process of respondents in regard to adoption of different dairy technologies.

3.5.2.1 Mass Media Exposure

A three point scale was used to measure a respondent's mass media exposure. The respondents were asked to rate each of nine different sources of mass media (viz. Radio, Television, Newspaper, Clinical camps, campaign, Exhibition, Demonstration, educational films and Magazine/ journal) on a three point scale, ranging from frequently used (score of 2), occasionally used (score of 1) and never used (score of 0). The respondent's ratings of all the sources of mass media were than totalled to yield an aggregate score for the respondents, which was a quantitative measure of his mass media

exposure. The total scores of all the respondents were aggregated and mean mass media exposure score was than obtained.

3.5.2.2 Extension worker contact

The respondents were asked to rate different extension service providers, regarding dairy technologies, that they access, viz. veterinary officer, livestock extension officer, private medicine dealer, progressive dairy farmers , milk co-operative society, K. V. K. scientists and NGO's engaged in animal science. The respondents were asked to rate each service provider on a 3-point continuum, ranging from frequently accessed (score of 2), occasionally accessed (score of 1) and never accessed (score of 0). The respondent's ratings of all the sources were than totalled to yield an aggregate score for the respondents, which was a quantitative measure of his extension contact. The total score of all the respondents were then aggregated and mean extension contact score was obtained.

3.5.3 Psychological variables

Risk attitude and risk perception of a farmer are important determinants of his decision making process. In the context of this study, farmers with different risk attitudes (risk averse or risk taking) and similarly, farmers with different risk perceptions (high or low) may vary in their choice regarding adoption of dairy technologies.

Risk attitude and risk perception are two different concepts. Risk attitude reflects the decision-maker's interpretation of the content of the risk and how much he dislikes this risk. In contrast, risk perception expresses the decision maker's interpretation of the chance that he will be exposed to the content of the risk (Pennings and Egelkraut, 2005)

Several measures to elicit a respondent's risk attitude and risk perception are available which use several-item scale (Bard and Berry, 2005; Lagerkvist, 2005; Meuwissen *et al*, 1999; Bardhan and Tewari, 2007 and Pennings and Egelkraut, 2005). In this study, two three item scales were developed to measure farmer's risk attitude and risk perception which are given below:

Risk attitude:

1. I like to play it safe
2. With respect to the conduct of business, I am risk averse
3. With respect to the conduct of business, I like to take the sure thing instead of the uncertain thing.

Risk perception:

1. I am not able to predict product prices
2. The markets in which I operate are not at all risky
3. I am exposed to large amount of risk when buying and selling.

To elicit respondent's risk attitude and risk perception, the respondents were asked to indicate their agreement with each item on a 5-point continuum, ranging from 'strongly disagree' (score of 1) to 'strongly agree' (score of 5). The respondent's ratings of the items on this continuum were then summed up to yield an aggregate score of the respondents, which was a quantitative measure of his risk attitude and risk perception. Thus, a higher aggregate score of the respondent was hypothesized to correspond to higher degree of risk aversion and risk perception.

The reliability of the scale, i.e. the extent to which the items included in the scales are true measures of the constructs (risk attitude and risk perception) being assessed, is given by Cronbach's coefficient

alpha, which was calculated for each of the two scales. Cronbach's coefficient alpha is measured as:

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum \sigma_i^2}{\sigma_y^2}\right)$$

Where, k is the number of statements, σ_i^2 is the variance of i^{th} statement and σ_y^2 is the total variance of the k-item scale. The higher is the Cronbach's coefficient alpha, the better is its reliability.

The values of alpha, which are measures of composite reliability of the scales - calculated using the above formula -, are given below:

Risk attitude scale : 67.53

Risk perception scale : 68.13

The above values indicate that the two scales account for 67.53 and 68.13 percent of the variation of the constructs that are being measured, i.e. risk attitude and risk perception, respectively. These values are higher than the minimally acceptable alpha value of 0.65 as proposed by Devillis (1991).

To categorize an individual as having risk averse or risk taking attitude and having high or low risk perception, the ratings given by the respondents to each item of the scales were subjected to factor analysis. Two principal components emerged for each of the two scales – with Eigen values greater than 1. Therefore two factor scores were obtained for each individual. These factor scores were weighted by their respective contribution to total variance and then aggregated. The mean aggregate score for all the respondents were obtained. The entire

sample was than grouped into respective categories, viz. risk averse and high risk perception (having score above mean) and risk taking and low risk perception (having score below mean).

3.6 Data analysis

3.6.1 Descriptive analysis

Descriptive statistics were used in the form of mean, percentage and frequency to derive meaningful inferences about socioeconomic profile of dairy farmers, patterns of adoption, reasons for disadoption and non adoption and constraints in adoption of dairy technologies.

Following is the detailed description of methodology adopted for some of the above analyses:

The analyses were carried out for each of the four selected technologies.

3.6.1.1 Pattern of adoption/disadoption

To ascertain the pattern of adoption and disadoption of selected technologies, farmer recall data were used. This method of ascertaining the dynamics of farm technology adoption has been used earlier in several studies, viz. Moser and Barrett (2006) and Besley and Case (1993). While the data for this survey were collected in a single visit to each respondent household, the farmers were asked to recall the year in which they first adopted each of the selected dairy technology. For those respondents who had disadopted a technology, they were asked to recall the year in which they stopped using it. From the recalled data collected in this way, changes in percentage of households - who were adopters of

each of the selected technologies - over time were ascertained. Changes in proportion of adopters who disadopted over time were also assessed.

3.6.1.2 Reasons for non-adoption and disadoption

Closed ended questions regarding the reasons for disadoption and non-adoption for specific dairy technologies were asked respectively to the respondents who disadopted the technologies at some point of time and to the respondents who never adopted these. The respondents were also asked to elicit any other reason which they perceive to be important in their disadoption/non-adoption decisions. The respondents were asked to rate each of the reasons for their disadoption/non-adoption on a three point scale - relevant (score of 2), not so relevant (score of 1) and irrelevant (score of 0). The scores for each of the reason were aggregated across all the respondents and mean score for each reason were obtained. The reasons for disadoption/non-adoption were than ranked on the basis of the mean scores.

3.6.1.3 Measurement of change in intensity of use of technologies

To measure any changes in intensity of technology use by adopters who were still using the technologies at the time of survey, the respondents were asked to rate their intensity of technology use on a 10-point continuum (score of 10 implying complete adoption, while score of implying rare adoption), both in the year in which they adopted the technology and at the time of survey. It was also explained to the respondents that their ratings regarding intensity of technology use, at both points of time, should be relative. The scores of all the respondents were totalled and mean scores obtained for both the initial year of adoption and at the time of survey. The mean scores were thus relative

quantitative measure of intensity of technology use at the two points of time.

3.6.1.4 Perception of respondents towards five characteristics of innovation

An innovation is an idea, practice or object that is perceived new by an individual or other unit of adoption. The perceived newness of the idea for the individual determines his or her reaction to it (Rogers, 1995).

According to Rogers (1995), there are five characteristics of an innovation that affect an individual's adoption decision. These are: 1) relative advantage, which is the degree to which an innovation is perceived as being better than the idea it supersedes; 2) compatibility, or the degree to which an innovation is perceived as consistent with the existing values and beliefs, past experiences, and the needs of potential adopters; 3) complexity, which is the degree to which an innovation is perceived as relatively difficult to understand and use; 4) trialability, or the degree to which an innovation may be used experimentally on a limited basis; and 5) observability, which is the degree to which the results of an innovation are visible to others.

The relative advantage and observability of an innovation describe the immediate and long-term economic benefits from using it, whereas compatibility, trialability and complexity indicate the ease with which a potential adopter can learn about and use an innovation (King and Rollins, 1995).

For the purpose of this study, the innovations are AI, vaccination, deworming and crossbreeding technologies.

In this study, an exercise was carried out to assess the relative importance of the five characteristics of innovation in terms of their contribution to diffusion of the innovativeness through social systems. The purpose of this analysis was to identify the attributes of each of these innovations which the adopters, from their own experience, perceive to be of relatively more importance than other attributes. Findings of such analysis would provide some indications regarding which characteristics or attributes are valued more by the adopters of such innovations and thus are of relatively greater importance in the distribution of innovativeness in the study area.

For this purpose, a pair wise ranking exercise was performed. In the exercise the five attributes were compared in pairs and the respondents were asked to name the attribute that they value relatively more than the other attribute in the pair. Since, there are five attributes, this ranking exercise was done for 10 pair.

3.6.2 Examination of factors influencing pattern of adoption The purpose of this analysis was to compare early, late and non-adopters of different dairy technologies on selected socio-economic characteristics, communication behaviour variables, psychological attributes and institutional variables and to determine the extent to which the above factors influenced the adopter categories. The specific variables considered in this study have already been described in details earlier in this chapter.

3.6.2.1 Identification of early and late adopters

The numbers of adopter categories are three, viz. early adopters, late adopters and non adopters for each of the selected dairy technologies. The determination of these three response categories was made by considering the frequency distribution over time. Those who

had not yet adopted a particular dairy technology were assigned to the non-adopter category. To distinguish between early and late adopters, the median year of adoption was found, for each of the selected dairy technologies, across all the sample respondents. Those who adopted the technology before the median year were assigned to the early adopter category, and those who adopted it in or after the median year were assigned to the late adopter category.

3.6.2.2 Comparison of early adopters, late adopters and non-adopters, on selected variables considered in the study

Chi-square test of independence was used to compare the different variables considered in the study of early, late and non-adopters for each of the selected dairy technologies.

3.6.2.3 Extent to which selected variables influenced adopter categories

The dependent variable for this objective has three response categories, viz. early adopters, late adopters and non-adopters. Our objective here was to ascertain the impact of specific variables on the probability that a respondent would belong to any of these three categories. The dependent variable thus takes discrete values which have natural ordering.

When the objective is to analyze the determinants behind given discrete choices of respondents, the approach in behavioral studies is the use of qualitative choice models, like Logit or Probit which allow the identification of significant variables discriminating among groups with different behaviours (Chilonda and Huylenbroeck, 2001). In this study

since the dependent variable can assume 3 ordered values (2 for early adopter, 1 for late adopter and 0 for non-adopter), a multinomial Logit or ordered Probit model would be appropriate. But given the small sample size and to generate sufficient degrees of freedom, two separate Logit discrete binary regression models were fitted, one to distinguish between early and late adopter, and another to distinguish between adopters (both early and late) and non-adopters. In both the models, the choice is dichotomous in regard to whether a respondent is early adopter (dependent variable coded as 1) or late adopter (dependent variable coded as 0) (for the first model) and whether a respondent is adopter (dependent variable coded as 1) or non-adopter (dependent variable coded as 0) (for the second model). The models thus determine the extent to which the selected variables influenced early and late adopter categories and adopter and non-adopter categories.

Model

The two Logit models used in this analysis specify binary response functions in which the dependent variable is a dummy variable being dichotomous in nature. To generate the dependent variables, the respondents were classified in two groups in each of the two sets of Logit models. In the first model, the groups are those who were early adopters (dependent variable assumes a value of 1) and those who were late adopters (dependent variable assumes a value of 0), and in the second model, those who were adopters (dependent variable assumes a value of 1) and those who were non-adopters (dependent variable assumes a value of 0).

The Logit model used is of the form:

$$P_i = \frac{1}{(1 + e^{zi})}$$

Where,

P_i is the probability that the dependent variable assumes a value of 1

$$1 - P_i = 1 - \frac{1}{(1 + e^{zi})}$$

is the probability that the dependent variable assumes a value of 0

Where, $z_i = \alpha + \sum \beta_i X_i$

$$\text{The odd's ratio} = \frac{P_i}{1 - P_i} = e^{zi}$$

Taking log on both sides,

$$L_n\left(\frac{P_i}{(1 - P_i)}\right) = Z_i = \alpha + \sum \beta_i X_i + e_i$$

Where X is the vector of independent variables and β_i's are the coefficients to be estimated. These coefficients represent the change in the log of odds of early adoption (in the first Logit model) or adoption (in the second Logit model). A positive estimated coefficient implies an increase in the likelihood that a respondent will be early adopter (in the first model) and an adopter (in the second model) with an unit increase in the concerned explanatory variable.

The e^{β} were calculated, which gives the odds ratio, associated with change in the independent variable. The concept of odds can be understood from the concept of probability. The probability of

occurrence of an event is defined by the number of favourable events to total of favourable and not favourable events. If the probability of being an early adopter is 0.75, it means that in three out of four cases, he is likely to be an early adopter. The odds mean the ratio of probability of happening of an event to probability of not happening of that event. In the above example, the probability of not being and early adopter is 0.25. Therefore, the odds of being an early adopter will be 0.75 / 0.25 = 3. The odds are expressed as single number to the ratio to 1. The odds of 3, in this example means that the likelihood of being and early adopter is 3 times than that of not being an early adopter.

One caveat in this analysis is that the adoption decision might not be of the person's who is interviewed. This may specially happen in the case of households which are early adopters. The household might have adopted a technology quite early, but the decision to do so might have been taken by some other members, who are no longer present in the household. Inclusion of such households in the above models would result in inconsistencies, especially in relation to drawing inferences on the basis of estimated coefficients of farmer-specific characteristics. To avoid such inconsistencies, those households were dropped from the Logit analyses, where the respondent who was interviewed, was not the decision maker in regard to adoption of a technology. In this context, 10, 7, 4 and 7 households were dropped from the total sample number of 80 households for the Chi-square and Logit analyses, incase of adoption of AI, vaccination, deworming and crossbreeding technologies, respectively.

3.6.3 Impact of adoption of package of dairy technologies

The purpose of this objective was to assess the impact of adoption of package of selected dairy technologies on specific impact parameters, viz. annual income from dairying, annual income from dairying per unit

herd size, milk production, milk production per unit herd size, milk consumption, breeding index, share of dairying in farm income, and employment generation. In this study, four dairy technologies have been considered. An adopter can adopt all the technologies or partially adopt few of them. Rather than to think of adoption and non-adoption of the package of the dairy technologies considered in the study as a dichotomous one, it becomes more appropriate to think of complete adoption and complete non-adoption of the package of technologies as a continuum. At one end of continuum lies package of technologies adopting households which adopt all the technologies. At the other end of the continuum lies the package of technologies non-adopting households, which do not adopt any of the four technologies. Many households lie between the polar extremes of complete adoption and complete non-adoption of package of technologies components.

To ascertain the impact that adoption of package of technologies has had on specific impact parameters, it is first essential to identify the adopters and non-adopters of the package of selected technologies in the context of above discussion. To do so, the methodology adopted by Pouchepparadjou *et al.* (2005) - who identified adoption and non-adoption of package of IPM technologies – was used in this study.

The adoption of each of the four technologies in the package was given a score of '1' for adoption and '0' for non-adoption. These scores were given on the basis of whether a household was using the technology for the last five years or more prior to the survey till the time of the survey. Such a household was categorized as adopter and given a score of '1'. A household, which had never adopted the technology or adopted it in less than five years prior to the survey or disadopted at any point during the five year preceding the survey was categorized as 'non-adopter' and assigned a score of '0'. The reason for doing so was that, the main objective of ascertaining adopters and non-adopters of package of selected technologies in the study was to assess the impact

of adoption of the package on selected impact parameters, viz. income from dairying, milk production, milk consumption, employment, etc. It takes time for the impact of adoption to be realized at the farm and household level. So, to ascertain the real impact of adoption of package of technology, we have to make accommodation for this time element. This explains the procedure adopted to categorize respondents as adopters and non-adopters of package of technology.

The scores were subjected to factor analysis. One principal component emerged with Eigen values greater than one. Therefore, one factor score was obtained for each individual. The factor score was weighted by its respective contribution to the total variance and then aggregated. The entire sample was then grouped into two categories, viz. adopter (having score above mean) and non-adopter (having score below mean).

The difference in the specific impact parameters – as mentioned above - across these two categories were then analyzed through 't' test, and necessary inferences drawn. This approach is similar to that taken by Nicholson *et al* (1999) in an adoption and impact study of grade cattle ownership in coastal Kenya.

In order to assess the impact of adoption of package of selected technologies on employment generation, a score of 1 was given to the household which has employed at least one labour in dairying and a score of 0 to the household which has not employed any labour. The mean scores was obtained for both adopter and non-adopter households and analyzed for any significant differences through 't' test.

Breeding index (BI) is an indicator of productivity of animals and it points to the degree of success that the households have achieved in increasing dairy animal fertility and decreasing calf mortality. Breeding index is calculated as follows:

$$BI = \frac{\% YA}{\% AF}$$

Where, YA = Number of Young animals in the herd

AF = Number of adult females in the herd

The above approach to estimate productivity in livestock was used earlier by Woods (2000) and Mugunieri *et al* (2004).

The breeding index was calculated for both the adopting and non-adopting households, and significant differences between the scores of the two categories of households were tested through 't' test.

3.6.4 Identification of constraints in adoption of selected dairy technologies

The respondents were asked to express their perception regarding the constraints faced in adoption of selected dairy technologies. Open-ended questionnaire was used for this purpose and the respondents were encouraged to elicit their own perceived constraints. Out of sample of 80, only 60 farmers expressed any constraints. The expressed constraints were then ranked on the basis of proportion of farmers perceiving these and the main constraints were identified.

Chapter 4 RESULTS AND DISCUSSION

4.1 Definitions and descriptive statistics of variables

Definitions and descriptive statistics of the variables considered in the study are presented in table 4.1. The average age of farmers surveyed was 47 years and majority (66%) of the respondents belonged to middle age group (35-59year). Proportion of farmers who were young (< 35 year) and old (>59) were comparatively low at 15 and 19 per cent, respectively. These findings have got substantial support from Arora (2002), who observed that majority of respondents belonged to middle age group (36-64 years) followed by upper age group (>64 years) and lower age group (< 36 years). Of the total number of farmers surveyed, 25 percent were illiterate, while 49, 15, 4 and 8 per cent had attained upto middle school, high school, intermediate and graduate and postgraduate levels of education, respectively. Singh and Kushwaha (2002) reported that majority of respondents (33.75%) had education up to primary level, followed by up to middle school level. Shinde *et al* (1998) had also reported that 47 per cent of respondents were illiterate, 25 per cent were educated up to primary school, 16 per cent up to middle school and 12.5 per cent up to high school and higher levels of education. The average household size was 7.28 and average number of males per household was higher (4) than that of females (3.22). These findings are supported by those of Gangil (2004) who reported that majority of livestock owners had 5-9 members. Arora (2002) also reported that large proportions of respondents were having medium sized families. Proportion of nuclear families (56%) in the sample households was higher than that of joint families (44%). These findings are in consonance with the findings of Manay and Farzana (2000) who observed that 89 per cent of respondents reside in nuclear families and

10.6 per cent reside in joint families. Gangil (2004) also reported that majority of livestock owners (70%) resided in nuclear families and the rest (30%) in joint families. Agriculture was the main source of livelihood for majority of the respondents (66%) followed distantly by agricultural labour (23%). Only 1 per cent of the respondents followed dairying as their main occupation. However, dairying provided mainly a supplementary source of income as almost all the households surveyed (99%) pursued this enterprise as subsidiary occupation. This is in consonance with the national scenario, wherein, dairying is pursued mainly as supplementary and as adjunct to agriculture. Agriculture, on the other hand, was followed as a subsidiary occupation by only 13 per cent of the respondents. Forty eight per cent of respondents belonged to a farmers' group (mostly cooperatives), while the rest (52%) did not have membership of any group. When grouped in term of wealth status, 28, 48 and 25 per cent of the respondents were in the 'rich', 'middle class' and 'poor' categories, respectively. This indicates that the study area was a relatively well-off region than other backward rural areas of India as reflected by greater proportion of rich and middle class households compared to the poor ones. Although; these figures do not tally with the national scenario where vast majority of farmers are resource poor, it should be stated that statistical representativeness of the sample as per the national scenario was not of primary concern for the study. Rather the study area and respondents were chosen keeping in mind the primary objective of the study, which was to provide an assessment of adoption patterns of dairy technologies and factors influencing them. This region has high concentration of state veterinary services infrastructure and also Pantnagar University is located nearby. On account of this, farm households are subject to frequent technology intervention in dairying. Thus the region provides an adequate test case

for carrying out adoption studies in regard to dairy technologies. This explains the sampling method adopted in the study. In 54 per cent cases, the farm owner was also the farm manager or decision-maker, while 44 per cent of heads of households had non-farm activity.

Average landholding per household was 5.9 acres and 41 per cent of the farmers had medium or large sized landholdings. The proportion of landless agricultural labourers (20%) and marginal farmers (14%) was less comparatively. The average herd size was 3.5 SAUs, with 78 per cent of respondents possessing medium sized herds. These findings are supported by Dixit *et al* (2006) who reported that 51 per cent farmers had 3-5 buffaloes, while 43 and 6 per cent of farmers owned 1-2 and more than 5 buffaloes. The annual farm income across all households was Rs. 74, 325. However, there was wide variation in the annual farm income reported by the households, as indicated by the very large standard error. Dairying contributed on an average about 28 per cent of annual farm income. Annual non-farm income for all households was observed Rs. 19, 463, even though, like farm-income, there was great variability across the households.

Average milk produced per day per household for six months prior to the time of survey was 5.7 litres. Present findings are in consonance with the findings reported by Arora (2002), who observed that majority of farmers were producing up to 5 litres of milk from their milch animals. Households sold 60 per cent of milk produced and retained the rest for home consumption. Average farm experience was 21 years. Only 11 per cent of farmers had low farm experience, while majority (71%) had medium level of farm experience.

Average distance to market for all households was 8.4 Km. Forty three per cent of farmers reported that they lived within short distance

from market, while 33 per cent stated that they lived for away from market. Probably, as majority of the respondents lived within short and medium distances from market, high frequency of visit to market was reported by a large proportion (60%) of farmers. Only 15 per cent of the respondents stated that they have low frequency of visits. On an average, respondents reported that they visit market 6 times per week. Thirty seven per cent of respondents reported that they have problem in hiring labour, while 31 per cent of the farmers mentioned that accessing credit is not easy. On the other hand, 43 per cent of respondents stated that accessing information is easy. Thus, information constraint was perceived as a slightly greater problem as compared to non-availability of hired labour and access to credit.

The average mass media exposure score for all respondents was observed 4.7. A vast majority (75%) had medium level of mass media exposure. Extension contact score, on the average, across all respondents was 3.3 and majority (56%) of them had medium level, followed by high level (25%) of extension contact. The relatively high level of extension contact could be attributed to significant presence of livestock health and extension services functionaries in the study area.

When categorized in terms of risk attitude and risk perception, it was observed that 86 per cent of the respondents were risk averse and 44 per cent had high risk perception in regard to dairying. As most of the farmers are risk averse, this has significant implication in regard to uptake decision of technologies, specially those which are perceived to be risky. Also the finding that a large section of respondents perceive dairy farming to be risky is of potential use to insurance agencies in term of having a rough estimate of demand of their products. Also, this is a finding which addresses the importance of developing such technologies and pursuing such strategies which aim at reducing the

Table 4.1: Definitions and Descriptive statistics of variables considered in the study (N=80)

Variables	Description	Mean	Percentage
I Socio-economic variables			
a. Farmer specific variables			
Age of head of household Lower age group Middle age group Upper age group	Chronological age of respondents	47.10 (12.21)	 15.00 66.25 18.75
Education Illiterate-0 Primary--1 Middle school-2 High school-3 Intermediate-4 Graduate and above-5	Level of formal education of household head	1.71 (1.46)	 25.00 23.75 25.00 15.00 3.75 7.50
Household size Male Female	Number of members in each household surveyed	7.28 (4.24) 4.06 (2.66) 3.22 (1.90)	
Family type Joint – 1 Nuclear - 0	Whether joint or nuclear	0.43 (0.49)	 43.75 56.25
Occupation	Main and subsidiary sources of livelihood		
Main occupation Agriculture Business Dairying Service Labour			 66.25 5.00 1.25 5.00 22.50
Subsidiary occupation Agriculture Business Dairying Service Labour			 12.50 5.00 98.75 3.75 1.25
Social participation Yes – 1 No - 0	Whether belong to a farmers' group or any other organization	0.47 (0.50)	 47.50 52.50
Wealth status High	Wealth status as measured by wealth index	1.85 (0.64)	 27.50

Medium Low			47.50 25.00
Non farm activity of head household Yes-1 No-0	Whether the head has non farm activity	0.43 (0.49)	 43.75 56.25
Is the farm owner the farm manager Yes-1 No-0	Management decision maker of the farm	0.53 (0.50)	 53.75 46.25
b. Farm specific variables			
Land holding Landless Marginal Small Medium Large	Area of land under the ownership of the household (acres)	5.90 (8.75)	 20.00 13.75 25.00 25.00 16.25
Herd size High Medium Low	Dairy herd size under the ownership of the household measured in terms of Standard Animal Units (SAUs)	3.51 (2.06)	 11.25 77.50 11.25
Annual farm income	Annual income from farm, crop, livestock and other farm enterprises	74325 (174047.33)	
Share of dairying in farm income	Contribution of dairying to total farm income (%)		28.38
Annual non farm income	Income from sources other than farm enterprises	19462.5 (35829.39)	
Milk production	Average milk production per day/ household for last 6 month	5.73 (4.43)	
% Sold	Proportion of milk produced sold by the household	3.45 (3.66)	60.21
%consumed	Proportion of milk produced consumed by the household	2.37 (1.46)	39.79
Farm experience High Medium Low	Number of years involved in dairy farming	20.51 (12.42)	 17.50 71.25 11.25
II Institutional variables			
Distance to market High Medium Low	Distance in km. to nearest market	8.42 (3.41)	 32.50 25.00 42.50
Visit to market High	Frequency of visit per week	6.11 (2.34)	 60.00

Medium Low			25.00 15.00
Non availability of hired labour Yes-1 No-0	Whether non availability of hired labour is a problem	0.46 (0.50)	 37 63
Credit access Yes-1 No-0	Whether access to credit is easy	0.68 (0.46)	 68.75 31.25
Information access Yes-1 No-0	Whether getting information is easy	0.42 (0.49)	 42.50 57.50
III Communication behaviour variables			
Mass media exposure High Medium Low	Mass media exposure as measured by mean media score	4.7 (1.87)	 12.50 75.00 12.50
Extension contact High Medium Low	Extension contact profile as measured by extension contact score	3.28 (1.60)	 25.00 56.25 18.75
IV Psychological variables			
Risk attitude Risk averse - 1 Risk taking – 0	Risk averse or risk taking as measured by risk attitude scale	0.86 (0.34)	 86.25 13.75
Risk perception High – 1 Low - 0	Perception towards risk in dairy farming as measured by risk perception scale	0.44 (0.50)	 43.75 56.25

Figures in parentheses indicate Standard Error

risks in farming rather than striving to bring about radical changes in production patterns.

4.2 Descriptive statistics of variables by wealth categories

Table 4.2 elicits the descriptive statistics wealth category wise. No major differences were observed in the mean age of respondents belonging to different wealth categories (48 for both rich and medium farmers and 45 for poor farmers). Rich farmers were more educated (mean score of 2.36) than middle class (1.81) and poor (0.8) farmers. As the mean education score suggest, rich farmers mostly were educated up to middle and high school, middle class farmers up to middle school level and poor farmers were mostly illiterate or educated up to primary level. Rich households had the highest number of members (9), while poor households had the least (6). Number of male members per household exceeded that of female members for all categories of households.

The larger household size for rich category households, also reflected in higher family type score (0.68), indicating that richer households mostly stayed in joint families as compared to other wealth categories. Poor farmers had the lowest family type score (0.2), indicating that poor households were mostly of nuclear type.

There were significant differences in the occupations - both main and subsidiary - followed by respondents belonging to different wealth categories. Agriculture was the main source of income for all the rich farmers and 76 per cent of middle class farmers, while only 10 per cent of poor farmers pursued agriculture as their main occupation. Agricultural labour was the main source of income for a vast majority (85%) of poor farmers. Cent per cent of rich and middle class farmers

and 95 per cent of poor farmers pursued dairying as their subsidiary occupation.

Thus, dairying was mostly supplementary to agriculture or agricultural labour as source of income in the study area. Dairying was followed as main occupation by only 5 percent of poor farmers. Membership of group was highest for middle class farmers (0.55), followed by rich (0.43) and poor farmers (0.35). This gives some indication that membership in a farmers' group increased with increase in wealth status. Non-farm activity was highest for poor farmers (0.8) and lowest for rich farmers (0.27). This could be attributed to the fact that majority of the poor farmers earned most of their income from agricultural labour, working in others' farms, and they reported this to be a non-farm activity.

It was also observed that poor farmers were the ones who took more decisions regarding their farming (mean score of 0.75) than farmers of higher wealth status (0.45 and 0.47 for rich and middle class farmers, respectively). This could be attributed to larger family size of the richer households and also their higher resource endowments. Both these factors probably made it possible for rich farmers to employ more labour, both family and hired, in their farms, which reduced their task of farm decision-making and managing to some extent.

As expected average land holding was largest for rich households (15 acres), followed distantly by middle class households (3 acres). The land holding per household for poor category was very meager (0.4 acres). Average herd size per household was also highest for rich category (4 SAUs), followed by middle class (3.7 SAUs) and poor (2.4 SAUs) categories. Higher farm resource endowments for the rich category households also reflected in their much higher annual farm

incomes (Rs. 2, 02, 273) as compared to middle class (Rs. 36, 579) and poor (Rs. 5300) households.

However, one significant pattern in regard to farm income across different wealth category households, that came out was that the share of dairying in total farm income increased exorbitantly with decline in wealth status. Thus, while dairying contributed only 5 per cent to total farm income for rich household, the share of dairying in farm income for poor households was high (71 per cent). This points out to the greater importance of dairying in the livelihoods of poor households. Annual non-farm income was highest for middle class farmers (Rs. 24, 342), followed by poor (Rs 18, 000) and rich (Rs. 12, 363) farmers.

Comparison of annual farm and non-farm income for all categories of households reveals that the wealthiness of rich farmers accrues more from their farm resources than non-farm sources.

Due to larger herd size, milk production per day per household is obviously highest in case of rich category households (7.5 litre/day) followed by middle class (5.5 litre/day) and poor (4.5 litre/day) households.

Middle class households sold the highest proportion of milk produced (61%), followed by poor (59%) and rich (57%) households. Proportions of milk produced that was consumed by the family were 43 per cent, 39 per cent and 41 per cent of, respectively, for rich, middle class and poor farmers. This indicates that contrary to the general perception, poor households are at par with wealthier households in terms of proportion of milk that is retained for home consumption. However, given the lower level of milk produced by the poor households, the absolute quantity of milk used for home consumption might be less than that for richer households.

Farm experience declined with decline in wealth status. Rich farmers had the most farm experience (28 years), followed by middle class (20 years) and poor farmers (13 years).

Distance to market was highest for middle class farmers (9 Km.) and lowest for poor farmers (7 Km.). Large farmers made the most frequents visits to market (7 times/ week), followed by poor (5.8 times/ week) and middle class (5.5 times / week) farmers.

One surprising finding was that much higher proportion of poor farmers (mean score of 9) reported that availing credit is easy compared to other wealth categories, (mean score of 0.72 and 0.55, respectively for rich and middle class farmers). Also, it was observed that more number of richer households had problems in hiring labour (mean score of 0.86 and 0.44, respectively for rich and middle class farmers) than poor farmers (mean score of 0.05). Although, it is generally believed that richer farmers have easy access to credit and affordability of richer farmers to hire farm labour is much more than poor farmers, but in this case the counter-intuitive findings could be explained by the fact that richer farmers mostly owe their wealthiness to income from farm enterprises. As such their farm resource endowments are much larger, e.g. land and livestock holding, and thus they are in more need for credit and hiring labour than poor farmers. Because of this, the richer farmers are more aware of the problem of credit constraints and non-availability of hired labour, which explains the high 'non-availability of hired labour' score in this regard.

More number of richer households have easy access to information (mean scores of 0.5 and 0.72 for rich and middle class households, respectively) than poor households (0.4).

Table 4.2: Descriptive statistics by wealth category wise

Variables	Rich (N=22)	Medium (N=38)	Poor (N=20)
I Socio-economic variables			
a. Farmer specific variables			
Age of household	47.63 (13.71)	47.94 (12.85)	44.9 (9.18)
Education	2.36 (1.70)	1.81 (1.39)	0.8 (0.76)
Household size Male Female	9.45 (6.04) 5.36 (3.49) 4.09 (2.74)	6.58 (3.37) 3.68 (2.30) 2.89 (1.41)	6.25 (2.22) 3.35 (1.69) 2.9 (1.29)
Family type	0.68 (0.47)	0.42 (0.50)	0.2 (0.41)
Occupation			
Main occupation Agriculture Business Dairying Service Labour	 100.00 - - - -	 76.31 10.52 - 10.52 2.63	 10 - 5 - 85
Subsidiary occupation Agriculture Business Dairying Service Labour	 - 18.18 100.00 4.54 -	 13.15 - 100.00 5.26 2.63	 25.00 - 95.00 - -
Social participations	0.45 (0.50)	0.55 (0.50)	0.35 (0.48)
Wealth status	2.78 (0.20)	1.75 (0.37)	1 (0)
Non farm activity of head household	0.27 (0.45)	0.34 (0.48)	0.8 (0.41)
Is the farm owner the farm manager	0.45 (0.50)	0.47 (0.50)	0.75 (0.44)
b. Farm specific variables			
Land holding	15.45 (11.97)	3.26 (2.12)	0.41 (0.64)

Herd size	4.19 (2.31)	3.71 (2.11)	2.41 (1.10)
Annual farm income	202272.7 (297892.30)	36578.94 (22626.97)	5300 (7406.25)
Share of dairying in farm income	5.16	21.99	71.07
Annual non farm income	12363.64 (27063.49)	24342.10 (47236.76)	18000 (8645)
Milk production	7.54 (5.22)	5.52 (4.41)	4.5 (3.03)
% Sold	56.61	61.41	58.89
%consumed	43.39	38.59	41.11
Farm experience	27.5 (12.41)	20.31 (11.51)	13.2 (10)
II Institutional variables			
Distance to market	8.31 (3.69)	9.0 (3.49)	7.45 (2.79)
Visit to market	7.45 (2.89)	5.5 (1.89)	5.8 (1.93)
Non availability of hired labour	0.86 (0.23)	0.44 (0.49)	0.05 (0.09)
Credit access	0.72 (0.39)	0.55 (0.49)	0.9 (0.18)
Information access	0.5 (0.51)	0.72 (0.45)	0.4 (0.5)
III Communication behaviour variables			
Mass media exposure	5.5 (1.73)	5.05 (1.59)	3.15 (1.69)
Extension contact	3.68 (1.28)	3.52 (1.44)	2.4 (1.90)
IV Psychological variables			
Risk attitude	0.91	0.84	0.85
Risk perception	0.64	0.39	0.30

Figures in parentheses indicate Standard Error

Mass media exposure and extension contact were both highest for rich respondents (3.5 and 3.68, respectively) and declined with decline in wealth status. For poor respondents, mass media exposure and extension contact score were 3.15 and 2.4, respectively. This points out to the need for developing a more 'pro-poor' outreach programme that overcomes the factors which act as barriers, artificial or not, between the extension functionaries and the rural poor.

Not much difference was observed in risk attitude across different wealth categories (0.91, 0.84 and 0.85, respectively for rich, middle class and poor households). However, surprisingly, rich respondents (0.64) perceived dairy farming as more risky, than middle class (0.39) and poor (0.38) respondents. This might be attributed to the fact, that dairying being more important in the livelihood of poorer households; they give more attention to their dairy enterprise and focus on efficient management, which renders them less vulnerable to external factors. Bardhan (2002) also reported that resource poor dairy farmers are more efficient in managing dairy enterprises, than the richer farmers, which brought down the per litre cost of milk production.

4.3 Percentage distribution of total animal population

Findings related to distribution of dairy animal population across different 'wealth' category households revealed that significant proportion of crossbred cow and Murrah buffalo population belonged to richer farmers whereas major proportion of indigenous and non-descript animals belonged to poor farmers (table 4.3). Fifty six per cent indigenous lactating animals were maintained by poor farmers while medium farmers accounted for 44 per cent indigenous animal population. Thirty eight per cent of lactating crossbred animals were

Table 4.3: Percentage distribution of total animal population

Category	Cattle						Buffalo					
	Indigenous			Crossbred			Nondescript			Murrah		
	Rich	Medium	Poor	Rich	Medium	Poor	Rich	Medium	Poor	Rich	Medium	Poor
In milk	-	44.4	55.5	37.73	52.83	9.43	30.0	40.0	30.0	43.24	37.83	18.91
Dry	-	60.0	40.0	66.66	33.33	-	-	-	-	-	66.66	33.33
Heifer												
Pregnant	-	-	-	32.14	60.71	7.14	-	100.0	-	12.5	62.5	25.0
Non- pregnant	-	-	-	18.75	68.75	12.5	-	-	-	100.0	-	-
Calves												
Male	-	50.0	50.0	31.81	50.0	18.18	-	-	100	46.15	46.15	7.69
Female	-	83.33	16.66	37.5	53.12	9.37	25.0	50.0	25.0	23.07	61.53	15.38
Bullock/ buffalo bull	-	-	-	-	-	-	-	-	-	-	-	100.0
Total		58.33	41.66	36.19	53.98	9.81	25.0	43.75	31.25	32.32	48.48	19.19

maintained by rich farmers and medium and poor farmers maintained 53 and 9 per cent, respectively. In case of non-descript buffaloes (in milk), 30, 40 and 30 percent of the population was owned by rich, medium and poor categories of farmers, respectively. The Murrah lactating buffaloes were mainly maintained by rich (43%) and medium (38%) households, while poor households only accounted for 18 per cent of the Murrah buffalo population.

Indigenous pregnant and non-pregnant animals were not maintained by any of the farmers of rich, medium and poor categories. In case of crossbred, (pregnant and non-pregnant) animals the percentages were 32 and 19 for rich farmers, 61 and 69 for medium farmers and 7, 13 per cent for poor farmers, respectively.

In case of non-descript buffaloes, cent-percent of pregnant animals were maintained by medium farmers. In regard to Murrah buffaloes, the proportions of pregnant animals were 13, 63 and 25 per cent for rich, medium and poor farmers respectively. Murrah (non-pregnant) buffaloes were cent-percent maintained by rich farmers. As far as bullocks of Murrah group are concerned, cent-percent were maintained by the poor farmers.

The overall (in milk, pregnant, non-pregnant and bullocks) distribution of animal population revealed that, medium and poor farmers accounted for 58 and 42 per cent of indigenous cow population, respectively, where as rich farmers were not having indigenous cattle. In case of crossbred cows, rich, medium and poor farmers maintained 36, 54 and 10 per cent population, respectively.

In regard to nondescript buffaloes, larger proportions were maintained by medium (44%) and poor farmers (31%), respectively, while rich farmers accounted for only 25 per cent. In case of Murrah

buffaloes, the percentage distributions were 32, 48 and 19 for rich, medium and poor farmers, respectively.

4.4 Per household dairy animal holding

Findings regarding per household holding of dairy animals - wealth category wise - revealed that poor farmers had largest holding of indigenous lactating cows (0.25/household), whereas the same for medium category households was 0.10 (table 4.4). Rich farmers did not maintain any indigenous cattle. On an average, overall per household lactating indigenous cattle holding was 0.11. In case of lactating crossbred cattle, the holdings were 0.90, 0.73 and 0.25 for rich, medium and poor farmers, respectively and 0.66 overall. In case of lactating non-descript buffaloes, the poor farmers had the highest holding (0.15) in comparison to 0.13 and 0.10 for rich and medium farmers, respectively, and overall each household owned 0.12 non-descript buffaloes in the study area. In regard to Murrah buffaloes, rich farmers owned the highest number per household (0.72), while medium and rich farmers owned 0.36 and 0.35, respectively. On an average, for all categories, each household in the study area owned 0.46 lactating Murrah buffaloes.

In case of crossbred pregnant and non-pregnant animals, the holdings were 0.40 and 0.13 for rich farmers, which were slightly low compared to medium farmers (0.44 and 0.28), while the values for poor farmers were 0.1 both for pregnant and non-pregnant animals, respectively. The overall holdings for pregnant and non-pregnant crossbred cattle per household were 0.35 and 0.20, respectively.

Table 4.4: Per household dairy animal holding

Category	Cattle								Buffalo							
	Indigenous				Crossbred				Nondescript				Murrah			
	Rich	Medium	Poor	Overall	Rich	Medium	Poor	Overall	Rich	Medium	Poor	Overall	Rich	Medium	Poor	Overall
In milk	-	0.10	0.25	0.11	0.90	0.73	0.25	0.66	0.13	0.10	0.15	0.12	0.72	0.36	0.35	0.46
Dry	-	0.07	0.1	0.06	0.36	0.10	-	0.15	-	-	-	-	-	0.05	0.05	0.03
Heifer																
Pregnant	-	-	-	-	0.40	0.44	0.1	0.35	-	0.02	-	0.01	0.09	0.26	0.2	0.20
Non-pregnant	-	-	-	-	0.13	0.28	0.1	0.2	-	-	-	-	0.09	-	-	0.02
Calves																
Male	-	0.05	0.1	0.05	0.31	0.28	0.2	0.27	-	-	0.05	0.01	0.27	0.15	0.05	0.16
Female	-	0.13	0.05	0.07	0.54	0.44	0.15	0.4	0.04	0.05	0.05	0.05	0.27	0.42	0.2	0.32
Bullock / buffalo bull	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.02
Total	-	0.36	0.5	0.3	2.68	2.31	0.8	2.03	0.18	0.18	0.25	0.2	1.45	1.26	0.95	1.23

In regard to Murrah buffaloes, the holdings for pregnant animals were 0.09, 0.26 and 0.20 for rich, medium and poor farmers respectively, where as overall per household holding of Murrah buffalos for pregnant and non-pregnant animals were 0.20 and 0.02, respectively.

The overall (lactating, pregnant, non-pregnant, male and female calves and bullocks/ buffalo bulls) per household holdings for indigenous cattle were 0.36, 0.5 for medium and poor households, respectively, while for crossbred cattle; the values were 2.68, 2.31 and 0.8 for rich, medium and poor households, respectively. It indicates that the poor farmers have very low number of crossbred animals compared to rich and medium farmers. It may be due to the high cost that is required for maintaining crossbred animals and high susceptibility of these animals to diseases.

In case of non-descript buffaloes, the holding (0.25) was highest for poor farmers compared to rich and medium farmers (0.18 in case of both the household categories). In case of Murrah buffaloes, the values were 1.45, 1.26 and 0.95 for rich, medium and poor categories of farmers, respectively.

4.5 Pattern of adoption and disadoption

To ascertain the pattern of selected dairy technologies, farmer recall data were used. While the data collected for this survey were collected in a single visit to each respondent household, the farmers were asked to recall the year in which they adopted each of the technologies and if there was disadoption, the year in which disadoption took place. This method of using farmer recall data to obtain

information about the dynamics of farm technology adoption was used earlier by Moser and Barrett (2006) and Besley and Case (1993).

Table 4.5 elicits the pattern of adoption and disadoption of the selected dairy technologies, in terms of trends in percentage of households who were adopters and disadopters, over time. 1982 was the earliest year in which adoption was reported by any of the surveyed respondents in case of all the four technologies. Since then, proportion of households who were adopters increased for all the technologies. This increase continued till the year 1999, for AI technology, when 79 per cent of surveyed households were adopters. Proportion of adopter households increased in case of vaccination and deworming till the year 2002, when 94 and 51 per cent of the households were adopters of the two technologies, respectively. For crossbreeding technology, the percentage of adopter households increased till the year 2000 when 69 per cent of the households reported that they were adopters.

Proportion of adopter households declined after the above mentioned years for respective technologies and in 2005, 66, 86, 49 and 66 per cent of households were adopters of AI, vaccination, deworming and crossbreeding technologies, respectively.

Disadoption started in the year 2000 for all technologies, and the proportions of households who disadopted, since then, was higher for AI compared to other technologies. In the year 2005, 26, 11, 5 and 9 per cent of households had disadopted AI, vaccination, deworming and crossbreeding technologies respectively.

Overall picture that the above patterns project is that adoption rates have been high for AI and vaccination over the years compared to deworming and crossbreeding. However in the last few years disadoption rates have been more for AI relative to other technologies. This is corroborated by table 4.6.

Table 4.5: Patterns of adoption /disadoption

year		1982	1987	1988	1990	1992	1993	1995	1996	1997	1998	1999	2000	2002	2003	2004	2005
A.I.	Adoption	1 (1.25)	10 (12.5)	11 (13.75)	24 (30.0)	30 (37.5)	31 (38.75)	46 (57.5)	47 (58.75)	59 (73.75)	62 (77.5)	63 (78.75)	62 (77.5)	60 (75.0)	58 (72.5)	54 (67.5)	53 (66.25)
	Disadoption	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	7 (8.75)	11 (13.75)	14 (17.5)	20 (25.0)	21 (26.25)
Vaccination	Adoption	1 (1.25)	6 (7.5)	- -	21 (26.25)	27 (33.75)	28 (35.0)	43 (53.75)	46 (57.5)	58 (72.5)	63 (78.75)	65 (81.25)	72 (90.0)	75 (93.75)	73 (91.25)	73 (91.25)	69 (86.25)
	Disadoption	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	1 (1.25)	2 (2.5)	5 (6.25)	- -	9 (11.25)
Deworming	Adoption	1 (1.25)	3 (3.75)	- -	9 (11.25)	13 (16.25)	- -	23 (28.75)	- -	32 (40.0)	34 (42.5)	36 (45.0)	40 (50.0)	41 (51.25)	39 (48.75)	39 (48.75)	39 (48.75)
	Disadoption	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	1 (1.25)	- -	3 (3.75)	- -	4 (5.0)
Crossbred	Adoption	1 (1.25)	3 (3.75)	- -	10 (12.5)	14 (17.5)	- -	27 (33.75)	29 (36.25)	35 (43.75)	39 (48.75)	43 (53.75)	55 (68.75)	52 (65.0)	53 (66.25)	53 (66.25)	53 (66.25)
	Disadoption	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	5 (6.25)	- -	7 (8.75)	- -

Figures in parentheses indicate Percentage

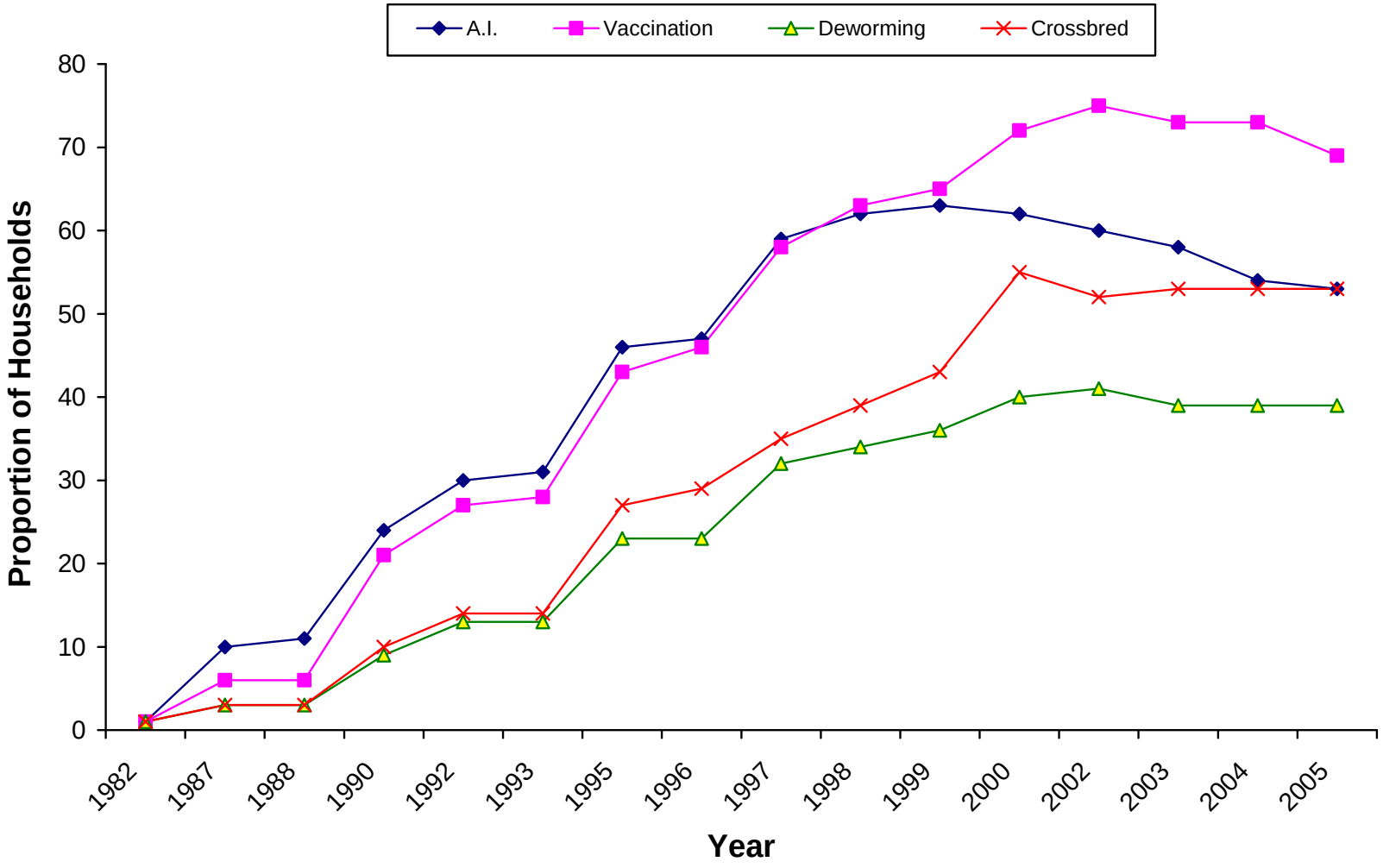

Figure 1: Percentage of households adopting different technologies over time

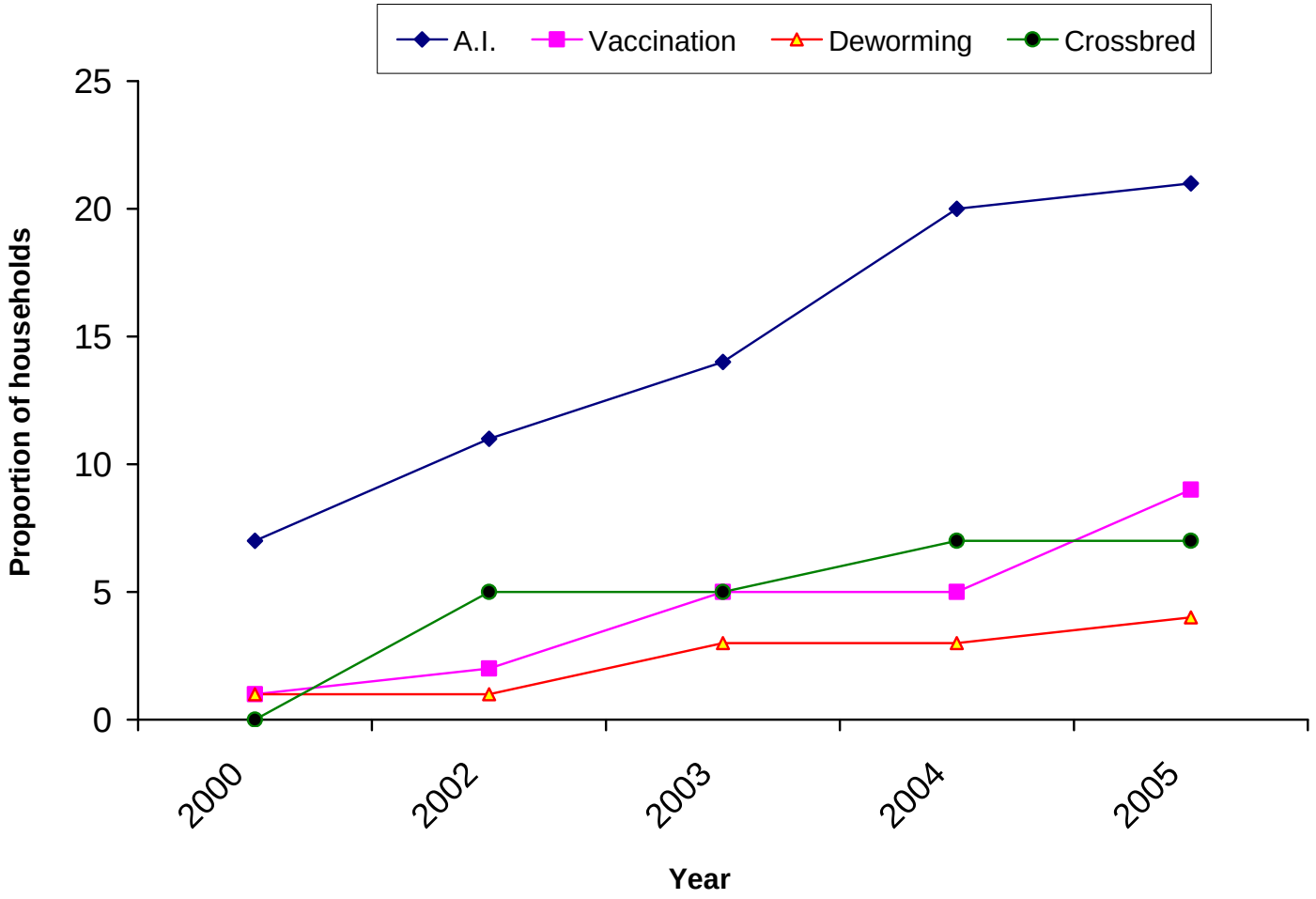

Figure 2: Percentage of households disadopting different technologies overtime

Table 4.6: Adoption and disadoption of selected dairy technology

Sl. No.	Particular	A.I.	Vaccination	Deworming	Crossbred
1	% household adopted (trying) the technology between 1982-2007	92.5	97.5	53.75	75.0
2	% of household still adopting in 2007	66.25	86.25	48.75	66.25
3	% of adopters who disadopted	28.37	11.53	9.30	11.66

Table 4.7: Proportion of farmers who adopted selected dairy technologies during various periods prior to study

Sl. No.	Particular	A.I.	Vaccination	Deworming	Crossbred
1.	Never adopted	7.5	2.5	46.25	25.0
2.	<5 year prior to study	6.25	6.25	2.5	6.25
3.	5-15 year prior to study	56.25	65.0	40.0	56.25
4.	>15 year prior to study	30.0	26.25	11.25	12.5

Table 4.8: Proportion of farmers who disadopted selected dairy technologies during various periods prior to study

Sl. No.	Particular	A.I.	Vaccination	Deworming	Crossbred
1.	Never disadopted	71.62	88.86	90.69	88.33
2.	<5 year prior to study	18.91	10.25	6.97	11.66
3.	5-15 year prior to study	9.45	1.28	2.32	-
4.	>15 year prior to study	-	-	-	-

Percentage of surveyed households which tried or adopted the technologies at any point of time was highest for vaccination (97.5%) and AI (92.5%), followed by crossbreeding (75%) and deworming (54%). However percentage of households still adopting the technologies at the time of survey, were 86, 66, 49 and 66 per cent for vaccination, AI, deworming and crossbreeding technologies, respectively. Given the high proportion of households who tried AI and the relatively lower percentage who are still adopting, it implies that a high rate of disadoption has occurred in the case of this technology.

Indeed, as seen in table 4.6, 28 per cent of adopters disadopted AI, while the per cent of adopters who disadopted were relatively lesser for other technologies, i.e. vaccination (11.5%), deworming (9%) and crossbred (12%). The high adoption rates of AI might be explained by the government policy to carry out AI on priority basis - to improve productivity of indigenous cattle - through its various functionaries. However, the higher disadoption rates in recent past suggest that necessary support services and infrastructural facilities, necessary for farmers' adoption of AI on sustained basis, might be lacking.

Distant location of AI centre from village, lack of visible results and its associated cost could be the specific contributing factors in disadoption of this technology. If we categorize the adopters of the technologies on the basis of various periods prior to the time of survey, in which adoption took place, we can observe that most households adopted the technologies in a 5-15 year period prior to the study (table 4.7). Very less number of farmers (2.5% in case of vaccination to 6.25% in case of other technologies) adopted these technologies in a less than 5 year period prior to the study. Disadoption, in contrast is of a more recent phenomenon. Most of disadoption took place less than five years prior to the study (19, 10, 7 and 12 per cent in case of AI, vaccination,

deworming and crossbreeding, respectively) as compared to a lesser rate of disadoption in the more than 5 year period prior to the study (9, 1, 2 and 0 per cent for AI, vaccination, deworming and crossbreeding, respectively) (table 4.8).

4.6 Reasons for disadoption and non-adoption of technologies

The respondents - either disadopters or non-adopters - were asked to elicit the specific reasons behind their disadoption and non-adoption decision. The respondents were asked to rate each of the reasons on a 3-point continuum (2 for very relevant and 0 for irrelevant). The score assigned to each reason were aggregated across all respondents and mean score was than obtained, which was a quantitative measure of the relative importance of the particular reason for disadoption/non-adoption. On the basis of the mean scores, the reasons were ranked according to their relative importance. The exercise was carried out for all the four technologies and the results are presented in table 4.9.

The number of disadopters was very less for vaccination (9), deworming (4) and crossbreeding (7) but relatively higher for AI (21). The findings in regard to reason for disadoption thus would be more meaningful for AI than the other technologies. Cumbersome application method (2) and the technology being non-profitable (2) were cited as the main reasons for disadoption of AI. Time involved in application of this technology (1.61) and lack of sufficient training (1.42) were also cited as other major contributing factors to their disadoption decision. Lack of credit, on the other hand, was given relatively lesser rating as a reason for disadoption of AI. Lack of sufficient training was cited to be the most important reason for disadoption of vaccination (1.55) and deworming (1.75), followed by lack of credit and much time required. Technology

being non-profitable received lesser importance as a reason for disadoption for both the technologies, especially for deworming. Cumbersome application method was the most important reason behind disadoption of crossbreeding technology (2), followed by the technology being not profitable (1.57), much time required (1.28) and lack of credit (1.14). Lack of sufficient training (0.14) played a relatively lesser role in disadoption decision of crossbreeding technology.

Non-adoption of AI and vaccination (6 and 2 respectively) were very less compared to deworming (37) and crossbreeding (20); thus the findings regarding reason for non-adoption would be more meaningful for the last pair of technologies. The most important reason for non-adoption of deworming was the respondents' unawareness about the technology or its benefits or misconception about its costs and benefits (mean score of 2). Equally important reasons for non-adoption of this technology were lack of scientific training and lack of adequate extension access. Other reasons, but relatively less important than the ones mentioned above, were lack of financial support (0.62), non-availability of technologies when needed (0.56) and lack of technical labour (0.54).

Respondents cited that the most important reason for not adopting cross breeding technology was cumbersome application method (1.5). Other major reasons for non-adoption were lack of scientific training (0.8), adequate extension access (0.8) and technical labour (0.5). Unawareness about a technology or its benefit (0.1) and lack of financial support (0.2) received relatively lesser importance as reason for non-adoption.

Table 4.9: Reasons for non-adoption

Reason	A. I. (N=6)		Vaccination (N=2)		Deworming (N=37)		Crossbred (N=20)	
	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank
Reasons for non-adoption								
(1) Not aware about the technology or its benefits misconception about cost and benefits	0	VI	2	I	2	I	0.1	V
(2) Technologies are not available or not available when needed	2	I	1	II	0.56	III	0.2	IV
(3) Cumbersome application method	2	I	0	III	0.35	V	1.5	I
(4) Lack of scientific training	1.33	III	2	I	2	I	0.8	II
(5) Lack of adequate extension access	1.66	II	2	I	2	I	0.8	II
(6) Lack of technical labour	0.66	IV	1	II	0.54	IV	0.5	III
(7) Lack of incentive due to absence of proper marketing outlets	0.16	V	1	II	0.08	VI	0	VI
(8) Lack of financial support	1.33	III	1	II	0.62	II	0.2	IV
Reasons	A. I. (N=21)		Vaccination (N=9)		Deworming (N=4)		Crossbred (N=7)	
	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank
Reasons for disadoption								
(1) Cumbersome application method	2	I	0.88	IV	0.25	III	2	I
(2) Technology is not profitable	2	I	0.66	V	0	IV	1.57	II
(3) Lack of sufficient training	1.42	III	1.55	I	1.75	I	0.14	V
(4) Much time is required	1.61	II	1	III	0.25	III	1.28	III
(5) Lack of credit	0.85	IV	1.11	II	1	II	1.14	IV

Non availability of the technology when needed (2) and cumbersome application method (2) were cited as the main reasons for non-adoption of A.I. Other major reasons for non-adoption were lack of adequate extension access (1.66), scientific training (1.33) and financial support (1.33). Lack of technical labour (0.66) was also a reason for non-adoption, although relatively of less importance.

The over all message that the findings regarding reasons for non-adoption gives is that more or less similar reasons were responsible for non-adoption of crossbreeding and A.I. technologies. They were mainly cumbersome application method, lack of adequate extension access and financial support. However respondents' rating indicated that they were aware of these technologies or their benefits. Further, the respondents felt there were adequate incentives for adoption of these technologies because of presence of proper marketing outlets. Thus, to ensure sustained adoption of these technologies, government should focus as making timely availability of these technologies when needed with adequate extension services and support services like financial support.

In regard to vaccination and deworming, unlike AI and crossbreeding, unawareness about these technologies and their benefits contributed the most to their non-adoption. To ensure farmers' adoption of technologies hence require making them aware of the benefits of these technologies and making sure that these technologies are available frequently and timely by strengthening the extension services.

4.7 Sources of information about different technologies

Regarding the source of information which led to adoption, the findings revealed more or less similar pattern for all the technologies (table 4.10).

Table 4.10: Source of information regarding adoption decision of selected dairy technologies:

Source	Technology															
	A.I.				Vaccination				Deworming				Crossbred			
	Rich	Medium	Poor	Total	Rich	Medium	Poor	Total	Rich	Medium	Poor	Total	Rich	Medium	Poor	Total
V.O.	54.54	49.52	25.0	43.75	59.09	50.0	25.0	46.25	31.81	39.47	10.0	30.0	40.9	44.73	25.0	38.75
L.E.O.	31.81	26.31	30.0	28.75	31.81	28.94	45.0	33.75	13.63	7.89	5.0	8.75	22.72	21.05	15.0	20.0
Cooperative	9.09	21.05	25.0	18.75	9.09	18.42	25.0	17.5	9.09	10.52	25.0	13.75	9.09	15.78	25.0	16.25
Pantnagar	4.54	-	-	1.25	-	-	-	-	-	-	-	-	-	-	-	-
Private	-	-	-	-	-	-	-	-	-	2.63	-	1.25	-	-	-	-

Majority of households learnt about the technologies from the Veterinary officer (44, 46, 30 and 39 per cent for A.I., vaccination, deworming and crossbreeding, respectively). The next important source of information was Livestock Extension officer (29, 34, 9 and 20 per cent for A.I., vaccination, deworming and crossbreeding, respectively) followed by milk co-operative societies (19, 18, 14 and 16 per cent for A.I., vaccination, deworming and crossbreeding, respectively). When analyzed wealth category wise, the important pattern that was revealed was that a greater proportion of richer households heard about all the technologies from VO, while comparatively, a higher proportion of poorer households than richer ones learnt about the technologies from milk co-operatives societies. More or less, a similar proportion of richer and poorer households found about the technologies from LEO. These findings probably indicate that milk co-operative society's doctors and LEOs are more readily accessible to poorer households than VO. Another important finding from the analysis was that not a single farmer reported of learning about technologies from other farmers, indicating towards lack of farmer-to-farmer diffusing of information.

4.8 Change in intensity of technology use

The adopters, who have not disadopted, were asked to indicate their relative intensity of technology use on a ten point continuum at two points of time: at the time or year in which they first adopted the technology and at the time of the study. Their rating on the 10-point intensity scale gave some indication about changes in intensity of technology use since their adoption. The findings of this analysis are presented in table 4.11. There was no significant change in intensity of technology use in regard to AI. The relative intensity scores at the two points of time, on the other hand, revealed that the farmer increased the intensity of use of vaccination, deworming and crossbreeding

technologies. The highest increase occurred in use of vaccination. When analyzed on the basis of wealth category, the above pattern of change in intensity of technology use was observed for all wealth categories. Thus, what these findings reveal is that not only disadoption rates of AI were high, but also adopters who have not disadopted were not increasing the intensity of use of this technology.

4.9 Perceptions of farmers towards characteristics of innovation

An innovation is an idea, practice or object that is perceived new by an individual or other unit of adoption. The perceived newness of the idea for the individual determines his or her reaction to it (Rogers, 1995).

According to Rogers (1995), innovation has five characteristics that affect an individual's adoption decision. These characteristics are:

1. Relative advantage, which is the degree to which an innovation is perceived as being better than the idea it supersedes,
2. Compatibility, or the degree to which an innovation is perceived as consistent with existing values and beliefs and the needs of potential adopters,
3. Complexity, which is the degree to which an innovation is perceived as relatively difficult to understand and use,
4. Trialability, or the degree to which an innovation may be used experimentally on a limited basis and
5. Observability, which is the degree to which the results of an innovation are visible to others.

Table 4.11: Change in the intensity of technology use as measured by intensity scale (1-Rare adopted, 10-Fully adopted)

Technology	Year of adoption				At present			
	Rich	Medium	Poor	Total	Rich	Medium	Poor	Total
A.I.	3.90 (1.37)	4.01 (1.69)	3.12 (1.96)	3.76 (1.70)	3.97 (3.42)	4.07 (3.25)	3.25 (3.45)	3.84 (3.32)
Vaccination	4.88 (0.53)	4.86 (1.29)	4.5 (1.30)	4.78 (1.13)	7.72 (4.00)	8.48 (3.15)	7.25 (4.12)	7.96 (3.64)
Deworming	2.38 (2.37)	2.69 (2.35)	1.87 (2.41)	2.40 (2.36)	4.20 (4.52)	4.80 (4.66)	2.62 (3.92)	4.09 (4.48)
Crossbred	3.40 (2.25)	4.40 (2.93)	3.5 (2.85)	3.90 (2.75)	5.34 (4.17)	6.44 (4.13)	4.5 (4.83)	5.65 (4.35)

Figures in parentheses indicate Standard Error

The relative advantage and observability of an innovation describe the immediate and long-term economic benefits from using it, whereas compatibility and trialability indicate the ease with which a potential adopter can learn about and use an innovation (King and Rollins, 1995).

For the purpose of this study, the innovations are AI, vaccination, deworming and crossbreeding technologies. From a socio-economic standpoint, the above technologies should possess the five perceived attributes of innovation. Because the perceived attributes of relative advantage, compatibility, complexity, trialability and observability of the technologies caused more farmers to adopt them from year to year (as seen earlier in the pattern of adoption of selected technologies, given in table 5), the technologies can be studied as innovations. As we have seen in the pattern of adoption, adoption did not occur at the same time for all farmers. First only few adopted. Then, a progressively larger number of farmers started adopting. This is referred to as distribution of innovativeness in a social system and affects the rate of adoption.

In this study, an exercise was carried out to assess the relative importance of the five characteristics of innovation in terms of their contribution to adoption decision. Findings of the analysis would provide some indications regarding which characteristic or attribute is of relatively more importance in the distribution of innovativeness in the study area.

A pair wise ranking exercise was carried out in which each characteristic was paired with each of the other four characteristics and the farmers were asked to mention that characteristic, which contributed more towards their adoption decision than the other

characteristics in the pair. This exercise was carried out for all the four technologies. The results of this analysis are presented in table 4.12.

Overall, relative advantage was deemed the major attribute regarding adoption decision, more or less, for all the technologies. Observability was also perceived as important characteristic contributing to adoption decisions in case of all the technologies. Compatibility was deemed to be of much greater importance regarding adoption decision in case vaccination and deworming than for AI and crossbreeding. Trialability was of, more or less, equal importance in regard to adoption decision for all the technologies.

Complexity was an attribute that contributed more towards the adoption decision in case of AI and crossbreeding than for vaccination and deworming.

Thus, the overall message this analysis provides is that relative advantage, trialability and observability were the characteristics that were, more or less, equally important in the distribution of innovativeness (as seen in the pattern of adoption) in case of all the technologies. Complexity was a major factor in this regard in case of AI and crossbreeding, while compatibility contributed more to the distribution of innovativeness in case of vaccination and deworming.

Table 4.12: Perceptions of farmers towards five characteristics of innovation

		R.A.	Compatibility	Complexity	Trilability	Observability
AI						
1	RA. /Compatibility	58.0	42.00			
2	R.A./Complexity	55.40		44.60		
3	R.A./Tribability	54.05			45.95	
4	R.A./Observability	64.86				35.14
5	Compatibility/ Complexity		45.94	55.06		
6	Compatibility/Tribability		55.40		44.60	
7	Compatibility/Observability		58.0			42.00
8	Complexity/ Tribability			25.67	74.33	
9	Complexity/ Observability			27.02		72.98
10	Tribability/ Observability				47.29	52.71
Vaccination						
1	RA. /Compatibility	74.0	26.00			
2	R.A./Complexity	97.43		2.57		
3	R.A./Tribability	66.66			33.34	
4	R.A./Observability	66.66				33.34
5	Compatibility/ Complexity		83.33	16.67		
6	Compatibility/Tribability		60.25		39.75	
7	Compatibility/Observability		65.38			34.62
8	Complexity/ Tribability			19.23	80.77	
9	Complexity/ Observability			12.82		87.18
10	Tribability/ Observability				58.97	41.03
Deworming						
1	RA. /Compatibility	60.46	39.54			
2	R.A./Complexity	86.04		13.96		
3	R.A./Tribability	51.16			48.84	
4	R.A./Observability	58.13				41.87
5	Compatibility/ Complexity		88.37	11.67		
6	Compatibility/Tribability		44.18		55.82	
7	Compatibility/Observability		67.44			32.56
8	Complexity/ Tribability			27.90	72.10	
9	Complexity/ Observability			37.20		62.80
10	Tribability/ Observability				53.48	46.52
Crossbred						
1	RA. /Compatibility	80.0	20.00			
2	R.A./Complexity	58.33		41.67		
3	R.A./Tribability	46.66			53.34	
4	R.A./Observability	51.66				48.34
5	Compatibility/ Complexity		36.66	63.34		
6	Compatibility/Tribability		30.0		70.00	
7	Compatibility/Observability		43.33			56.67
8	Complexity/ Tribability			51.66	48.34	
9	Complexity/ Observability			70.0		30.00
10	Tribability/ Observability				48.33	51.67

4.10 Comparison of different adopter categories (early adopters, late adopters and non-adopters) on selected variables

The chi-square procedure was used for socio-economic characteristics, communication, institutional and psychological variables to compare early, late and non-adopters. The analysis was carried out for each of the four technologies, viz. AI, vaccination, deworming and crossbreeding, and the results are presented in table 4.13, 4.14, 4.15 and 4.16, respectively.

4.10.1 Artificial Insemination

Out of total of 24 variables, the variables education, membership of group, distance to market, non-availability of hired labour, information constraints and mass media exposure were statistically significant. There were no significant differences among the three adopter categories in term of other variables (table 4.13).

In terms of education, illiterate farmers were 60 per cent early adopters and 40 per cent late adopters. Farmers who had education up to middle school level were 15 per cent early adopters, 68 per cent late adopters and 18 per cent non-adopters. Farmers who were educated up to high school and above were 44 per cent early adopters and 56 per cent late adopters.

Farmers, who had had membership of a farmers' group were 70 per cent late adopters and 30 per cent early adopters, while farmers, with no membership were 46 per cent late adopters, 38 per cent early adopters and 16 per cent non-adopters.

In regard to distance to market, farmers, who lived at a long distance from market, were 27 per cent early adopters and 73 per cent late adopters, while farmers who resided within a short distance from market, were 39 per cent early adopters, 55 per cent late adopters and 6 per cent non-adopters.

Table 4.13: Comparison of different adopter categories in case of AI on selected variables

Sl. No.	Variable	Early adopter (24)		Late adopter (40)		Non adopter (6)	
		Frequ-ency	Mean score	Frequ-ency	Mean score	Frequ-ency	Mean score
1.	Age						
	Lower age group	-	-	3	100	-	-
	Middle age group	16	30.76	31	59.16	5	9.16
	Upper age group	8	53.33	6	40	1	6.67
2.	Education**						
	Illiterate	12	60.00	8	40.00	-	-
	Up to Middle School	5	14.71	23	67.65	6	17.65
	Up to High school and above	7	43.75	9	56.25	-	-
3.	Family type						
	Joint-1	12	40	16	53.33	2	6.66
	Nuclear- 0	12	30	24	60	4	10
4.	Occupation						
	Main- Agriculture	18	39.13	25	54.34	3	6.52
	Business	1	25	3	75	-	-
	Dairy	-	-	1	100	-	-
	Service	2	66.66	1	33.33	-	-
	Labour	3	18.75	10	62.5	3	18.75
	Subsidiary-Agriculture	4	44.44	5	55.55	-	-
	Business	2	50	2	50	-	-
	Dairy	24	34.78	39	56.52	6	8.69
	Service	3	100	-	-	-	-
	Labour	-	-	1	100	-	-
5.	Membership of group**						
	Yes-1	10	30.30	23	69.69	-	-
	No-0	14	37.83	17	45.94	6	16.21
6.	Wealth status						
	High	11	55	8	40	1	5
	Medium	9	28.12	21	65.62	2	6.25
	Low	4	22.22	11	61.11	3	16.66
7.	Non farm activity of head household						
	Yes-1	10	31.25	19	59.37	3	9.37
	No-0	14	36.84	21	55.26	3	7.89
8.	Is the farm owner farm manager						
	Yes-1	10	26.31	23	60.52	5	13.15
	No-0	14	43.75	17	53.12	1	3.12
9.	Land holding						
	Landless	2	14.28	10	71.42	2	14.28
	Marginal	1	10	8	80	1	10
	Small	7	38.88	9	50	2	11.11
	Medium	8	47.05	8	47.05	1	5.88
	Large	6	54.54	5	45.45	-	-
10.	Herd size						
	High	2	25	5		1	
	Medium	18	32.14	33		5	
	Low	4	66.66	2		-	

11.	Annual farm income	-	116500 (237688)	-	40925 (53323)	-	26666 (302760)
12.	Share of dairying in farm income	-	17.06 (26.83)	-	36.31 (39.30)	-	39.02 (38.77)
13.	Annual non farm income	-	29583 (32616)	-	17925 (33652)	-	12500 (14053)
14.	Milk production % Sold % Consumed	 - -	5.37 (4.26) 2.79 (2.88) 2.58 (1.88)	 - -	6.62 (4.61) 4.25 (4.08) 2.37 (1.21)	 - -	2.0 (1.67) 0.5 (0.83) 1.5 (1.22)
15.	Farm experience High Medium Low	 8 14 2	 57.14 28.57 -	 5 30 5	 35.71 61.22 -	 1 5 -	 7.14 10.20 -
16.	Distance to market*** High Medium Low	 6 6 12	 27.27 35.29 38.70	 16 7 17	 72.72 41.17 54.83	 - 4 2	 - 23.52 6.45
17.	Visit to market High Medium Low	 17 3 4	 39.53 18.75 36.36	 21 12 7	 48.83 75 63.63	 5 1 -	 11.62 6.25 -
18.	Non availability of hired labour** Yes-1 No-0	 16 8	 48.48 21.62	 16 24	 48.48 64.86	 1 5	 3.03 13.51
19.	Credit access Yes-1 No-0	 17 7	 35.41 31.18	 26 14	 54.16 63.63	 5 1	 10.41 4.54
20.	Information access*** Yes-1 No-0	 11 13	 37.93 31.70	 13 27	 44.82 65.85	 5 1	 17.24 2.43
21.	Mass media*** High Medium Low	 7 15 2	 70 30 20	 3 31 6	 30 62 60	 - 4 2	 - 8 20
22.	Extension contact High Medium Low	 5 16 3	 29.41 41.02 21.42	 11 21 8	 64.70 53.84 57.14	 1 2 3	 5.88 5.12 21.42
23.	Risk attitude Risk averse Risk taking	 20 4	 32.78 44.44	 35 5	 57.37 55.55	 6 -	 16.21 -
24.	Risk perception High Low	 10 14	 34.48 34.14	 16 24	 55.17 58.53	 3 3	 10.34 7.31

Significant at **5% and ***10% levels of significance

Figures in parentheses indicate Standard Error

Equal proportions (48.5 per cent) of farmers, who faced the problem of hired labour non-availability, were early and late adopters, while only 3 per cent of them were non-adopters. On the other hand, farmers, who did not face this problem, were 22 per cent early adopters, 65 per cent late adopters and 13 per cent non-adopters.

Farmers, who perceived that access to information is easy, were 38 per cent early adopters, while farmers, who did have information constraints, were 32 per cent early adopters, 66 per cent late adopters and 2 per cent non-adopters.

Farmers, who had high mass media exposure, were 70 per cent early adopters and 30 per cent late adopters, while farmers with low level of mass media exposure were 20 per cent early adopters, 60 per cent late adopters and 20 per cent non-adopters.

4.10.2 Vaccination

The results of chi square analysis in regard to vaccination are presented in table 4.14. Farmers belonging to lower age group were 0 per cent early adopter, 80 per cent late adopters and 20 per cent non-adopters, while farmers who belonged to upper age group were 53 per cent early adopters, 47 per cent late adopters and 0 per cent non-adopters. Illiterate farmers were 55 per cent early adopters, 40 per cent late adopters and 5 per cent non-adopters. Farmers who were educated up to high school and above were 41 per cent early adopters, 53 per cent late adopters and 6 per cent non-adopters.

Landless and marginal farmers were 13 per cent and 10 per cent early adopters, 75 per cent and 90 per cent late adopters and 13 per cent and 0 per cent non-adopters, respectively. On the other hand, medium and large farmers were 53 per cent and 36 per cent early adopters, 47 per cent and 64 per cent late adopters, respectively.

Table 4.14: Comparison of different adopter categories in case of vaccination on selected variables

Sl. No.	Variable	Early adopter (23)		Late adopter (48)		Non adopter (2)	
		Frequ-ency	Mean score	Frequ-ency	Mean score	Frequ-ency	Mean score
1.	Age**						
	Lower age group	-		4	80	1	20
	Middle age group	15	28.30	37	69.81	1	1.88
	Upper age group	8	53.33	7	46.66	-	-
2.	Education*						
	Illiterate	11	55.00	8	40.00	1	5.00
	Up to Middle School	5	13.89	31	86.11	-	-
	Up to High school and above	7	41.18	9	52.94	1	5.88
3.	Family type						
	Joint-1	11	34.37	21	65.62	-	-
	Nuclear-0	12	29.26	27	65.85	2	4.87
4.	Occupation						
	Main- Agriculture	17	36.17	30	63.82	-	-
	Business	1	25	3	75	-	-
	Dairy	-	-	1	100	-	-
	Service	2	50	1	25	1	25
	Labour	3	17.64	13	76.47	1	5.88
	Subsidiary-Agriculture	3	37.5	5	62.5	-	-
	Business	2	50	2	50	-	-
	Dairy	23	31.94	47	65.27	2	2.77
	Service	3	100	-	-	-	-
	Labour	-	-	1	100	-	-
5.	Membership of group						
	Yes-1	9	26.47	25	73.52	-	-
	No-0	14	35.89	23	58.97	2	5.12
6.	Wealth status						
	High	9	50	9	50	-	-
	Medium	11	30.55	24	66.66	1	2.77
	Low	3	15.78	15	78.94	1	5.26
7.	Non farm activity of head household						
	Yes-1	9	26.47	23	67.64	2	5.88
	No-0	14	35.89	25	64.10	-	-
8.	Is the farm owner farm manager						
	Yes-1	9	23.07	28	71.79	2	5.12
	No-0	14	41.17	20	58.82	-	-
9.	Land holding***						
	Landless	2	12.5	12	75	2	12.5
	Marginal	1	10	9	90	-	-
	Small	6	37.5	10	62.5	-	-
	Medium	9	52.94	8	47.05	-	-
	Large	5	35.71	9	64.28	-	-
10.	Herd size						
	High	1	12.5	7	87.5	-	-
	Medium	19	33.33	37	64.91	1	1.75
	Low	3	37.5	4	50	1	12.5

11.	Annual farm income	-	71782 (57147)	-	62125 (174907)	-	0 (0)
12.	Share of dairying in farm income	-	17.04 (27.28)	-	35.92 (39.23)	-	50.0 (70.71)
13.	Annual non farm income	-	30869 (47593)	-	16500 (31242)	-	17500 (3535)
14.	Milk production % Sold % Consumed	-	5.47 (4.18) 2.82 (2.94) 2.65 (1.82)	-	6.25 (4.64) 3.94 (4.01) 2.31 (1.25)	-	0 (0) 0 (0) 0 (0)
15.	Farm experience* High Medium Low	 7 14 2	 50 28 22.22	 7 36 5	 50 72 55.55	 - - 2	 - - 22.22
16.	Distance to market** High Medium Low	 4 6 13	 17.39 33.33 40.62	 19 10 19	 82.60 55.55 59.67	 - 2 -	 - 11.11 -
17.	Visit to market High Medium Low	 17 3 3	 37.77 17.64 27.77	 26 14 8	 57.77 82.35 72.72	 2 - -	 4.44 - -
18.	Non availability of hired labour** Yes-1 No-0	 16 7	 48.48 17.5	 17 31	 51.51 77.5	 - 2	 - 5
19.	Credit access Yes-1 No-0	 17 6	 34.69 25	 31 17	 63.26 70.83	 1 1	 2.04 4.16
20.	Information access Yes-1 No-0	 13 10	 41.93 23.80	 18 30	 58.06 71.42	 - 2	 - 4.76
21.	Mass media High Medium Low	 6 16 1	 60 30.18 10	 4 36 8	 40 67.92 80	 - 1 1	 - 1.88 10
22.	Extension contact High Medium Low	 4 16 3	 22.22 40 20	 14 23 11	 77.77 57.5 73.33	 - 1 1	 - 2.5 6.66
23.	Risk attitude Risk averse Risk taking	 20 3	 31.25 33.33	 43 5	 67.18 55.55	 1 1	 1.56 11.11
24.	Risk perception High Low	 11 12	 33.33 30	 22 26	 66.66 65	 - 2	 - 5

Significant at *1%, **5% and ***10% levels of significance

Figures in parentheses indicate Standard Error

Equal proportions (50%) of farmers, who had high farm experience, were early and late adopters. Farmers who had low farm experience were 22 per cent early adopters, 55 per cent late adopters and 22 per cent non-adopters.

Farmers, who resided at a long distance from market, were 17 per cent early adopters and 83 per cent late adopters, while farmers, living within a short distance from market, were 41 per cent early adopters and 60 per cent late adopters.

Farmers, who faced the problem of hiring labour due to non-availability, were 48 per cent early adopters and 51 per cent late adopters, while farmers, availing the services of hired labour, were 18 per cent early adopters and 78 per cent late adopters.

4.10.3 Deworming

The variables, education, subsidiary occupation, membership of group, wealth status, the farm owner being the farm decision maker, herd size, distance to market, frequency of visit to market, non-availability of hired labour, information constraints and mass media exposure were statistically significant (table 4.15).

Illiterate farmers were 25 per cent early adopters, 20 per cent late adopters and 55 per cent non-adopters. Farmers, who had education up to and higher than high school level, were 17 per cent early adopters, 50 per cent late adopters and 33 per cent non-adopters.

Respondents, who had business and service as subsidiary occupation, were 50 per cent and 100 per cent early adopters, 25 and 0 per cent late adopters and 25 and 0 per cent non-adopters, respectively, while respondents having dairying as subsidiary occupation, were 12

per cent early adopters, 39 per cent late adopters and 49 per cent non-adopters.

Farmers, having membership of farmers' group, were 11 per cent early adopters, 66 per cent late adopters and 23 per cent non-adopters, while farmers, having no membership, were 12 per cent early adopters, 17 per cent late adopters and 71 per cent non-adopters.

In regard to wealth status, farmers, belonging to 'rich' category, were 27 per cent early adopters, 23 per cent late adopters and 50 per cent non-adopters, while farmers belonging to 'poor' category, were 0 per cent early adopters, 40 per cent late adopters and 60 per cent non-adopters.

Farmers, who were also farm decision-makers, were 5 per cent early adopters, 36 per cent late adopters and 59 per cent non-adopters. On the other hand, farmers, who were not decision makers, were 21 per cent early adopters, 44 per cent late adopters and 35 per cent non-adopters

Farmers, who had large herd size, were 13 per cent early adopters, 75 per cent late adopters and 13 per cent non-adopters, while farmers, who belonged to small herd size group, were 13 per cent early adopters, 0 per cent late adopters and 88 per cent non-adopters.

Farmers, who resided at long distance from market and had high frequency of visit to market, were 17 and 13 per cent early adopters, 83 and 24 per cent late adopters, and 0 and 63 per cent non-adopters, respectively. Farmers, who resided within a short distance from market and had low frequency of visit to market were 12 and 8 per cent early adopters, 26 and 75 per cent late adopters and 62 and 17 per cent non-adopters, respectively.

Table 4.15: Comparison of different adopter categories in case of deworming on selected variables

	Variable	Early adopter (9)		Late adopter (30)		Non adopter (37)	
		Frequ-ency	Mean score	Frequ-ency	Mean score	Frequ-ency	Mean score
1.	Age						
	Lower age group	-	8	4	44.44	5	55.55
	Middle age group	4	29.41	20	40	26	52
	Upper age group	5		6	35.29	6	35.29
2.	Education**						
	Illiterate	25	25	4	20.00	11	55.00
	Up to Middle school	1	2.63	17	44.74	20	52.63
	Up to High School	3	16.67	9	50.00	6	33.33
	And above						
3.	Family type						
	Joint-1	6	18.75	14	43.75	12	37.5
	Nuclear-0	3	6.81	16	36.36	25	56.81
4.	Occupation						
	Main- Agriculture	9	18	21	42	20	40
	Business	-	-	2	50	2	50
	Dairy	-	-	1	100	-	-
	Service	-	-	1	33.33	2	66.66
	Labour	-	-	5	27.77	13	72.22
	Subsidiary*						
	Agriculture	-	-	3	30	7	70
	Business	2	50	1	25	1	25
	Dairy	9	12	29	38.66	37	49.33
	Service	3	100	-	-	-	-
	Labour	-	-	-	-	1	100
5.	Membership of group*						
	Yes-1	4	11.42	23	65.71	8	22.85
	No-0	5	12.19	7	17.07	29	70.73
6.	Wealth status**						
	High	6	27.27	5	22.72	11	50
	Medium	3	8.82	17	50	14	41.17
	Low	-	-	8	40	12	60
7.	Non farm activity of head household						
	Yes-1	2	5.88	12	35.29	20	58.82
	No-0	7	16.66	18	42.85	17	40.47
8.	Is the farm owner farm manager**						
	Yes-1	2	4.76	15	35.71	25	59.52
	No-0	7	20.58	15	44.11	12	35.29
9.	Land holding						
	Landless	-	-	6	40	9	60
	Marginal	-	-	5	45.45	6	54.54
	Small	1	5.26	7	36.84	11	57.89
	Medium	5	25	8	40	7	35
	Large	3	27.27	4	36.36	4	36.36
10.	Herd size**						
	High	1	12.5	6	75	1	12.5
	Medium	7	11.66	24	40	29	48.33

	Low	1	12.5	-	-	7	87.5
11.	Annual farm income	-	103333 (58523)	-	76800 (216365)	-	41945.94 (52253.09)
12.	Share of dairying in farm income	-	6.75 (2.91)	-	32.17 (37.10)	-	33.18 (39.28)
13.	Annual non farm income	-	32777 (31928)	-	15566.66 (29739.88)	-	21081.08 (42264.62)
14.	Milk production % Sold % Consumed	-	8.11 (4.91) 4.77 (3.45) 3.33 (2.44)	-	7.33 (5.27) 5.06 (4.64) 2.26 (1.20)	-	3.83 (2.56) 1.62 (1.79) 2.21 (1.25)
15.	Farm experience						
	High	4	28.57	4	28.57	6	42.85
	Medium	5	9.25	23	42.59	26	48.14
	Low	-	-	3	37.5	5	62.5
16.	Distance to market*						
	High	4	17.39	19	82.60	-	-
	Medium	1	5.26	2	10.52	16	84.21
	Low	4	11.76	9	26.47	21	61.76
17.	Visit to market*						
	High	6	13.04	11	23.91	29	63.04
	Medium	2	11.11	10	55.55	6	33.33
	Low	1	8.33	9	75	2	16.66
18.	Non availability of hired labour*						
	Yes-1	9	25.71	13	37.14	13	37.14
	No-0	-	-	17	41.46	24	58.53
19.	Credit access						
	Yes-1	7	13.20	17	32.07	29	54.71
	No-0	2	8.69	13	56.52	8	34.78
20.	Information access***						
	Yes-1	3	9.09	9	27.27	21	63.63
	No-0	6	13.95	21	48.83	16	37.20
21.	Mass media***						
	High	3	30	4	40	3	30
	Medium	6	10.71	24	42.85	26	46.42
	Low	-	-	2	20	8	80
22.	Extension contact						
	High	2	11.11	12	66.66	4	22.22
	Medium	7	16.27	14	32.55	22	51.16
	Low	-	-	4	26.66	11	73.33
23.	Risk attitude						
	Risk averse	7	10.60	25	37.87	34	51.51
	Risk taking	2	20	5	50	3	30
24.	Risk perception						
	High	4	12.12	12	36.36	17	51.51
	Low	5	11.62	18	41.86	20	46.51

Significant at *1%, **5% and ***10% levels of significance

Figures in parentheses indicate Standard Error

Farmers, who did not hire labour due to non-availability, were 26 per cent early adopters, 37 per cent late adopters and 37 per cent non-adopters, while farmers who availed the services of hired labour, were 0 per cent early adopters, 41 per cent late adopters and 59 per cent non-adopters.

Farmers, who had information access, were 9 per cent early adopters, 27 per cent late adopters and 64 per cent non-adopters, while respondents, who perceived easy information access, were 14 per cent early adopters, 49 per cent late adopters and 37 per cent non-adopters.

Farmers, having high mass media exposure, were 30 per cent early adopters, 40 per cent late adopters and 30 per cent non-adopters, while farmers having low mass media exposure were 0 per cent early adopters, 20 per cent late adopters and 80 per cent non-adopters.

4.10.4 Crossbreeding

The variables age, education, subsidiary occupation, membership of group, farm owner being the farm decision maker, farm experience, distance to market, credit and information constraints, mass media exposure and risk perception were statistically significant. There were no significant differences among the three adopter categories in terms of the remaining variables (table 4.16).

In terms of age, farmers who belonged to lower age group were 0 per cent early adopters, 83 per cent late adopters and 17 per cent non-adopters, while farmers, who belonged to upper age group, were 60 per cent early adopters, 33 per cent late adopters and 7 per cent non-adopters.

In regard to education, illiterate farmers were 55 per cent early adopters, 20 per cent late adopters and 25 per cent non-adopters, while

farmers, who were educated up to high school and above, were 17 per cent early adopters, 56 per cent late adopters and 28 per cent non-adopters.

Farmers, who pursued dairying as subsidiary occupation, were 32 per cent early adopters, 40 per cent late adopters and 28 per cent non-adopters. None of the farmers, who had agriculture and business as their subsidiary occupation, were early adopters, while 33 per cent and 100 per cent and 67 per cent and 0 per cent of them were late adopters and non-adopters, respectively.

Farmers who had membership of group were 62 per cent early adopters, 32 per cent late adopters and 6 per cent non-adopters, while farmers who had no social participation, were 31 per cent early adopters, 23 per cent late adopters and 46 per cent non-adopters.

Farmers, who were also their farm decision maker, were 18 per cent early adopters, 41 per cent late adopters and 41 per cent non-adopters, on the other hand, farmers who did not take the farm decision were 47 per cent early adopters, 41 late adopters and 12 per cent of non-adopters.

Farmers, who had high farm experience, were 57 per cent early adopters, 36 per cent late adopters and 7 per cent non-adopters, while farmers with low experience were 50 per cent early adopters and 50 per cent late adopters.

Farmers, who resided at long distance from the market, were 36 per cent early adopters, 64 per cent late adopters, while farmers living within short distance from market were 56 per cent early adopters, 23 per cent late adopters and 21 per cent non-adopters.

Farmers, who had easy access to credit and information, were 32 and 38 per cent early adopters, 30 and 22 per cent late adopters, and 38 and 41 per cent non-adopters, respectively, while farmers who did not have easy access were 30 and 17 per cent early adopters, 65 and 44 per cent late adopters and 4 and 39 per cent non-adopters, respectively.

Farmers, with high mass media exposure were 30 per cent early adopters, 60 per cent late adopters and 10 per cent non-adopters, while farmers with low mass media exposure were 20 per cent early adopters, 10 per cent late adopters and 70 per cent non-adopters.

Farmers with high risk perception were 34 per cent early adopters, 28 per cent late adopters and 38 per cent non-adopters, while farmers with low risk perception were 29 per cent early adopters, 51 per cent late adopters and 20 per cent non-adopters.

In all 24 variables were analyzed to assess their influence on adopter categories. However one problem in the inclusion of 24 variables in the qualitative choice response (Logit) model in this study - to ascertain the extent of influence of each of these variables on adopter categories - was the relatively small sample size.

Since, the method of estimating a Logit model is generally a large sample method; the meaningful application of this model requires sufficient degrees of freedom. The above chi-square analysis was in fact a means to address the issue of small sample size and to save degrees of freedom. The chi-square analysis provided an estimate of the significant factors associated with different adopter categories (as described above). These significant factors were included as regressors in the Logit model to have a better understanding of the nature of their influence on dependent variable.

Table 4.16: Comparison of different adopter categories in case of Crossbreeding on selected variables

	Variable	Early adopter (23)		Late adopter (30)		Non adopter (20)	
		Frequ-ency	Mean score	Frequ-ency	Mean score	Frequ-ency	Mean score
1.	Age**						
	Lower age group	-	-	5	83.33	1	16.66
	Middle age group	14	26.92	20	38.46	18	34.61
	Upper age group	9	60	5	33.33	1	6.67
2.	Education***						
	Illiterate	11	55.00	4	20.00	5	25.00
	Upto Middle School	9	25.71	16	45.71	10	28.57
	Upto High School and above	3	16.67	10	55.56	5	27.78
3.	Family type						
	Joint-1	13	4193	13	41.93	5	16.12
	Nuclear-0	10	23.80	17	40.47	15	35.71
4.	Occupation						
	Main- Agriculture	17	35.41	22	45.83	9	18.75
	Business	1	25	1	25	2	50
	Dairy	-	-	1	100	-	-
	Service	-	-	2	66.66	1	33.33
	Labour	5	29.41	4	23.52	8	47.05
	Subsidiary*						
	Agriculture	-	-	3	33.33	6	66.66
	Business	-	-	4	100	-	-
	Dairy	23	31.94	29	40.27	20	27.77
	Service	3	100	-	-	-	-
	Labour	-	-	1	100	-	-
5.	Membership of group*						
	Yes-1	11	32.35	21	61.76	2	5.88
	No-0	12	30.76	9	23.07	18	46.15
6.	Wealth status						
	High	6	37.5	6	37.5	4	25
	Medium	11	28.94	18	47.36	9	23.68
	Low	6	31.57	6	31.57	7	36.84
7.	Non farm activity of head household						
	Yes-1	8	24.24	14	42.42	11	33.33
	No-0	15	37.5	16	40	9	22.5
8.	Is the farm owner farm manager*						
	Yes-1	7	17.94	16	41.02	16	41.02
	No-0	16	47.05	14	41.17	4	11.76
9.	Land holding						
	Landless	6	40	4	26.66	5	33.33
	Marginal	1	10	3	30	6	60
	Small	7	38.88	8	14.44	3	16.66
	Medium	3	17.64	11	64.70.30.	3	17.64
	Large	6	46.15	4	76	3	23.07
10.	Herd size						
	High	3	33.33	5	55.55	1	11.11
	Medium	16	28.57	23	41.07	17	30.35

	Low	4	50	2	25	1	25
11.	Annual farm income	-	106086 (247358)	-	53966 (55429)	-	32200 (29211)
12.	Share of dairying in farm income	-	32.95 (41.05)	-	28.00 (35.55)	-	31.19 (36.76)
13.	Annual non farm income	-	19130 (36170)	-	20066 (33199)	-	24000 (44915)
14.	Milk production % Sold % Consumed	-	5.73 (4.13) 3.06 (3.06) 2.67 (1.95)	-	7.6 (5.15) 5.2 (4.52) 2.4 (1.32)	-	3.45 (1.87) 1.55 (1.27) 1.90 (0.78)
15.	Farm experience** High Medium Low	 8 11 4	 57.14 21.56 50	 5 21 4	 35.71 41.17 50	 1 19 -	 7.14 37.25 -
16.	Distance to market** High Medium Low	 8 4 19	 36.36 23.52 55.58	 14 5 8	 63.64 29.41 23.53	 - 8 7	 - 47.05 20.59
17.	Visit to market High Medium Low	 15 5 3	 34.09 29.41 25	 13 9 8	 29.54 52.94 66.66	 16 3 1	 36.36 17.64 8.33
18.	Non availability of hired labour Yes-1 No-0	 14 9	 40 23.68	 13 17	 37.14 44.73	 8 12	 22.85 31.57
19.	Credit access* Yes-1 No-0	 16 7	 32 30.43	 15 15	 30 65.21	 19 1	 38 4.34
20.	Information access*** Yes-1 No-0	 12 7	 37.50 17.07	 7 18	 21.87 43.90	 13 16	 40.62 39.02
21.	Mass media** High Medium Low	 3 18 2	 30 33.96 20	 6 23 1	 60 43.39 10	 1 12 7	 10 22.64 70
22.	Extension contact High Medium Low	 7 11 5	 38.88 27.5 33.33	 9 16 5	 50 40 33.33	 2 13 5	 11.11 32.5 33.33
23.	Risk attitude Risk averse Risk taking	 19 4	 29.68 44.44	 27 3	 42.18 33.33	 18 2	 28.12 22.22
24.	Risk perception*** High Low	 11 12	 34.37 29.26	 9 21	 28.12 51.21	 12 8	 37.5 19.51

Significant at *1%, **5% and ***10% levels of significance

Figures in parentheses indicate Standard Error

Further, to identify which variables significantly distinguished between adopter categories, two sets of Logit models were fitted: one to distinguish between early and late adopters and another to distinguish between adopters (both early and late) and non-adopters.

A positive estimated coefficient implied an increase in the likelihood a respondent will be an early adopter (in first model) or the likelihood that a respondent will be an adopter (in second model). A negative estimated coefficient implied that there is less likelihood for the same.

The results of the Logit models to ascertain the extent of influence of variables on adopter categories are given in the following section. In view of the proceeding discussion, the implications of finding of the chi-square and Logit analyses are discussed thereafter.

4.11 Extent to which variables influenced adopter categories

4.11.1 Extent to which selected variables influenced early and late adopters

The results of the Logit models fitted to identify the factors significantly distinguishing between early and late adopters – for each of the selected technologies - are presented in table 4.17.

The estimated goodness of fit statistics, like R^2 (McFadden), - 2 Log likelihood (Chi-square values) and per cent correct predictions, for each model, are given in the table. However it should be noted that in a binary regressand model, goodness of fit is of secondary importance. What matters are the expected signs of the regression coefficients and their statistical and/or practical significance (Gujrati, 2004). Hence, the

models are discussed only with respect to the signs and significance of the estimated coefficients of the variables.

Out of the specific variables included in the Logit models - one for each of the four technologies - 3, 2 and 7 variables were statistically significant at 0.10 level of probability or better in case of AI, vaccination and crossbreeding technologies, respectively. None of the variables included in the Logit model in case of deworming were statistically significant. This implies that the explanatory power of the Logit model, distinguishing between early and late adopters of deworming, is limited. This lower explanatory power of the model in part reflects the nature of the data: there are relatively few early adopters of deworming – compared to other technologies – and so there is less information available to the statistical procedure for determination of the factors influencing early adoption (Greene, 1993).

The statistically significant variables were education, mass media exposure and hired labour problem (all at $P<0.10$ probability) in case of AI; distance to market and hired labour problem (both at $P<0.05$ probability) in case of vaccination; and education ($P<0.10$), distance to market ($P<0.10$), information access ($P<0.05$), membership of group ($P<0.05$), credit access ($P<0.10$), household head being the farm decision maker ($P<0.05$), and dairying being the subsidiary occupation ($P<0.10$) in case of crossbreeding.

In regard to the Logit model related to adoption of AI, the estimated coefficient of mass media score and hired labour problem were positive, while the estimated coefficient of education was negative. This implies that as the mass media exposure increases, education level decreases and as farmer faces the problem of non-availability of hired labour, the likelihood of being an early adopter of AI increases.

In regard to the Logit model related to adoption of vaccination, the estimated coefficient of distance to market was negative, while that of hired labour problem was positive. It implies that as distance to market declines and as the farmers face the problem of non-availability of hired labour, the likelihood of adoption of vaccination increases.

In regard to the Logit model related to adoption of crossbreeding, the estimated coefficients of education, head being the farm decision maker and distance to market were negative while those of, membership of group, credit access, information access and dairying being the subsidiary occupation, were positive. This implies that as education level decreases, access to information and credit increases, distance to market decreases, the likelihood of being an early adopter increases. The probability of being an early adopter also increases when the head is not farm decision maker, dairying is followed as subsidiary occupation and when farmer is a member of a farmers' group.

Table 4.17 also gives the odds ratios, associated with change in the independent variables. As can be seen from the table, as the formal education increases by on level (as conceptualized in the educational score), the odds of being an early adopter of AI decreases by 32 per cent. With one unit increase in mass media score, the odds of being an early adopter of AI increase by 41 per cent. Also, farmers who face the problem of hiring labour are 2.9 times more likely to be an early adopter than farmers who do not face this problem.

As the distance to market increases by 1 km, the odds of being an early adopter of vaccination, decreases by 19 per cent. On the other hand, farmers, who face the problem of hiring labour, are 4.4 times more likely to be an early adopter than those who do not face this problem.

In case of cross breeding, the odds ratios revealed that the variables which have highest influence on probability of being an early adopter are membership of group (farmers with membership are 43 times more likely than those without), followed by dairying being subsidiary occupation (farmers who pursue dairying as subsidiary occupation are 28 times more likely than those who do not), access to credit (farmers who have easy access to credit are 15 times more likely than those who do not) and information (farmers who have easy access to information are 14 times more likely than those who do not). On the other hand, odds of adopting crossbreeding declines by 65, 90 and 30 per cent when education increases by one level, head is not the farm decision-maker and distance to market increases by 1 km.

Formal education is generally believed to impart significant positive role in technology adoption; but for AI and crossbreeding, the opposite case was observed. The negative influence of education on early adoption of technology here might be because of the immediate non-observability of the results of both these technologies. Further, as seen in table 2, respondents with low level of education are also those who are ‘poor’. The ‘poor’ households in the study area have time and often been targeted for technology dissemination, specially in case of AI and cross bred animals, by government authorities under specific schemes and programmes. The negative influence of formal education upon early adoption also points out to the potential importance of livestock extension system in developing and implementing informal education and even vocational educational programmes.

In contrast to formal education, mass media exposure was positively associated with early adoption in case of AI. This provides indication that rather than formal education, what works in favour of early adoption is the proclivity on the part of farmer to gather

information from various mass media sources. This point towards the potential usefulness of designing educational TV and radio programmes and publication of relevant farm literature to support adoption of dairy technology, like AI.

Findings also revealed that when head is not the farm manager or decision-maker, the probability of early adoption of cross breeding increases. This implies that other members of households might have more important role to play in adoption decisions than the head, more so, in case of cross breeding, because crossbred animals require more time for care and feeding which in turn envisages engagement of family labour. Thus, extension approach which is more family oriented rather than exclusively targeting the head of household, could favourably affect early adoption.

Membership in a farmers' group greatly increased the probability of early adoption of crossbreeding as indicated by the high odds ratio. Participation in social groups enhances a farmer's access to information and resources. Further, various development programmes are also emphasizing this technology transfer through farmers' groups like Self-Help Groups (SHGs), cooperatives, etc. to quicken the uptake of technologies. SHGs are focusing on dairying through crossbred animals as the major key activity, while cooperatives are also encouraging uptake of crossbreeding by providing support services.

Distance to market was negatively associated with probability of being an early adopter in case of vaccination and crossbreeding. The demand for milk in villages and local communities is relatively less. Thus, the closer a farmer is to an output market, not only he has greater access to selling milk and greater profitability, but also has easy access to various inputs, viz. feed and fodder, required for supporting

crossbred animals. Thus, he has stronger incentive to be an early adopter. This finding underscores the importance of investments in rural infrastructure to provide easy access to market.

Access to information was positively associated with the probability of being an early adopter of crossbreeding technology, although it did not significantly influence adoption of other technologies. This might be because as opposed to other technologies, crossbreeding is not an on-off adoption decision. A farmer after adoption of crossbred animals has to constantly look after them and knowledge on scientific management practices is imperative if he has to profitably rear these animals. Thus, farmers who had easy access to information are more likely to be early adopters.

Hired labour problem was positively associated with the likelihood of being early adopter in case of AI and vaccination. Availability of labour is generally perceived to have favourable impact on adoption, but the counter-intuitive findings here might be because in the study area, vaccination and AI have been disseminated at the farmers' doorsteps by government agencies, viz. State Animal Husbandry Department and ULDB, from time to time. Thus, those farmers who perceived difficulty in hiring labour were more inclined to adopt these technologies as and when these were delivered to their doorsteps, so that non-availability of hired labour does not come in their way of doing so in the future.

The findings related to Logit regression also revealed that farmers who have easy access to credit are likely to adopt crossbred animal earlier than other farmers. This point towards the importance of provision of credit facilities to ensure uptake of resource intensive technologies, like crossbreeding.

Table 4.17: Logit estimates of factors distinguishing between early and late adopters of selected dairy technologies

Independent variables	AI (N=64)		Vaccination (N=71)		Deworming (N=39)		CB (N=53)	
	Coefficient	OR	Coefficient	OR	Coefficient	OR	Coefficient	OR
Intercept	-0.711		-2.382		-0.511		-7.599	
Age	-	-	0.050	1.05	-	-	0.052	1.05
Education	-0.382*	0.68	-0.078	0.92	-0.064	0.94	-1.053*	0.35
Farm Experience	-	-	0.007	1.01	-	-	0.011	1.01
Head is farm manager	-	-	-	-	-0.026	0.97	-2.318*	0.10
Memb. of group	-0.879	0.42	-	-	-0.981	0.37	3.758*	42.86
Dairy is sub. Occpn.	-	-	-	-	1.110	3.03	3.321**	27.69
Mass media	0.342*	1.41	-	-	0.263	1.30	-0.016	0.98
Risk perception	-	-	-	-	-	-	-0.183	0.83
Distance to market	-0.135	0.87	-0.210*	0.81	-0.124	0.88	-0.349*	1.42
Visit to market	-	-	-	-	0.004	1.00	-	-
Access to Inform.	0.208	1.23	-	-	0.162	1.18	2.636*	13.96
Hired labour prob.	1.063**	2.90	1.486*	4.42	1.692	5.43	-	-
Credit access	-	-	-	-	-	-	2.726*	15.27
Landholding	-	-	0.056	1.06	-	-	-	-
Herd size	-	-	-	-	0.246	1.28	-	-
Wealth status	-	-	-	-	0.154	1.17	-	-
R^2 (McFadden)	0.169		0.185		0.392		0.459	
-2 log likelihood ($\chi 2$)	14.31*		16.52@		11.32		33.32@	
% Correct predictions	64.06		71.83		82.05		83.02	

Significant at @1, *5 and **10% level of significance, respectively

The Logit model results also provide information about factors that do not appear strongly associated with early adoption of the selected technologies. This study found no statistically significant affect of age and farm experience on adoption of all the technologies. This finding is in contrast to that of Rogers (1995), who observed that early adopters of farm technologies are younger than late adopters. The lack of significant association of age and farm experience with early adoption in this study can be attributed to the perceived economic benefit of this technology. If respondents perceived economic benefit from the adoption of a new idea, they might be more likely to try the innovation, regardless of age and farm experience. Boz and Akbay (2005) also observed that age had no significant effect on early adoption of maize.

Risk attitude and risk perception were not statistically associated with adopter (early and late) categories, implying that variables other than psychological ones, have more bearing on the adoption decisions. Farmers are willing to adopt the technologies irrespective of perceived riskiness of their business.

Wealth status was also, interestingly, not a significant explanatory variable, implying that it is not only the wealthiest households that are taking up the dairy technologies.

4.11.2 Extent to which selected variables influenced adopter (early and late) and non-adopters

The Logit estimates of variables significantly influencing adopter (early and late) and non-adopter categories – for each of the selected technologies - are presented in table 4.18.

One, 2 and 4 variables were statistically significant at 0.10 level of probability or better in case of AI, deworming and crossbreeding technologies, respectively. None of the variables included in the Logit model in case of vaccination were statistically significant. The poor explanatory power of the model in case of vaccination could be attributed to very few (2) non-adopters of vaccination.

The statistically significant variables were information access ($P<0.10$) in case of AI; membership of group and herd size (both at $P<0.10$) in case of deworming and distance to market ($P<0.10$), age ($P<0.05$), credit access ($P<0.10$) and dairying being the subsidiary occupation ($P<0.05$) in case crossbreeding.

In regard to the Logit model related to adoption of AI, the estimated coefficient of information access was positive. This implies that as farmers have easy access to information, the likelihood of being an adopter increases.

In terms of the Logit model related to adoption of deworming, the estimated coefficients of membership of group and herd size were positive. This implies that farmers, who are members of groups and have large herd size, are more likely to be adopters than others.

In regard to the Logit model related to adoption of crossbreeding, the estimated coefficients of age, dairying being the subsidiary occupation and credit access were positive, while that of distance to market was negative. This implies that with increase in age and credit access, the likelihood of being an adopter of crossbreeding increases. The probability of being an adopter also increases as the farmers pursue dairying as subsidiary occupation and live closer to the market.

The odds ratios reveal that farmers who have easy access to information are 8 times more likely to be adopters of AI than those who do not. Farmers who are members of a group and have large herd size are 3 and 1.5 times more likely to be adopters of deworming than those who are not members and have smaller herd size, respectively. Farmers who have easy credit access and pursue dairying as subsidiary occupation are 12 and 7 times more likely to be adopters of crossbreeding than others, respectively. One km increase in distance to market, on the other hand reduced the odds of adoption by 25 per cent.

Age was not a significant explanatory variable for adoption of all the technologies, except crossbreeding. However, even the, the odds ratio was relatively small indicating that the probability of being an adopter of crossbreeding does not increase by much with increase in age. Membership of a group was positively associated with adoption of deworming. This was however, not a significant explanatory variable in the first Logit model distinguishing between early and late adopters of deworming, as the explanatory power of that model was limited due to relatively less number of late adopters of deworming. Farmers, who are members of cooperatives, are recipients of deworming services provided by the cooperative doctors. This explains the positive coefficient of the membership of group variable. The variable did not significantly influence adoption of other technologies although it exerted positive and significant influence on early adoption of crossbreeding. This implies that membership of a group is a more important determinant of whether a farmer will adopt crossbreeding early or not, rather than whether he will adopt at all or not. For AI, farmers' uptake decisions were not influenced by membership of a group.

Farmers who pursued dairying as subsidiary occupation also showed a greater likelihood of being an adopter of crossbreeding, than

Table 4.18: Logit estimates of factors distinguishing between adopters (early and late) and non-adopters of selected dairy technologies

Independent variables	AI (N=70)		Vaccination (N=73)		Deworming (N=76)		CB (N=73)	
	Coefficient	OR	Coefficient	OR	Coefficient	OR	Coefficient	OR
Intercept	2.485		-300.077		-2.306		-6.218	
Age	-	-	.935	2.54	-	-	0.164*	1.18
Education	-0.410	0.66	0.580	1.79	0.274	1.32	0.296	1.34
Farm Experience	-	-	2.284	9.82	-	-	-0.088	0.91
Head is farm manager	-	-	-	-	0.787	2.20	-0.695	0.50
Memb. Of group	1.601	4.96	-	-	1.183*	3.26	-1.260	0.28
Dairy is sub. Occpn.	-	-	-	-	-0.127	0.88	1.984*	7.27
Mass media	0.498	1.65	-	-	0.084	1.09	0.118	1.13
Risk perception	-	-	-	-	-	-	-0.079	0.92
Distance to market	-0.133	0.88	-2.822	0.06	0.121	1.13	-0.292**	0.75
Visit to market	-	-	-	-	-0.067	0.94	-	-
Access to Inform.	2.048**	7.75	-	-	0.101	1.11	0.905	2.47
Hired labour prob.	0.972	2.64	-1.692	0.18	0.940	2.56	-	-
Credit access	-	-	-	-	-	-	2.513**	12.34
Landholding			0.023	1.02	-	-	-	-
Herd size	-	-	-	-	0.402*	1.49	-	-
Wealth status	-		-	-	-0.904	0.40	-	-
R^2 (McFadden)	0.347		1.000		0.338		0.473	
-2 log likelihood ($\chi 2$)	14.21*		18.23@		35.77@		40.56@	
% Correct predictions	92.86		81.58		93.26		84.93	

Significant at @1, *5 and **10% level of significance, respectively

farmers who had other subsidiary sources of income. This implies that dairying as a subsidiary occupation provides enough incentives to the farmers to adopt resource intensive technology like crossbreeding.

The negative statistically significant relationship between distance to market and adoption of crossbreeding implies that probability of adoption increases with decrease in distance to market. The reason for this corresponds to the same given to explain the negative relationship between distance to market and early adoption of cross bred animals.

Access to credit and information exerted positive influence on probability of adoption of crossbreeding and AI, respectively, underscoring the importance of institutional support services in the adoption of knowledge and resource intensive technologies.

Having large herd size also indicates towards greater chance of transmission of infectious diseases between animals. This might explain the positive association between adoption of deworming and herd size. Although, the same positive relationship was expected for vaccination also, but the coefficient of herd size was non-significant due to poor fit of the Logit model that distinguished between adopter and non-adopters of vaccination.

4.12 Factors associated with adoption of package of selected dairy technologies

In a previous section, the factors influencing adoption of each of the selected dairy technologies were analyzed. In this section, an attempt has been made to ascertain the factors associated with adoption of package of the four selected technologies. In doing so, it has been assumed that adoption of package of technology is not a discrete

phenomenon, rather it is a continuum, i.e. on one extreme, there are respondents who have not adopted any of the elements of the package (non-adopter) and on the other, there are respondents who have adopted each and every elements of the package (adopter). In between these two extremes, are respondents with varying rates of adoption of different elements of the package. To categorize respondents as adopters and non-adopters of package of selected technologies in the study, respondents who adopted a technology at least 5 years previous to the survey and have not yet disadopted, was considered as adopters, and other respondents were referred to as non-adopters. The reason for doing so was that, the main objective of ascertaining adopters and non-adopters of package of selected technologies in the study was to assess the impact of adoption of the package on selected impact parameters, viz. income from dairying, milk production, milk consumption, employment, etc. It takes time for the impact of adoption to be realized at the farm and household level. So, to ascertain the real impact of adoption of package of technology, we have to make accommodation for this time element. This explains the procedure adopted to categorize respondents as adopter and non-adopter of package of technology.

A score of 1 was given if a respondent was adopter of a selected technology, in the above context, and 0, if he was non-adopter. The score for each of the four technologies, across all the respondents, were then subjected to factor analysis. One principal component emerged with Eigen value greater than 1. The factor scores of this principal component were multiplied with its percentage contribution to the total variability and the mean of these weighed factor scores, across all the respondents, were obtained. Respondents with weighted factor scores greater than the mean were categorized as adopter, while respondents

whose weighted factor scores were lower than the mean score, were categorized as non-adopter.

To ascertain the factors associated with adoption of package of selected dairy technologies, chi-square analyses were performed for all the 24 variables to compare the adopters and non-adopters. The results of the analysis are presented in table 4.19. The variables membership of group, farm experience, distance to market and mass media exposure were statistically significant at 0.10 level of probability or better.

Farmers, who had high farm experience, were 43 per cent adopters and 57 per cent non-adopters, while farmers, who had low farm experience, were 89 per cent adopters and 11 per cent non-adopters.

Farmers, who lived at long distance from market, were 54 per cent adopters and 46 per cent non-adopters, while farmers, who lived within short distance from market, were 65 per cent adopters and 35 per cent non-adopters.

Farmers with high mass media exposure were 60 per cent adopters and 40 per cent non-adopters, while farmers with low mass media exposure, were 20 per cent adopters and 80 per cent non-adopters.

Farmers who had membership of group were 79 per cent adopters and 21 per cent non-adopters, while farmers with no membership were 36 per cent adopters and 64 per cent non-adopters.

The above findings have suggested that adopters of package of technologies have membership of farmers' group, low farm experience, high mass media exposure and lived closer to market.

Table 4.19: Comparison of adopters and nonadopters of package of dairy technologies on selected variables:

Sl. No.	Variable	Adopter (45)		Non-adopter (35)	
		Frequency	Mean score	Frequency	Mean score
1.	Age				
	Lower age group	6	50	6	50
	Middle age group	29	54.11	24	45.28
	Upper age group	10	66.66	5	33.33
2.	Education				
	Illiterate	11	55	9	45
	Primary	10	52.63	9	47.36
	Middle	13	65	7	35
	High school	5	41.66	7	58.33
	Intermediate	1	33.33	2	66.66
	Graduate and above	5	83.33	1	16.66
3.	Family type				
	Joint-1	19	54.28	16	45.71
	Nuclear-0	26	57.77	19	42.22
4.	Occupation				
	Main- Agriculture	31	58.99	22	41.50
	Business	2	50.0	2	50.0
	Dairy	-	-	1	100.0
	Service	1	25.0	3	75.0
	Labour	11	57.89	7	36.84
	Subsidiary-Agriculture	7	70.0	3	30.0
	Business	1	25.0	3	75.0
	Dairy	44	55.69	35	44.30
	Service	1	33.33	2	66.66
	Labour	-	-	1	100.0
5.	Membership of group*				
	Yes-1	30	78.94	8	21.05
	No-0	15	35.71	27	64.28
6.	Wealth status				
	High	10	45.45	12	54.54
	Medium	24	63.15	14	36.84
	Low	11	55.0	9	45.0
7.	Non farm activity of head household				
	Yes-1	19	54.28	16	45.71
	No-0	26	57.77	19	42.22
8.	Is the farm owner farm manager				
	Yes-1	22	51.16	21	48.83
	No-0	23	62.16	14	37.83
9.	Land holding				
	Landless	11	68.75	5	31.25
	Marginal	3	27.27	8	72.72
	Small	13	65.0	7	35.0
	Medium	11	55.0	9	45.0
	Large	7	53.84	6	46.15

10.	Herd size				
	High	6	66.66	3	33.33
	Medium	35	56.45	27	43.54
	Low	4	44.44	5	55.55
11.	Annual farm income	-	103533 (227860)	-	49671 (43610)
12.	Share of dairying in farm income	-	34.75 (39.51)	-	23.04 (32.65)
13.	Annual non farm income	-	22044 (42326)	-	16142 (25381)
14.	Milk production		7.17 (4.79)		4.08 (3.12)
	% Sold	-	4.64 (4.00)	-	1.91 (2.46)
	% Consumed		2.53 (1.63)		2.17 (1.20)
15.	Farm experience***				
	High	6	42.85	8	57.14
	Medium	31	54.38	26	45.61
	Low	8	88.88	1	11.11
16.	Distance to market*				
	High	14	53.85	12	46.15
	Medium	8	40.00	12	60.00
	Low	15	64.71	12	35.29
17.	Visit to market				
	High	26	54.16	22	45.83
	Medium	10	50.0	10	50.0
	Low	9	75.0	3	25.0
18.	Non availability of hired labour				43.24
	Yes-1	21	56.75	16	44.18
	No-0	24	55.81	19	
19.	Credit constraints				
	Yes-1	30	54.54	25	45.45
	No-0	15	60.0	10	40.0
20.	Information constraints				
	Yes-1	17	50.0	17	50.0
	No-0	28	60.86	18	39.13
21.	Mass media**				
	High	6	60.00	4	40.00
	Medium	37	61.66	23	38.33
	Low	2	20.00	8	80.00
22.	Extension contact				
	High	14	70.0	6	30.0
	Medium	22	48.88	23	51.11
	Low	9	60.0	6	40.0
23.	Risk attitude				
	Risk averse	37	53.62	32	46.37
	Risk taking	8	72.72	3	27.27
24.	Risk perception				
	High	21	60.0	14	40.0
	Low	4	16.0	21	84.0

Significant at *1%, **5% and ***10% levels of significance

Figures in parentheses indicate Standard Error

4.13 Impact of adoption of package of selected technologies

Specific information regarding certain parameters, viz. income from dairying, share of dairying in farm income, milk produced, milk consumed, breeding index and employment generation were culled out from the survey data, which allowed for the examination of impact of adoption of package of dairy technologies. To ascertain the impact of adoption, the mean of the above mentioned impact parameters were examined across adopters and non-adopters, for any significant differences, using 't' test. The results of this analysis are presented in table 4.20.

Significant differences in means across adopters and non-adopters were observed in case of annual income from dairying and milk production. To account for herd size, which might influence income from dairying, differences in mean of annual income from dairying and milk production per unit herd size were also examined and significant differences in means of these parameters were observed across adopter and non-adopter categories. Average annual cash income from dairying was much higher for adopting households than non-adopting households. Adopting households reported annual income from dairying Rs. 6511 as against Rs. 4500, reported by non-adopting households. The difference in income from dairying across these two categories of households was Rs. 2011 at 5% level of significance. Adopting households also reported higher milk production and difference in milk production (3.1 litre/household/day) between adopter and non-adopter categories was significant at 1 per cent probability.

Adopting households also had significantly higher mean annual income from dairying per unit herd size (Rs. 2280) than non-adopting households (Rs. 1578), at 5 per cent probability. Average milk production per unit herd size was also significantly high for adopters than non-adopters at 1 per cent probability.

Share of dairying in farm income was, although, more in adopting households than non-adopting households, but there was no significant difference in regard to this parameter between the two categories of households. This implies, that although non-adopter households had significantly lesser income from dairying, their incomes from other sources, might be high. This finding is an important pointer to the importance of adoption of dairy technologies on sustained basis specifically for those households who derive a greater share of income from dairying.

The above findings provide some indication that adoption of package of selected technologies has had beneficial impact upon not only milk production and income from dairying, but also, more importantly, on productivity of dairy animals.

No significant differences were found between adopter and non-adopter categories in regard to milk consumption, breeding index and employment generation.

Thus adoption of dairy technologies did not ensure higher household milk consumption and employment generation. Nicholson *et al* (1999) and Shapiro *et al* (1998) had also observed that adoption of grade cattle technology had little effect on household milk consumption and nutritional status in coastal Kenya and Ethiopia, respectively.

In regard to employment generation, also, the findings of this study are in consonance with those of Nicholson *et al* (1999), who reported that grade cattle technology adoption on the number of labourer hired had limited impact in coastal Kenya.

This implies that, generally, in the study area, the adopters were able to handle the increased work load, due to adoption of package of technology, without hired assistance, i.e. with engagement of family labour.

Table 4.20: Impact of adoption of package of selected dairy technologies

Impact parameters/Adopter categories	Adopters	Non-adopters	Difference between two categories
Annual income from dairying	6511.11	4500.00	2011.11 't'cal = 2.187**
Annual income from dairying per SAU	2280.71	1578.48	702.23 't'cal = 2.146**
Share of dairying in farm income	34.76	23.05	11.71 't'cal = 1.417
Milk produced	7.18	4.09	3.092 't'cal = 3.304*
Milk produced per SAU	1.962	1.391	0.571 't'cal = 2.221**
Breeding index	1.286	1.566	-0.28 't'cal = 1.01
Milk consumption	2.53	2.17	0.362 't'cal = 1.100
Employment generation	0.53	0.54	-0.01 't'cal = -0.084

Significant at * 1% and ** 5% level of significance

4.14 Constraints in adoption of dairy technologies

Although the constraints in adoption of dairy technologies have somewhat been analyzed in the section on reasons for disadoption and non-adoption of technologies, the farmers were asked in the survey to mention the major constraints that they face in adopting the dairy technologies. Open ended questionnaire was used for this purpose.

The farmers were encouraged to elicit as many constraints that they may think of, not necessarily, in order of their severity. The very purpose of this exercise was to have an overview of the different constraints faced by the farmers, at a glance. The constraints were arranged in order of the proportion of respondents who cited these constraints and the results are presented in table 4.21.

The constraints which were reported by the maximum proportions of respondents were all related to adoption of AI. Problem of repeat breeding in AI (50%), non-availability of AI facilities at village level (42%) and AI being not profitable (37%), were cited as the major constraints in adoption of this technology. However, cost associated with AI was not perceived as a major constraint as only 8 per cent of respondents reported this to be a constraint. Other major constraints reported by the respondents, were mostly of financial character. Thirty eight per cent, 37 per cent, 28 per cent and 22 per cent of respondents cited that non-remunerative price of milk, high cost of concentrate feed, high fee charges by veterinary doctors and lack of financial support, were major constraints in adoption of dairy technologies, respectively. Other major constraints were problem in heat detection (23%), non-availability of veterinary service problems when required (20%) and lack of adequate information (23%). Lack of provision of information about new technology and lack of proper market facilities were cited as constraints by 12 per cent of the respondents.

Table 4.21: Constraints in adoption of dairy technology

Sl. No.	Constraints	Frequency N=60	%
1.	A.I. is costly	5	8.3
2.	Problem of repeat breeding is more in A.I.	30	50.0
3.	Facility of A.I. is not available at village level	25	41.66
4.	A.I. is not profitable	22	36.66
5.	Less information about new technology	7	11.66
6.	Lack of information	14	23.33
7.	Vaccines not available timely	13	21.66
8.	V.O., L.E.O. not available when needed	12	20.0
9.	Market facility not proper	7	11.66
10.	Problem of labour	4	6.66
11.	Non availability of clinical camps	4	6.66
12.	Problem in heat detection	14	23.33
13.	Less effective treatment of animal	5	8.33
14.	Lack of financial support	13	21.66
15.	Urbanization	1	1.66
16.	Milk rate is low	23	38.33
17.	Doctors fee is high	17	28.33
18.	High cost of concentrate	22	36.66

Chapter 5 SUMMARY AND CONCLUSION

The present investigation was carried out on 80 farmers in five randomly selected villages of Rudrapur Block of Udham Singh Nagar District of the newly created state of Uttarakhand to study the pattern of adoption of selected dairy technologies, factors influencing the pattern of adoption and impact of adoption of package of selected technologies on specific impact parameters. Studies on adoption of dairy technologies assume crucial significance, given the importance of dairy animals in the livelihood of rural households, specially the resource poor, and the critical role that technologies play in increasing the profitability of dairy enterprises and thus the socio-economic status of the rural people. The present study was necessitated by the fact that although several studies on adoption of dairy technologies are available, scant research attention has been given to the pattern of adoption of dairy technologies and what are the factors that influence these patterns, especially in the Indian context. Findings of such studies would provide crucial inputs to policy makers regarding what are the factors responsible for early adoption of specific technologies, what are the reasons for disadoption and non-adoption, what attributes of technologies contribute more to the diffusion of innovations through the social system, etc.

The study area was a relatively well-off region than other backward rural areas of India as reflected by greater proportion of rich and middle class households compared to the poor ones. Findings of the study revealed that agriculture was the main source of livelihood for majority of the respondents, in the study area, followed distantly by

agricultural labour. Very meager proportion of respondents pursued dairying as their main occupation. However, dairying provided mainly a supplementary source of income as almost all the sample households pursued this enterprise as subsidiary occupation. Findings regarding socio-economic characteristics of respondents revealed that richer farmers were more educated than poorer farmers. Richer farmers had larger family size than poorer farmers and the former category also showed a greater tendency to live in joint families than the later one. Agriculture was mostly the main source of income for the richer farmers, while agricultural labour was the main source of income for a vast majority of poor farmers. There were some indications that membership in a farmers' group increased with increase in wealth status. It was observed that poor farmers were the ones who took more decisions regarding their farming than farmers of higher wealth status. Richer households had much higher farm resource endowments than poorer households in terms of both land and livestock holdings. However, share of dairying in total farm income increased exorbitantly with decline in wealth status, indicating towards the greater importance of dairying in the livelihoods of poor households than richer ones. It was observed that poor households are at par with wealthier households in terms of proportion of milk that is retained for home consumption, although in absolute terms, the amount of milk consumed by the poor households might be less. Greater proportion of poor farmers had easy access to credit than farmers of wealthier categories, which might be attributed to the provision of microfinance facilities through formation of SHGs under SGSY programme, although the quantum of credit provided through this scheme might be less. Not much difference was observed in risk attitude across different wealth categories, although it

was observed that rich respondents perceived dairy farming as more risky than other categories of respondents.

Findings regarding pattern of adoption revealed that adoption rates, in terms of proportion of households which adopted the technologies, have been high for AI and vaccination over the years compared to deworming and crossbreeding. However in the last few years disadoption rates have been more for AI relative to other technologies. The high adoption rates of AI might be explained by the government policy to carry out AI on priority basis - to improve productivity of indigenous cattle - through its various functionaries. However, the higher disadoption rates in recent past suggest that necessary support services and infrastructural facilities, necessary for farmers' adoption of AI on sustained basis, might be lacking. It was also seen that most households adopted in a 5-15 year period prior to the study, in case of all technologies. Disadoption, on the other hand, is of a more recent phenomenon as most of disadoption took place less than five years prior to the study.

Findings regarding reasons for disadoption and non adoption revealed that more or less similar reasons were responsible for non-adoption of crossbreeding and AI, viz. cumbersome application method, lack of adequate extension access and financial support. However respondents were aware of these technologies or their benefits. Further, the respondents felt there were adequate incentives for adoption of these technologies because of presence of proper marketing outlets. Thus, to ensure sustained adoption of these technologies, government should focus as making timely availability of these technologies when needed with adequate extension services and support services like financial support. On the other hand, in regard to vaccination and deworming, unlike AI and crossbreeding, unawareness about these

technologies and their benefits contributed the most to their non-adoption. To ensure farmers' adoption of technologies hence require making them aware of the benefits of these technologies and making sure that these technologies are available frequently and timely by strengthening the extension services.

When the sources of information were analyzed, which led to adoption decision, findings revealed that greater proportion of richer households heard about all the technologies from VO, while comparatively, a higher proportion of poorer households than richer ones learnt about the technologies from milk cooperatives societies. The findings also provided indication that milk cooperative doctors and LEOs are more readily accessible to poorer households than VO.

Farmers increased the intensity of use of all technologies, except AI in the period between their adoption and at the time of survey. Thus, what these findings reveal is that not only disadoption rates of AI were high, but also adopters who have not disadopted were not increasing the intensity of use of this technology.

When the attributes of innovations, which contributed more to the diffusion of innovations through social system, were analyzed it was observed that relative advantage, trialability and observability were the characteristics that were, more or less, equally important in the distribution of innovativeness in case of all the technologies. Complexity was a major factor in this regard in case of AI and crossbreeding, while compatibility contributed more to the distribution of innovativeness in case of vaccination and deworming.

Findings regarding factors which influenced early adoption and relevant policy implications can be summarized as follows:

1. Early adoption of AI and crossbreeding was negatively influenced by formal education, which points out to the potential role that the livestock extension system could play in developing and implementing non-formal education and even vocational educational programmes. This was corroborated by the positive association between early adoption and mass media exposure, in case of AI, indicating towards potential usefulness of designing educational TV and radio programmes and publication of relevant farm literature to support adoption of dairy technology, like AI.
2. Probability of early adoption of crossbred animals decreased when head or farm-owner was the farm decision maker, implying that extension approach which is more family oriented rather than exclusively targeting the head of household, could favourably affect early adoption, especially in case of labour intensive technologies.
3. Early adoption of cross breeding was strongly influenced by membership in a farmers' group. Thus extension personnel would achieve better results if they work through a farmers' group, while disseminating or promoting a technology. This is all the more true in case of knowledge intensive technologies, like crossbred animals.
4. Distance to market was negatively associated with probability of being an early adopter in case of vaccination and crossbreeding. The closer a farmer is to an output market, the greater access he has to selling milk and greater is his profitability. Thus, he has stronger incentives to adopt technologies, especially the resource intensive ones, than a farmer who is distantly located from a market. Thus, providing farmers easy access to markets in terms

of better infrastructure might work in favour of early adoption of technologies.

5. Access to credit and information positively influenced early adoption of crossbreeding. This point towards the importance of provision of infrastructural support facilities to ensure uptake of resource intensive technologies.
6. Labour availability is not an obstacle in adoption of technologies, when the technologies are delivered at farmers' doorsteps, as shown by the positive influence of hired labour problem with early adoption.
7. Age, farm experience, risk attitude and risk perception did not significantly influenced early adoption. It implies that rather than human endowment of farmers, the institutional endowments available to them affect the adoption of dairy technologies.

Findings regarding factors distinguishing between adopters and non adopters of technologies revealed more or less similar results as obtained in the case of factors influencing early adoption. Credit and information access, membership of group and distance to market significantly influenced the adoption of different dairy technologies.

The findings regarding adoption of package of dairy technologies revealed that adoption of dairy technologies significantly increased the income from dairying, milk production and productivity. Adoption of the technologies also has potential in increasing the household consumption of milk. However, beneficial effects of adoption of dairy technologies were not observed in case of employment generation. This implies that, generally, in the study area, the adopters were able to handle the increased work load, due to adoption of package of technology, without hired assistance, i.e. with engagement of family labour

Overall, it can be said that adoption of dairy technologies has had some favourable impacts in the study area. Thus extension functionaries should work towards promoting technology as technology adoption is key to improving farmer productivity and household income. However, the findings of the study overwhelmingly point towards the importance of providing institutional support services, viz. information, credit, linkage to market, membership of farmers' group, etc. in ensuring adoption of dairy technologies by the rural households. Human endowments are of secondary importance in uptake decisions of dairy technologies.

The findings of the study provide some insights into factors associated with early adopters. The extension services when promoting innovations in rural areas, should identify and work together with early adopters. Once early adopters accept the new idea, they may serve as change agents to influence other people in their neighbourhoods. This will probably facilitate the change agents' work on promoting technologies and lower programme delivery costs.

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INTERVIEW SCHEDULE

Sr. No. ……

Name of Respondent …… Village ……

Block …… District ……

1: SOCIOECONOMIC PROFILE

(i.) Age (in years) :

(ii) Caste : (a) General (b) OBC (c) SC (d) ST

(iii) Family type : (a) Nuclear (b) Joint

(iv) Family Profile:

Sr. No.	Name	Relation	Gender (M/F)	Age	Education	Occupation		Income
						Main	Subsidiary	

(v) Herd size:

Category	Cattle (No;s)		Buffaloes (No;s)	
	Indigenous	Crossbred	Nondescript	Murrah
In milk				
Dry				
Heifers				
Pregnant				
Non pregnant				
Calves				
Male				
Female				
Bullock				

(vi) Land holding:

Category	Total area	Total irrigated area
Owned land		
Leased land		

(vii) Annual farm income (in Rs) :

Annual non-farm income (in Rs) :

(Types/income source) :

Share of dairying in household income (farm) :

(viii) Milk Production :

Milk sold :

Milk consumed :

(ix) Wealth index

Category	Rating				
	Scale	Person 1	Person 2	Person 3	Person 4
Wealthy	1				
Medium class	2				
Poor	3				

(x) Farm experience (in years) :
(xi) Information constraints : Yes/No
(xii) Whether head has non farm activity : Yes/No
(xiii) i. Whether head is the farm owner : Yes/No
ii. Whether head is the farm manager : Yes/No
iii. Whether head is the decision maker : Yes/No

2. DYNAMICS OF ADOPTION/DISADOPTION

(i) YEAR OF ADOPTION/DISADOPTION

TECHNOLOGY	Did you adopt the method		Have you disadopted the method	
	year	Source of information	year	Whether still adopting or not
A.I.				
Vaccination				
Deworming				
H.Y.V.F.				
Crossbred				

ii) Perceptions of farmers according to five characteristics of innovation:

Sl. No.	Particulars	A. I.	Vaccination	Deworming	H.Y.V.F.	Crossbred
1.	Relative advantage/ Compatibility					
2.	Relative advantage/ Complexity					
3.	Relative advantage/ Tribability					
4.	Relative advantage/ Observability					
5.	Compatibility/ Complexity					
6.	Compatibility/ Tribability					
7.	Compatibility/ Observability					
8.	Complexity/ Tribability					
9.	Complexity/ Observability					
10.	Tribability/ Observability					

(iii) Change in the intensity of technology used

Technology	Year of adoption	At Present	Intensity used
A.I.			
Vaccination			
Deworming			
H.Y.V.F.			
Crossbred			

iv) Reasons for Change in Intensity

Sl. No.	Particulars	A. I.	Vaccination	Deworming	H.Y.V.F.	Crossbred
1.	Relative advantage (cost, yield, management, input availability)					
2.	Compatibility					
3.	Complexity					
4.	Triability					
5.	Observability					

3. Reasons for non-adoption

Reason	A. I.			Vaccination			Deworming			H.Y.V.F.			Crossbred		
	Relevant	Not so	Irrelevant	Relevant	Not so	Irrelevant	Relevant	Not so	Irrelevant	Relevant	Not so	Irrelevant	Relevant	Not so	Irrelevant
(1)Own perception															
(2) Not aware about the technology or its benefits misconception about cost and benefits															
(3) Technologies are not available or not available when needed															
(4) Cumbersome application method															
(5) Lack of scientific training															
(6) Lack of adequate extension access															
(7) Lack of technical labour															
(8) Lack of incentive due to absence of proper marketing outlets															
(9) Lack of financial support															

4. Reasons for disadoption

Reasons	A. I.			Vaccination			Deworming			H.Y.V.F.			Crossbred		
	Relevant	Not So	Irrelevant	Relevant	Not So	Irrelevant	Relevant	Not So	Irrelevant	Relevant	Not so	Irrelevant	Relevant	Not so	Irrelevant
(1) own perception															
(2) Cumbersome application method															
(3) Technology is not profitable															
(4) Lack of sufficient training															
(5) Much time is required															
(6) Lack of credit															

5. VARIABLES INFLUENCING ADOPTION

(i) Training attended : Frequently/Rarely/Never

(ii) Whether belong to any association : Yes/ No

If Yes Name of organization :

How long have you been a member :

(iii) i. Distance to market (km) :

ii. Transport cost (Rs) :

iii. How often you visit to market/town :

(iv) Whether non availability of hired labour is a problem : Yes/ No

(v) Availability of credit is easy : Yes/ No

Amount credit used (Rs) :

Credit constraints : Yes/No

Adequacy of credit : Yes/No

Timeliness of credit : Yes/No

Certainty of credit : Yes/No

(vi) Source of fodder : Home cultivated/Purchased/Harvested from nearly field

Distance from source :

(vii) Mass media exposure:

Source	Frequently (2)	Occasionally (1)	Never (0)
(1) Radio			
(2) Television for Krishi Darshan programme			
(3) Other T.V. Programs Related With Agriculture			
(4) Newspaper			
(5) Clinical camps			
(6) Campaign			
(7) Exhibition			
(8) Demonstration			
(9) Educational films			
(10) Magazine/Journals			

(viii) Extension contact:

sources	Frequency of adoption		
	Frequently (2)	Occasionally (1)	Never (0)
(1)veterinary surgeons or livestock assistants			
(2) progressive dairy farmers			
(3) K.V.K. scientests			
(4)N.G.O$_S$ engaged in animal sciences			
(5) Private medicine dealer			
(6)Milk co-operative society			
(7) veterinary representatives			

(ix) Risk attitude:

Statements	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
a. I like to 'play it safe'					
b. With respect to the conduct of business, I am risk averse					
c. With respect to the conduct of business, I like to take the sure thing instead of the uncertain thing					

(x) Risk perception

Statements	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
a. I am able to predict product prices					
b. The markets in which I operate are not at all risky					
c. I am exposed to a large amount risk when buying/selling					

Constraints in adoption of dairy technologies-

1. ……..
2. ……..
3. ……..
4. ……..
5. ……..

VITA

The author of this manuscript, Prakash Mishra was born on 5th July 1981 in Pilibhit, Uttar Pradesh. He did his schooling from Public Inter College Puranpur and S.D.B.B.Rama Inter College, Pilibhit. He completed his B.V.Sc. & A.H. from College of Veterinary Science and Animal Husbandry from N.D.U.A.T. Kumarganj Faizabad in the year of 2006. Thereafter, he joined Department of Veterinary and Animal Husbandry Extension for his master degree in Veterinary and Animal Husbandry Extension.

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ABSTRACT

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Thesis Title: Pattern of adoption of selected dairy technologies by rural households: Evidence from tarai area of Uttarakhand

The study conducted in tarai region of Uttarakhand stste revealed that adoption rates, in terms of proportion of households which adopted the technologies, were high for AI and vaccination over the years compared to deworming and crossbreeding. However in the last few years disadoption rates have been more for AI relative to other technologies.

When the reasons for disadoption and non adoption were analyzed it was revealed that more or less similar reasons were responsible for non-adoption of crossbreeding and AI, viz. cumbersome application method, lack of adequate extension access and financial support. However respondents were aware of these technologies or their benefits. Further, the respondents felt there were adequate incentives for adoption of these technologies because of presence of proper marketing outlets.

Analysis of factors distinguishing between adopters and non adopters of dairy technologies revealed more or less similar results as obtained in the case of factors influencing early adoption. Credit and information access, membership of group and distance to market significantly influenced the adoption of different dairy technologies.

It was observed that adoption of dairy technologies significantly increased with the income from dairying, milk production and productivity. Adoption of the technologies also has potential in increasing the household consumption of milk. However, beneficial effects of adoption of dairy technologies were not observed in case of employment generation.

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