

SUSTAINABILITY OF ANIMAL HUSBANDRY TECHNOLOGIES



Thesis

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BY

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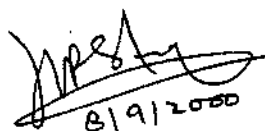
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CERTIFICATE

Certified that the research work embodied in this thesis entitled **"Sustainability of Animal Husbandry Technologies"** submitted by **Niranjan Lal**, Roll No. 424, for the award of **Ph.D. Degree** in the subject of **Extension Education of Deemed University Indian Veterinary Research Institute**, is the original work carried out by the candidate himself under my supervision and guidance.

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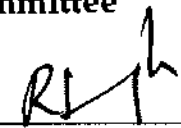

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Dedicated to

*My Beloved Parents
&
My Nephew*

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ABBREVIATIONS

AI	:	Artificial Insemination
HS	:	Haemorrhagic Septicaemia
FMD	:	Foot & Mouth Disease
RP	:	Rinder Pest
Max.	:	Maximum
Deur.	:	Deworming
FES	:	Family Education Status
A.H.	:	Animal Husbandry
TA	:	Technical Appropriability
EF	:	Economic Feasibility
EV	:	Economic Viability
ES	:	Environmental Soundness
TS	:	Temporal Stability
LA	:	Local Adaptability
RUE	:	Resource Use Efficiency
SA&SS	:	Social Acceptability & Social Sustainability
PT	:	Political Tacitness
AM	:	Administrative Manageability
CD	:	Cultural Desirability

Chapter-1

INTRODUCTION

India is in a commanding position on the livestock map of the world as it owns world's 15% cattle, 53.3% buffaloes, 20% of goats and 6% of sheep population. Also, recently, it has become number one milk producer in the world. The contribution of livestock sector to the GDP is rising while the contribution of agriculture sector in general is gradually coming down. This only shows that the animal husbandry is gaining importance and attracting the attention of policy makers, scientists and development experts. With the rising demand for livestock products, the pressure is also increasing to improve the productivity and production as happened in case of cereal crops during the green revolution days wherein stress was laid on input supply, breeding and disease control measures. Improving the productivity potential of native breeds has been a concern since late 1950's when the cross-breeding programmes were initiated. The efforts in this direction are pursued with massive funding in recent times by the government agencies, dairy cooperatives, NGOs and private sector resulting in improvement in productivity of livestock.

Various programmes have been initiated by the government of India to improve the productivity of livestock. Most of these programmes aim at generation of technologies and their dissemination to the farmers. Apart from productivity improvement measures and technology transfer activities now the concerns are being raised on the sustainability issues as well. The sustainability has become buzz word in most development forums globally. In agricultural sector, the sustainability is being discussed even more strongly as the survival and welfare of mankind is being increasingly attached with the sustainability of resources. The sustainability has been defined in a number of different ways by as many number of scholars. As such, there is multiplicity in the definitions of sustainability.

The Technical Advisory Committee (TAC), established by the Consultative Group on International Agricultural Research (CGIAR) has defined the sustainable agriculture as "Sustainable agriculture should involve the successful management of resources for agriculture to satisfy changing human needs while maintaining or enhancing the quality of the environment and conserving natural resources". *Successful* implies that the production system should generate adequate income and otherwise be economically viable and socially acceptable; *management* include policy decisions that can affect agriculture at all levels from national and state governments to the individual producers; *resources* include inputs and manufactured goods coming from outside the agricultural section (e.g. agricultural chemicals, machinery etc.); *maintaining the quality of the environment* suggests changes in the

environment or the availability of natural resources should not threaten the capacity to meet the changing needs and that production needs should be met without unnecessarily damaging natural ecosystem.

Sustainability has been evolved from the original meaning ability to continue. It is the ability of a system to maintain productivity in spite of a major disturbance, such as, caused by intensive stress or large perturbation. A stress is here defined as a regular, sometimes continuous, relatively small and predictable disturbance, for example, the effect of soil salinity or indebtedness. Whereas, a perturbation is an irregular, infrequent, relatively large and unpredictable disturbance, such as caused by drought, flood, new pest or new diseases. As such, sustainability is defined as the ability of an agro-eco-system to maintain productivity when subjected to a major disturbing force.

The actual or potential disturbance may be caused by an intensive stress, where stress is defined as a frequent, sometimes continuous, relatively small and predictable disturbing force which has a large cumulative effect. Salinity, toxicity, erosion, indebtedness or declining market demand are examples of such forces.

Alternatively, the disturbance may be caused by a shock, defined here as an infrequent, relatively large and unpredictable, disturbing force which has the potential of creating an immediate, large disturbance or perturbation. The example of shocks include a rare drought or flood or new pest or the sudden rise in an input price, such as that of oil in the mid - 1970s.

Following a stress or shock the productivity of the agro-eco-system may be unaffected, or may fall and then return to the previous level or trend, or settle to a new lower, or sometimes higher level or may disappear (Vanishing) altogether.

There are various indicators through which sustainability can be measured. They include the inertia (resistance), elasticity, amplitude, hysteresis and malleability of agro-eco-system in response to a disturbing force (Oriens, 1975; Westmen, 1978). Sustainability thus determines the persistence or durability of an agro-eco-system productivity under known or possible conditions. It is a function of the intrinsic characteristic of the agroecosystem, of the nature and strength of the stresses and shocks to which it is subjected, and of the human input that may be introduced to counter these stresses and shocks.

According to Nicodemus (1992) sustainability is the successful management of resources to satisfy changing human needs, while maintaining or enhancing the quality of environment and conserving natural resources. American society of Agronomy defines sustainability as the ability to fulfil a set of goals. "Sustainable agriculture is one that, over the long term, enhances environmental quality and the resource base on which agriculture depends, provides basis for human food and fibre needs, is economically viable, and enhances the quality of life for farmers and society as a whole".

FAO (UN) defines sustainable agriculture as "the management and conservation of the resource base and the orientation of technological

and institutional changes in such a manner as to ensure attainment and continued satisfaction of human needs for present and future generations. Such sustainable development is environmentally non-degrading, technically appropriate, economically viable and socially acceptable. In all these definitions, "environmental protection" has been identified as the key feature of sustainability.

All the definitions and descriptions of sustainability indicate the need for developing a comprehensive understanding of the term sustainability in simple ways so that it could be understood with clarity. Therefore, sustainability has been popularly defined as using the natural resources for meeting the present needs without jeopardizing the future potential.

The meaning of sustainable agricultural technologies is not only restricted to term such as organic, regenerative, ecological, alternative or low input but also refers to the capacity of the system to sustain the production level at a desired level. Thus, the criteria of sustainability have to be seen in terms of capacity to produce adequate food, be environmentally safe, protect the resource base as well as profitable (Reganold *et al.* 1990). The sustainable agriculture should be economically viable system which minimises the use of external inputs such as pesticide, fertilizer and heavily relies on farm renewable resources (Madden, 1987).

Contemporary development pathway, however, are associated in most of cases with three distressing features. These are : increasing

rich-poor disparity in per capita income, damage to the basic life support system of land, water, forests, biodiversity and the atmosphere and jobless economic growth. Such pathways of development are both environmentally and socially disruptive. There is hence a search today for an alternative development paradigm which will foster job-led economic growth rooted in the principles of ecology, equity, economics, energy efficiency and employment generation. The biovillage model of rural development described by M.S. Swaminathan Research Foundation, 1994-95 is a nice example of sustainable development since it pays concurrent and integrated attention to natural resources conservation, productivity improvement and poverty eradication. The model is based on the identification and promotion of market driven small scale enterprises, which lend themselves to decentralized production supported by a few key centralised services.

Economic viability is essential for replicability, while environmental soundness and gender equity are essential for ecological and social sustainability. Integrating factor relating to production efficiency, economic viability, environmental soundness and equity is not an easy task at field level. Often, undesirable trade-offs are involved. It requires a process of learning through doing. Such doing, to be effective and meaningful, has to be done jointly with rural women and men. Thus, the biovillage project is based on a participatory action research mode with resource poor farm families, scientists and financial institutions working and learning together.

SCOPE OF THE PROBLEM

Though our country is well endowed with large number of livestock, the production and productivity in animal sector is still very low. Many useful animal husbandry technologies have been evolved by the reserach system, need to be essentially transfered to the livestock owners to derive the benefit and enhance the production and productivity at their farms. Still, many reports & studies have pointed out that only 30% of the generated technologies have reached to the farmers, suggesting that much more concerted efforts are to be made to transfer the available technologies to the farmers. Furthermore, technologies transferred are not being widely adopted by the farmers as these are not suiting to their environment. Thus, there is a need to assess and refine the technologies to make it more appropriate. The various dimensions associated with the sustainability of the animal husbandry technologies need to be studied. The potential of new technologies need to be explored and fully utilized to maximise the output. The extension research intervention is imperative which will throw light on many relevent aspects of sustainability of animal husbandry technolgoeis. The technologies generated and disseminated for use by the farmers need to be studied on the scale of profitability and sustainability to find the fate of these technologies generated at heavy cost.

NEED AND IMPORTANCE OF THE STUDY

In over five decades of research in crop and animal sciences, many useful technologies have been generated by the research institutes and

State Agricultural Universities which have been transferred to the farmers to enhance the crop and livestock production and productivity. However, technologies available with research system have not been fully percolated down and reached to the farmers and still there exists a wide gap between the production potentials of technologies and performance at farmers' fields. The general criticism is that the technologies generated are not appropriate, sustainable and suiting to farmers' micro-situations or environment and there is a need to assess and refine them so these suits to their environment and thus are widely accepted and adopted by them. Many efforts have been made to study the sustainability issues in crop sciences but very little attempt has been made to study the sustainability of animal husbandry technologies. Infact, it is imperative to make detail probe on various dimensions of sustainability in animal science because of the fact that animal husbandry is an integral component of agriculture and is highly symbiotic, supplementary and complementary to crop enterprise. The proposed study is expected to explore the exisiting practices of animal husbandry being practiced by the farmers and the sustainability of these animal husbandry technologies at farmers level. The study also assumes importance as these technologies are being assessed and refined by the research system to make it more appropriate, acceptable and profitable as well as the extent to which this has been attempted and being adopted by the farmers. There is an urgent need to make detail probe on all these relevent issues through emperical research. This study was hence, conducted with the following objectives :

OBJECTIVES

General

The broad objective of the study is to find out the sustainability and profitability of selected animal husbandry technologies.

Specific

1. Identification of animal husbandry technologies being recommended and introduced in specific area.
2. To study the prevailing situation where the technologies are being recommended.
3. To study the perceived profitability of selected animal husbandry technologies.
4. To study the perceived sustainability of selected animal husbandry technologies.

PRACTICAL UTILITY

1. The study gives a good pathway for the future scientific researcher/extensionist for using modern agriculture technology in the field with special reference to animal husbandry in a balanced manner for achieving sustainable development.
2. This study would provide direction to the farmers for better production, protection, guarantee and self equity for long term viability.
3. This study will bring about practices in resource conserving animal husbandry technologies with low cost input for sustainable development.

LIMITATION OF THE STUDY

1. The study was limited to six villages of a block of Bareilly district.
2. The study was based on the recall data of the five years (Based on discussion) 1994-1998 and also on the perception of the farmers.
3. This study was limited to animal husbandry practices only.
4. Time and money was an obvious limiting factor of the study.

ORGANISATION OF THE THESIS

The study has been presented in five chapters. The current chapter, 'INTRODUCTION' highlights glimpses of sustainability such as meaning and concept of sustainability, goals of sustainability, environmental problems and sustainability etc. along with the scope of problem. Need, importance and objectives of study are also included in this chapter. Past studies, experiences and observations have been cited in second chapter 'REVIEW OF LITERATURE'. The third chapter, 'RESEARCH METHODOLOGY' describes locale of the study, sampling procedures, variables and their measurement, methods and procedures of data collection and analysis of data in details. 'RESULTS AND DISCUSSION', the fourth chapter deals with the findings of study and their discription. Finally, the sunumary of finding and their implications have been reported in the fifth chapter, 'SUMMARY AND CONCLUSION'. The literature consulted and cited in the body of presentation have been given under the head 'REFERENCES'. This is followed by relevant Appendices.

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Chapter-2

REVIEW OF LITERATURE

A review is meant to determine what work, both theoretically and empirically has been done in the past, provide insight into the methods and procedures, suggest operational definition of major concepts and provide a basis for interpretation of the findings. In this chapter, an attempt has been made to present the meaningful and relevant research work done in the past. All the available materials have been presented under the following three heads, the sake of convenience.

2.1 SUSTAINABILITY

Aree Wibunphong and Songsak Sribooncht (1988) reported that sustainability of an agricultural system is treated on the aggregate outcome of productivity, stability and equitability analytic condition of system, an agricultural system is said to be sustainable as long as it can support population consumption. The productivity of an agricultural system is generated income from the optimum combination of farming system.

Dormaar (1988) in a grazing study in the foothills of southwestern Alberta on the rough fescue grasslands (*Festuca campestris* (Rydb)) in

1949 revealed that the heavy grazing pressure jeopardized the sustainability of the ecosystem by reducing fertility and water holding capacity.

Korte (1990) found that farmers' have an economic and relatively short-term (10-15 years) ~~in~~ view of sustainable management. The sustainability of intensive dairy farm system and hill country sheep beef farm is examined. It is concluded that physical factors do not generally have a significant effect on the economic sustainability of agricultural systems in high rain fall zone of New Zealand on farm costs of soil erosion are usually less than off farm down-stream costs (silting and flooding). Future government policies should attempt to encourage more appropriate land use where soil erosion is a major problem.

Chinnery (1991) revealed that an ecological approach to agricultural production is necessary if sustainability is to be restored and chemical inputs are to be minimised or eliminated and agroforestry is introduced as an ecofarming sustainable agriculture practice, concludes that sustainable development is predicted on sustainable agriculture.

Stenholm and Waggoner (1991) stressed that poultry is one of the world's major and fastest growing sources of meat representing over 22% of all meat production in 1989. The agricultural sector should develop best management practices that continue to provide profitability and sustainability for producers. The poultry industry in the United States and many other countries has progressed probably more than

any other branch of livestock production in the trend toward intensive production system. The poultry industry of future will need to meet steadily consumer's demand and water and air pollution.

Swaminathan (1991) indicated fourteen dimensions of sustainable agriculture, these are : Technological appropriability, Economic feasibility, Economic viability, Environmental soundness, Temporal stability, Resource use efficiency, Local adaptability, Social acceptability and Social sustainability, Political tacitness, Administrative manageability, Cultural desirability, Renewability, Equity and Productivity.

Maclead (1992) observed that the present systems of farming were not sustainable. The result suggested that the groups have different view on the sustainability of present system the causes of land degradation, scope for reversing degradation problems, and the key players in providing solution.

Fliert (1993) has emphasized that the non-formal training approach appeared to be consistent with the ecological approach of integrated pest management (IPM). The experience of the Indonesian IPM Programme showed interesting perspectives for extension supporting sustainable agriculture.

Gong and Zhang (1993) stated that the development of sustainable agriculture in China is considered in relation to the treatment of particular aspect of agriculture to allow for simplification,

intensification and possible sustainable combination of production. *Animal husbandry* is considered as a distinct area for development. Other aspects includes the development of agriculture combined with industries suited to small town and villages. The combination of animal production with natural agricultural techniques is a possible area for development of sustainable system. Other areas important in sustainable system include breeding and mechanization.

Ma (1993) suggested that the research on sustainable agriculture in China includes consideration of the concern and characteristics of sustainable systems with discussion of the degree of sustainability, appropriate system and systems which give the greatest effect. Mention is made of work on a wide range of subject including biological N fixation, fertilizer use, soil N, storage, animal production, application of science technology and economics.

Wimalasuriya (1993) indicate that crop ruminant livestock integration could enhance the sustainability of rainfed upland farming in the dry zone of Sri Lanka, with minimal disturbance to the existing socio-economic environment. Crop livestock rotation and agro-sylvo-livestock models should be tested on farmers field.

Yunn and Leng (1993) found that farming system predominantly devoted to food grain production and pig raising inefficient use of resources and ineffective enhancing/boosting agricultural production and farmers income. The effectiveness of system was appraised by formulating quantified indices for stability, sustainability, equitability

diversity and human carrying capacity. Diversified economy had a stable and sustainable development food production, while positive could not balance economic development.

Bell, *et al.* (1994) has emphasized that a vision of global agricultural, health and environmental research system is necessary to meet the needs of the first decades of the 21st century. Completion of the development of global research systems in agriculture, health and the environment is a necessary component of a global effort to establish and mobilize the intellectual capacity and energy that will be needed to sustain development.

Bouma, *et al.* (1994) revealed that sustainable agricultural development requires an eco-regional approach that integrates biophysical and socio-economic work on cropping systems, livestock, the environment and natural resources.

Bishnoi and Sardana (1994) studied the factors determining sustainability of agriculture in 'pre' and 'post' green revolution period in India. Three factors were studied viz. cropping pattern, growth performance and resource use efficiency determining sustainability of agriculture for the period 1950-1970 and 1971-1992.

Champbell (1994) reported that the land management research and extension in Australia are undergoing rapid change in response to profound environmental, social and economic challenges, and the emerging political momentum of sustainable development.

Chantalakhana (1994) stated that the implication of sustainable animal production on the environment, production system and resource management and conservation are then considerations and requirements for future research and development in animal production in order to promote food production without polluting the environment and depleting natural resources are proposed.

Devendra (1994) discussed the resource management for increasing animal productivity and enhancing the environment in the context of increased efficiency in the use of natural resources, and the justification in Asia, to increase food production, alleviate poverty, ensure sustainable system of production and environments integrity. Prevailing land use systems are discussed and the need for increased development focus in the upland and highland ecosystems is emphasized. The implications for development are : a need for more holistic system oriented approaches that address production and integrated resource use, a conducive policy environment and more environmentally sustainable system of production.

Deybe, *et al.* (1994) has emphasized that the long term viability of the system is compromised by the current rate of erosion, a policy to relax liquidity constraints on farming would be positive for the environment.

Negatu (1994) stated that durum wheat farmers in the central highlands of Ethiopia apply less than the recommended rate of N and P nutrients for Durum wheat none the less, sustainable Duum wheat

production, sustained use of fertilizer is essential which in turn requires a favourable socio-economic environment.

Bagchi (1995) found some agro-ecological and socio-economic parameters that have affected the sustainability of sub-humid, rainfed, low productive rice dominated degraded monocropped system of a small watershed in Giridih district, Bihar, India. Environmental factors that are considered to lead to a loss of sustainability are water management and different soil conditions, socio-economic factors include the fact that most farmers belong to small and marginal categories.

Banerjee (1995) suggested that resource variable programming which allows sustainable enterprises to be modelled at either the micro (farm) level or the macro (village) level as different levels for important of different objectives at each level.

Bezuneh *et al.* (1995) indicated the interrelated objectives of increasing productivity, income and short term food security of small scale farmers but the achievements may have come at the expense of long term sustainability in agricultural development. The system has relied too heavily on farmer's priorities and technologies developed, but short term sustainability issues must be included in the programme. Since the FSR/E programme was established in the early 1980's, relevant factors that pushed the issue of sustainability to the forefront have been recognized. Specific recommendation includes low input technologies restoring soil fertility, animal husbandry and agroforestry.

Chakraborti (1995) suggested that a method which measure sustainability, qualitatively, variable which demonstrate changes in sustainability (e.g. nutrient retention or the presence of nematode in soil) can be further analysed with the use of spatial interpretation of grouping.

CGIAR (1995) stated that the challenges of environmentally sustainable global agricultural development with even greater vigour and effectiveness than before through the renewal programme, the CGIAR is clarifying its vision, refocusing its research agenda, improving its government and operations, restructuring its financial arrangements, and securing stable financial support for its mission.

Drummond (1995) found Integrated Crop Management (ICM) as a whole farm philosophy that is site specific, bringing together the farming system and the positive management of landscape and wildlife and habitat features. Planning aspects and use of the LEAF (Linking Environment and Farming) environmental audit as management tool are discussed and the importance of ensuring that the decision for landscape management are fully integrated into the whole farm philosophy.

Ehui and Jabbar (1995) have emphasized that technologies also need to maintain ecological stability and preserve the national resource while enhancing food production.

Entsua-mensan (1995) studied that the gap between available knowledge on improved technologies and actual practice and effective information delivery service which is the missing link between the

research extension interface on the one hand, and practical application of the results by the peasant farmers on the other. These activities are needed to sustain increased food production since information can serve as a catalyst for the adoption of innovative techniques. Available options like efficient extension service through out reach and demonstration programme, agricultural shows, the use of opinion leaders, news media audio-visual material and porters may be used.

Gibberd (1995) stated that stress is laid on the prominent role played by farmers in setting up and interpreting the results of the projects managed trials and in testing the projects ideas, findings and other innovation on their own farm. Trials involved the use of animal manure, agroforestry bar follows, crop densities date of planting variety and soil surface water management on all the areas of major crops, chiefly pearl millet, sorghum, cowpeas and grams, both as soil and intercrops. A range of new crops and varieties as well as wide range of tools were tried and farmers' views on all this are reported.

Gohl (1995) revealed that a new model for links between research, extension and farmers is needed. More research has to be carried out in co-operation with farmers and research/extension priorities will have to be determined together with farmers themselves. With more experiments carried out together with farmers in their own environment research will be more relevant and welfare of farmers can be improved. Degradation in environmentally fragile areas is closely linked to poverty and both problems must be addressed at the same time. Participation of

farmers in research will also help to maintain biodiversity and sustainability.

Golan (1995) suggested that the social accounting matrix are equipped to examine the employment and distribution effects of various conservation options. The six factors which have combined to accelerate the process of soil degradation and desertification in the Sahel and Sudan zones are : (1) the fragile structure of the soils in the zone, together with the low humus content and low water retention capacity; (2) continuous and rapid destruction of tree varieties; (3) the rapid expansion of land dependence on groundnut (peanut) cultivation; (4) population pressures; (5) disappointing results from introduced agricultural techniques; (6) the period of drought has affected the sahel region since 1968.

Hansen (1995) has stressed that the method begins with the goal setting of sustainability i.e. ecological, economic and social sustainability. These goals are resolved into a number of objectives by using such indicators. Sustainable agriculture can be viewed from the three themes, ecological, economic and social perspectives and should be assessed relatively to all three. Sustainable agriculture may also be viewed as a series of interacting system at various spatial scales.

International Service for National Agricultural Research (1995) revealed that the workshop had two main objectives for research leaders, policy makers and other involved in agricultural research to engage in a dialogic on issues of research policy, organization and managment, arising from the growing awareness of the important of NRM in

agricultural development to identify NARS priorities for the integration of NRM issues into their agricultural research agenda, ways in which NARS can mobilize their resources for this purpose and the services and support NARS require from regional and international organizations, including ISNAR, to achieve this integration.

Lassalle (1995) manifested that the farmers often have reached a high level of agricultural intensifications, the agro-ecological system seems to have reached its limit of supporting agricultural activities. As a result of precarious nature of the farming system in the area, it was necessary to have some form of intervention in order to try to improve sustainability.

Pandey and Hardakar (1995) studied that sustainability in agriculture involves inter temporal trade offs in the use of natural resources analysis of sustainability necessary involves the study of the dynamics of change in the stock of natural resources to understand and analysis sustainability better it is important to be able to forecast the future consequences of current resource use decisions. As the time frame involved may be long, and complex interaction among various parts of the farming system need to be well understood, modelling in a good tool for studying such phenomena.

Parminter, *et al.* (1996) stated that a participatory study with livestock farmers in Waikato, New Zealand was designed to prioritize farmers information needs to achieve a range of farming goals. The results indicate that lack of information to implement sustainability

objectives is limiting the ability of some farmers to improve the condition of their natural resources.

Penfold *et al.* (1995) revealed that the trial aim to compare organic, biodynamic, integrated and conventional broadacre farming systems for attributes of sustainability. Monitoring of indicators such as soil physical, chemical and biological changes products quality, economics, crop and water usage, and energy requirements, the comparative advantage or disadvantage of each system are being evaluated in terms of productivity, profitability and environmental sustainability used management remains the impediment to high production levels on the organic and biodynamic treatments, while input costs, variable yields, and low returns for grazed pastures are major constraints to high economic returns on the integrated and conventional systems.

Phillips (1995) stated that the current emphasis of development in Nigeria concentrates on the rural areas where a majority of Nigerians reside. What the local people know and want for improvement must be fully understood and used to develop a participatory development model. In this case, indigenous knowledge becomes the key to local level development. The importance of agricultural development and local knowledge system, the role of the Nigerian Institute of Social and Economic Research (NISER) and its programme development and implementation.

Pozy (1995) manifested that small subsistence farmers in the Burundi highlands are facing production systems problems due to pressure of population growth. Extension works for late twenty years have failed to increase productivity by poor farmers adoption of intensive crop and livestock systems. Sahiwal breeding and potato technologies based on research results and adapted by prior on farm trials were included in traditional production system and extended to a diverse sample of small farmers. Alternative technologies were adopted because they enhance sustainability (use of available resources on a renewal basis) and improve food production for home consumption (food security).

Rabbing (1995) stated that the eco-regional research helps in priority setting at lower integration levels and may give an answer to questions formulated at the regional level. A solid scientific basis of these studies could be given by system approaches at the integration levels that integrate defaulted biophysical studies and socio-economic research.

Read and Bert (1995) revealed that last (landscape approach to sustainability in the tropics) approach will use participatory research in SANREM (Sustainable Agriculture and Natural Resource Management) to assist the people of Donsin improve their standard of living by developing tools which can be used for appropriate management of natural resources. Inter disciplinary research on the role of livestock needs to be incorporated into broader research themes within the context of human and agricultural ecology to assist farmers in Donsin manage natural resources.

Rugumamu (1995) found that planners and policy makers should address the ensuring problems and successes from existing land use practices. This approach will form the basis for formulating replicable plans and policies which are essentially people based and have a direct bearing on conservation.

Simmons (1995) focus on the conflicting goals, viewpoints, and priorities of the forest agent and coulibaly concerning conservation of the forest ecosystems, desertification, and family and village needs. It provides a basis for inductive discussion on the sustainability of natural resource and agricultural management policy issues locally, regionally, and internationally and also serves to increase student's understanding of the environmental implications of subsistence agricultural practice characteristics of many semiarid tropical area.

Singh (1995) suggested a new policy in which land use should be according to land capability and human and livestock population pressures should be in accordance with carrying capacity. The mismanagement of land can be halted through human resource development and strong legislative measures.

Stiles (1995) stated that a primary goal of the workshop was to formulate recommendations of what needs to be done to achieve sustainable development in the dryland. A prerequisite for success of any intervention affecting a local community is that the planners recognize the institutions, systems of indigeneous knowledge and management structures that already exist.

Stock (1995) stated that the training was found to increase farmers capacity to learn and it is concluded that Farmer Field School can lead to a more sustainable agriculture in the presence of institutional/ policy support, strong farmers' organization and mechanisms for follow-up including continued participatory research after the training is over.

Webster (1995) suggested that in some cases gross margins can be maintained using fewer inputs, but the identification and measurement of indicators of sustainability is still under development. Research results tend to be location-specific and so it is very difficult to forecast the regional, national or EU-level economic impact of adoption of sustainable systems. It would appear that the impact of sustainability on farm incomes is likely to be quite variable, but generally negative.

Heitschmidt *et al.* (1996) in a study of the long term sustainability of animal agriculture in an ecological context revealed that the low levels of efficiency were found to be largely the result of the interaction effect of the high levels of culture energy require to maintain a productive cow herd and grow and finish calves in the rather harsh environment of the Northern Great Plains. Results pointedly reveal the high level of dependency of the U.S. beef cattle industry on fossil fuels.

Irvin (1996) stated that technologies for the control of ticks and tick-borne diseases (TBDs) in sub-Saharan Africa still need improvement but many are now at the stage where, if correctly applied, they can have a major impact on reducing the deleterious effect of ticks and TBDs. However, uptake of these technologies is slow, and programmes must

in the future focus more on delivery than on technologies development. If the technologies are to be adopted, policy makers, veterinarians and farmers to have to perceive them as reliable, affordable, available, appropriate and sustainable.

Jasiorowski (1996) studied that the sustainability of beef production in Poland. He stated that beef cattle development programme in Poland may play important role as conserving and shaping environment.

Kogi (1996) reported that composite breeds have proved to be especially valuable as a means of incorporating improved productivity with adaptability. Sustainability of the Dual Purpose Goat (DPG) technology depends on existence of institutional linkages and smallholder recognition of benefits of the new technology. To ensure sustainability of the KDPG breed for the benefit of the producers the Kenya Dual Purpose Goat Multiplication Program is required.

Lowrence (1996) revealed that extension worker had a broader awareness of regional linkage between environmental problems and a more technical understanding than farmers' of ecological interactions within the farming system.

MALMR (1996) opinioned that the current status of fisheries is looked at as well as institutional linkages, legal support and policy directions, the status of technologies, environmental influences, various socioeconomic factors, community participation, private sector involvement as well as regional and international obligations.

Ngaido (1997) stated that the concerns of the states of Mashreq and Maghreb region regarding efficiency, equity and sustainability issues are translated in the wealth of instructional and legal reform that they carried out in their different countries. The mechanisms are similar but differ very much in the rights they granted to the local communities and individuals. These rights have direct effect on farmers and on communities possibility to improve their resources.

Netting and Stone (1996) studied that the Kofyae Communities in central Nigeria are intensive agricultural. Practices are widely used, yet a high level of biodiversity is found and discussion explores the role of biodiversity in system of small, like that of the foster biodiversity as part of enviromental and economic sustainability even as they adapt to new agricultural conditions.

Pereira (1996) revealed the need for consideration of the implication of sustainable development while developing education and training for sustainability related to enviromental and health impacts, water quality management, modern irrigation systems, technologies for use of waste and saline water, basi wide integrated planning of land and water resources, water saving techniques, economics of agricultural development.

Risse (1998) worked that agriculture is one of several industries that face criticism today because of its impact on the environment. Pollution prevention technologies can go along way toward addressing these concerns. They could also benefit producers as they represent a

move toward efficiency. The most common environmental pollutants from crop production are sediment, nutrients, and pesticides. He identifies pollution prevention opportunities that are economically viable to the farmer and minimize the impacts of crop production pollutants. He also lists impediments that limit the adaptation of these practices. Finally, he identifies areas where pollution prevention techniques would be economically viable, technically sound, and environmentally sustainable and suggests methods of encouraging the adoption of these technologies.

Vavra (1996) considered that the question of sustainability of agricultural production and the use of natural resources has become a popular topic. Most scientists agree that current systems are generally non-sustainable. Current rates of resource extraction will lead us to a depleted earth in the future. Sustainability is defined in many ways. For this paper sustainability should be considered the overlap of what is wanted and what is ecologically possible. Attempts have been made to place a quantitative measure on sustainability. However, it should be considered a trajectory or goal, a direction that guides constructive change, rather than a single quantitative measure. Research and extension personnel may have to take a broader look at their efforts and expand their knowledge base in order to address the issue of sustainable production systems. Both natural events and those caused by humans bring about changes in production potential that require shifts in management. Uncertainty and change should be incorporated into adaptive management strategies. Interdisciplinary efforts are needed

to confront these issues. Animal scientists need to formulate management system that are environmentally compatible or face restrictive legislation that will force change. Members of the American Society of Animal Science seem to agree : efficient and sustainable use of natural resources appears in the draft of the strategic plan of the society, and a poll of members revealed that environmental concerns about animal agriculture was a primary issue facing animal scientists.

Sayer (1997) stated that technology will help to address the challenges for sustainable forestry in the 21st century. Some of the challenges will include the shift of production from native forest to plantations in areas of comparative advantage, more efficient processing delinking end-use products from raw wood characteristics, increased demand, better information technologies to support decision makers, and more options for conserving biodiversity. Definitions of sustainability will vary in time and space as society's expectations and aspirations change, so there can be no "silver bullet" to ensure sustainability. However, progress may be facilitated with a systematic approach to forest management embracing the usual planning cycle : formulation of objectives, preparation of a strategy, planning, implementing, monitoring, and reappraisal. This requires a good understanding of each particular situation. Managers need good resource assessment and decision support system : they must foster stakeholder participation in decisions, cost and benefits; and ensure effective procedures to resolve conflicts. Within an appropriate system, technical advances such as better machines and new implements may

help to make a difference, but will not in themselves ensure sustainable. The important technologies for sustainable forestry are those that foster better communication between stakeholders and allow informed decisions spanning scales from the gene to the ecosystem. This remains an important challenges for forest managers in their search for sustainability.

Alo (1997) results showed that SRCSP (small ruminant coconut system project) involved its beneficiaries in all phases of the project and that participation was GENIUNE, occurring as "Cooperation". The study likewise noted that SRCSP took a sustainable path of change two years after its phase out from the villages of Sta. Cruz, Laguana (Philippines). Sustained beyond Project completion was 72.64 percent of project gains. Over the two year period of from 1994 to 1996, the individual competency level, the household economic assets, and the ecological integrity improved markedly. However, the social assets decreased by more than 16 percent. The project's participatory communication activities were found to have directly triggered the growth of the individual competency level, the economic, and the social assets, it indirectly influenced the improvements in the ecological dimension. Thus, because of participatory communication, it can be said, that the project was sustained beyond support termination. This occurred in the midst of a typhoon in November 1995 that destroyed the animal pens of the farmer cooperators. This study was deemed very significant as it showed why and how the SRCSP and its beneficiary organization, KMPC (Kamtupa Multi-Purpose Cooperative), succeeded and failed,

respectively. Through these lessons, planners are expected to get an idea of the importance of participatory communication on project sustainability. As there is no standard measure in the country nor abroad (Munansinghe and Shearer, 1995) for determining sustainability to date, the process employed by the researcher may be useful for future evaluators in assessing similar rural development projects particularly those dealing with livestock specifically, the sustainability indicators used and recommended may come in handy for other evaluators.

ILRI (1998) This document supported with photographs, presents and discusses eight different articles on International livestock Research Institute's (ILRI's) activities. The first article and nutrient cycling : maintaining a balance clearly shows how livestock support intensified agricultural production systems. The article making sense and use of genetic diversity highlights the role for indigenous animal genetic resources in the low external input production systems used by the vast majority of the world's smallholder farmers. ILRI's biotechnology research accounts for about 25 percent of the total annual CGIAR investment in biotechnology. Improving productivity and reducing wastages from disease and parasites have real environmental benefits. It also demonstrates that livestock can play central role in improving the lives of rural people without degrading the environment. There is a need for a systems that takes into account both productivity and sustainability. Concerns have been expressed that widespread environmental degradation would follow the control of the tsetse fly and trypanosomiasis in sub-Saharan Africa.

Lal (1998) reported that growing pulses in rainy season instead of rice or in winter season rice fallows in place of wheat is more beneficial than raising of rice and wheat is more beneficial than raising of rice and wheat. In growing pulses the inputs required are less than those in raising rice and wheat. Wherever possible urdbean, mungbean and pigeonpea can replace rice during the rainy season and chickpea, field pea, lentil and french bean or rajma can replace wheat in rice fallows.

Li-Pun, H. (1998) reported that the main objective of International Livestock Research Institute's (ILRI's) sustainable production systems programme is to improve human welfare through the development of more productive and sustainable studied that system in developing countries. The programmes focus is on market-oriented smallholder systems. In order to improve the productivity and studied of these systems, biological, environmental and socio-economic constraints have to be overcome. Therefore, opportunities for changing the systems in a sustainable manner have to be carefully identified and chosen. Currently the programme has activities under four themes, viz, systems analysis and impact assessment, livestock policy-analysis, market-oriented smallholder dairy and improving livestock productivity under disease risk, and in three ecoregions, viz. highlands-Ethiopia, subhumid-Nigeria, and semi-arid-Niger.

Sayre (1998) stated that virtually all current strategies to implement modern, sustainable crop management production practices involve conservation/zero tillage prior to seeding, some form of crop

residue retention and management, fertilizer application methodologies that minimize nutrient losses, and integrated insect disease and weed management practices that relay on minimal or no use of pesticides. In nearly all instances, the use of these modern, sustainable crop management strategies has by-passed most small farmers (especially small wheat farmers) in developing countries for several reasons, including :1) the lack of small scale-planters that are compatible with two-wheel or small four-wheel tractors, or with draft animals, and appropriate for sowing into residues in reduced or zero tillage system : 2) the need of many farmers to remove or pasture crop residues for livestock feed or to remove residues for cooking : 3) the lack of knowledge by small farmers (and most researchers) about how to best to apply fertilizers (when and where, with main emphasis on nitrogen fertilizers) to minimize losses while complementing farm level nutrient sources including farmyard manure/composts and/or green manures, especially when combined with reduced zero tillage systems : and 4) the largely unknown ramifications of these practices, which may modify insect, disease, and weed incidence. Research is underway at different institutions in several countries to address these problems and help to ensure that sustainable crop management practices relevant to small wheat farmers will become a reality.

2.2 PROFITABILITY

Benchaphum *et al.* (1990) revealed that farming system often claimed to result in the increase of productivity, decrease in production cost and increase in the farmers income in several area. This impact

study masses use of an agroeco system of farming analysis in evaluating productivity, stability sustainability and equitability of farming systems research technology is well as assessing the impact on the community the basis for consideration of the impact is comparision of changes with and without new technology and also this study has a period of 3 years for operation.

Liu (1993) indicate that the animal husbandry has developed in recent years with a marked increase in milk production and related increase in profits. Animal husbandry produces manure for arable agriculture and consumer's crop by products. Milk used by industry in the production of powdered milk showed a greater profit than milk marketed as fresh milk and the same is true of other milk products and some products.

Byerlee (1994) manifested that the contribution of modern varieties of the three major cereal crops (rice, wheat and maize) in the post green revolution period, especially during the part decades or so, is reviewed in light of recent changes in the technical, economic and institutional environmental in which agricultural development strategies are being formed, particular emphasis is given to the interactions of modern varieties with input intensification, input efficiency and sustainability. Economical and institutional issues in structuring plant breeding programs for the most efficient use of resources.

Elhue and Shapiro (1995) considered the research and technology transfer strategies needed to promote livestock development goal in low

income countries. Recommendations are made for a framework for international action which include all the partners in the global research and development system.

Goetz (1995) stated that a mix of crops is cultivated supporting the argument that diversification as a prerequisite for sustainable agriculture production, is a necessary condition for long run profit maximizing behaviour of the farmer.

Hanson, *et al.* (1995) analysed that conventional system with government programmes were more profitable while low input systems offered a higher lower limit of risk.

Kar and Mukhopadhyay (1995) advocated an organic approach to farming which will increase production, without degrading the environment. They further noted that organic farming may be more expensive at first but the cost will be reduced over time with the use of renewable resources, and the use of improved technology which will ensure maximum efficiency of such resources.

Sustainable financing programme of SACCAR (1995) discussed that two interrelated reasons are given for the need of a new funding mechanism, the increasing loss of donors who have traditionally supported agricultural and natural resources research and training and the need to stabilize funding. The mandate to find new funding mechanisms is outlined, potential area of funding, new programmes, and the opinions for funding are discussed.

Altier (1996) found that the ecological principles underlying the sustainability of traditional farming systems can often be adopted to increase productivity. Thus, the combination of both traditional and modern agroecology presents a promising avenue for the future development of sustainable agricultural models for the needs.

Cotman (1996) revealed the management practices and user friendly indicators to aid monitoring were obtained. Sustainable farming recognises socio-economic goals of farming (Viable business, enjoyable lifestyle, good living standards, good short term profitability satisfied farmers and resource goals (efficient contented animals, productive pasture, clean water, control of feral pests, unrestricted market access, adequate rural services, family health). Grazing guidelines have been produced using the above information and on farm study groups set up to demonstrate these practices in a whole farm system. User friendly indicators have also been developed are in use.

Gangwar and Bhatia (1998) suggested that during the rainy season the crop loss may be as high as 50-100% due to floods. In these areas socio-economic status of farmers as well as communication and transport infrastructure are poor. In the features of diaralands, yield gap and major constraints in diara areas along with improved techniques for sustained productivity in these areas are given in a lucid manner.

2.3 EFFECTIVE MANAGEMENT AND APPLICATION OF TECHNOLOGIES

Abington (1992) studied that the agricultural systems of the hill and mountain areas of Nepal are coming under stress and degradation of the natural resources occurring. The role of livestock with the traditional systems to determinings the constraints which currently limit productivity and to consideration of whether in the longer term livestock production can be increased on a subtainable basis. In the large situations of ruminants like (Cattle & Buffalo), snall ruminants (Sheep and Goats), monogastic and small stock (Poultry, Pig, Rabbits) and fodder & forage production when these situation is imbalance than the common two themes of farmers themselves perceive as major constraints to their livelihoods are steady decline crop yield and degradation of the fodder resource so that they can no longer maintain their livestock in good condition throughout the year.

Auburn (1993) studies that the sustainable agriculture network (SAN) is a cooperative effort of university, government, business and non profit organizations dedicated to information exchange although developed as a national effort in the USA, its databases and e-mail discussion group are accessible to, and used by, individuals and organizations throughout the world. It is being developed by a committee from diverse organizations with support from the US department of Agricultures national Sustainable Agriculture Research and Education (SARE) progarmine.

Kolmans (1993) revealed that red de agriculture ecologica (RAE) has been useful, especially at a time when many NGOs are experiencing teething problems and struggling for greater efficiency and effectiveness through cooperation and the exchange of experience. It demonstrates that networking is possible without a great deal of external financial supports using members contributions in kind as the main source of capital.

Permsak (1993) indicated that agroforestry is landuse system and technologies which can be catagorized in two groups i.e. the traditional agroforestry and the newly developed one. A deliberate integration/consolidation of tree, crop and animal under proper management create productivity, sustainability of land utilization and adoptabilities by farmers. Appropriate agroforestry implementation is site specific systems and practices. It is necessary to diagnose existing land utiliaztion, farmer's circumstances, the plan as well as design of agroforestry adaptation, on farm trial, extension research and extension support.

Prain, *et al.* (1993) studies that networks are open system and therefore it's aim is to catalyze the expansion of autonomous research and development capacity and activities within the framework of a participation, user focused photosophy. This can be achived by providing modest funding stimulating the flow of information, supporting workshop on methods and approaches and finally, disseminating the food will and the shared belief that, through connecting in these way, a difference can be made.

Quintal and Gandhimatti (1993) studied that training has two outputs : A report on the initial site characterization of a village with emphasis on problem diagnosis and initial solutions, which are gender sensitive and participants adaptive research or action plans for their own sites formulated by applying lessons learned in the course.

Rist (1993) emphasized that the main Agro-ecology programme of the University of Cochabamba (AGRUCO) is stimulate of the dissemination of organic agriculture practices and technologies among and by the institutions involved in rural extension work by governments and NGOs. The activities of AGRUCO had to be redefined to allow room for the re-evaluation and revival of indigenous knowledge. It tries to stabilise a holistic approach, ensuring feedback between the four area of activities participatory research support to non governmental and governmental organization community support and academic education.

Singh and Chauhan (1993) stated that rainfed uplands in eastern India cover several million hectare and are largely contiguous in the chotanagpur plateau region because of ^e low land and concentrated rainfall, these land are sporadically cultivated only in the wet season to grow a crop of minor millet, black gram or rice in a 4 years crop rotation cycle. The studies conducted in the Hazaribagh upland in Bihar are very encouraging and indicate greater potential for increasing cropping intensity through integrated farming practices in ^s there environment.

Ogle (1995) revealed that one innovative feature of the M.Sc. course of the students is that they are conducted on farm with some

supportive on-station or laboratory work and equipped with portable computers and trained in electronic communication to enable them to rapidly exchange information and access relevant advisory expertise, wherever it may be available.

Preston and Speedy (1995) premise that postgraduate training in industrialized countries to develop the human resource base in a tropical developing country is expensive and not always appropriate, the potential of modern electronic communication technology in training of students from developing countries is discussed.

Toure and Mortelmans (1996) studied that the several African sub-Saharan countries within the subhumid zone have high agropastoral potentialities yet underexploited as a result of glossins transmitted animal trypanosomiasis. In the face of a population increase and possible reduction of food availability, an accelerated agricultural development is a prerequisite as well as combating against trypanosomiasis. He further stated that the present control techniques are environmentally sound and give higher opportunity for community participation which is more suitable for sustainable land recovery.

Ahmed (1997) found that in the past, agricultural researchers tended to ignore the fisheries factors in global food and nutritional security. However, the role of fish is becoming critical as a result of changes in fisheries regimes, income distribution, demand and increasing international trade. Fish has become the fastest growing food commodity in international trade and this is raising concern for the supply of fish

for poorer people. As a result, the impact of international trade regimes on fish supply and demand, and the consequences on the availability of fish for developing countries need to be studied. Policies aimed at increasing export earnings are in conflict with those aimed at increasing food security in third world countries. Fisheries policies research will need to focus on three primary areas which have an impact on the marginal and poorer communities of developing countries : increased international demand for low value fish on the supply for poorer countries : improved aquaculture technologies and productivity on poorer and marginal farmers and land and water allocation policy on productivity, food security and sustainability across farm, fishery and related sectors. The key to local food security is in the integration of agriculture, aquaculture and natural resources but an important focus of fisheries policy research will be to look at the linkages between societal, economy and natural systems in order to develop adequate and flexible solutions to achieve sustainable use of aquatic resources systems.

Irvin (1998) stated that to the productivity and sustainability of smallholder farming systems can be severely compromised by ill health and diseases. However, disease is only one of the constraints which limit productivity in such systems. This means that improving animal health must form part of a strategy within which appropriate attention must also be given to improving management, nutrition and breeding in an integrated way. It is unlikely that any one intervention on its own will result in sustainable improvements. Improving animal health must also adopt an integrated approach which includes genetic improvement,

improved management, chemotherapy, vaccination, vector control and diagnosis. Understanding the epidemiology of diseases in different farming systems will enable a correct balance of these interventions to be developed which are appropriate to different diseases and situations.

Klausner (1998) reported a process for integrating knowledge to develop and evaluate nutrient management plans for dairy farms. The focus was on accounting for and managing N, P, and K on a commercial farm. The case study farm was a well managed, progressive dairy farm located in central New York with 320 lactating cows (*Bos taurus*), 290 heifers, and 600 acres of crop land. This farm had the resources and management skills that are a model for dairy farming in the future. However, mass nutrient balances indicated the 60 to 72% of imputed N, P and K were in excess of nutrient exports from the farm 60 to 80% of the important nutrients were from purchased feeds. Evaluation and refinement of animal diets resulted in a reduction in crude protein content of the rations by 2 percentage points while supporting a 13% increase in milk production and a 34 % decrease in total N excretion. Partial budgets projected that ration reformulation increased net farm income by 40 200. Implementation of a crop nutrient management plan was expected to decrease fertilizer purchases and application expenses by about \$ 1350, but construction of a remote manure storage pond and custom spreading of manure resulted in a decrease of net farm income of \$4000. The vast quantity of data required and the complexity of the analysis indicate that developing computerized decision aid tools will be necessary to apply the process to a large number of farms.

Huitson (1999) estimated the environmental losses of N and net excess of P in different subsections of a dairy farm in New York State. Losses of N from volatilization on the barn floor and in storage were estimated to be 16% of excreted N. As a partial check on these results, manure nutrient composition for lactating cows was analyzed at excretion, entering storage, and leaving storage. Soil leaching losses from the farm were calculated using the LEACHIN model, and were 9% of total N inflows to the farm. Predicted nitrate N concentrations in the leachate were 10.6 ppm. Results from monitoring a stream originating from the farm gave an annual average of 14.4 ppm of nitrate N. About 80% of the total N inflows were accounted for as milk sold (25%), animals sold (2%), leaching losses (9%), and volatilization/ denitrification losses (46%). Environmental losses accounted for 75% of the excess N. Projected scenarios for increased use of farm-produced forages, reduction in fertilizers, and increased feed conversion to milk resulted in only minor improvements in the nutrient imbalance on this farm.

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Chapter-3

RESEARCH METHODOLOGY

This chapter deals with various methods and procedures used with respect to the selection of area and locale of the study, sampling design and data collection procedures, variables under study, their empirical measurements and statistical methods employed for the analysis of the data. The various aspects included in this chapter are presented under the following sections/heads:

- ☞ Locale of the Study
- ☞ Sampling Procedure
- ☞ Tools of the Study
- ☞ Construction of Schedule
- ☞ Variables and their Measurements
- ☞ Definition and Meaning of Profitability and Sustainability
- ☞ Dimensions of Sustainability
- ☞ Development of Sustainability and Profitability Index
- ☞ Detailed Description of Adopted Technologies : Observation & Case Studies
- ☞ Methods of Data Collection
- ☞ Statistical Analysis/ Analysis of Data

LOCALE OF STUDY

In order to have a clear picture of an ability to continue of the animal science technology users which were disseminated in a cluster of six villages of Bareilly district, this study was conducted purposively selected villages, namely, Mudia Ahemad Nagar, Mohanpur, Indira Nagar, Kalapur, Aspura and Khata (Fig 3.1). Some of the important considerations in selection of villages were as follows.

1. Package of practices of sustainable animal science technologies are uses by a good of the villagers.
2. It was inevitable necessary to have a thorough understanding of the animal agriculture farm situations/socio-economic conditions and problems in fostering of technology users in livestock enterprises/avocation. The researcher was familiar with the area, population/good parlence of village people, field extension personnel and officials and the vernacular (language) which helped in collection of data with easy way.
3. Above, all the villages were conveniently accessible to the researcher/ because of their location around two and three animal science projects are running from last two decades regularly with the participation of IVRI, Izatnagar Bareilly U.P. The researcher had an added advantage of work experience in field extension programme of IVRI.
4. The farmers under field extension programmes/projects of IVRI, Izatnagar, were exopsed to use the animal science innovations for his growth of dairy enterprise.

5. Local dialect was not a barrier/impediment with the researcher. Being well versed in Hindi, he could easily establish rapport with the farmers and gather information from them.

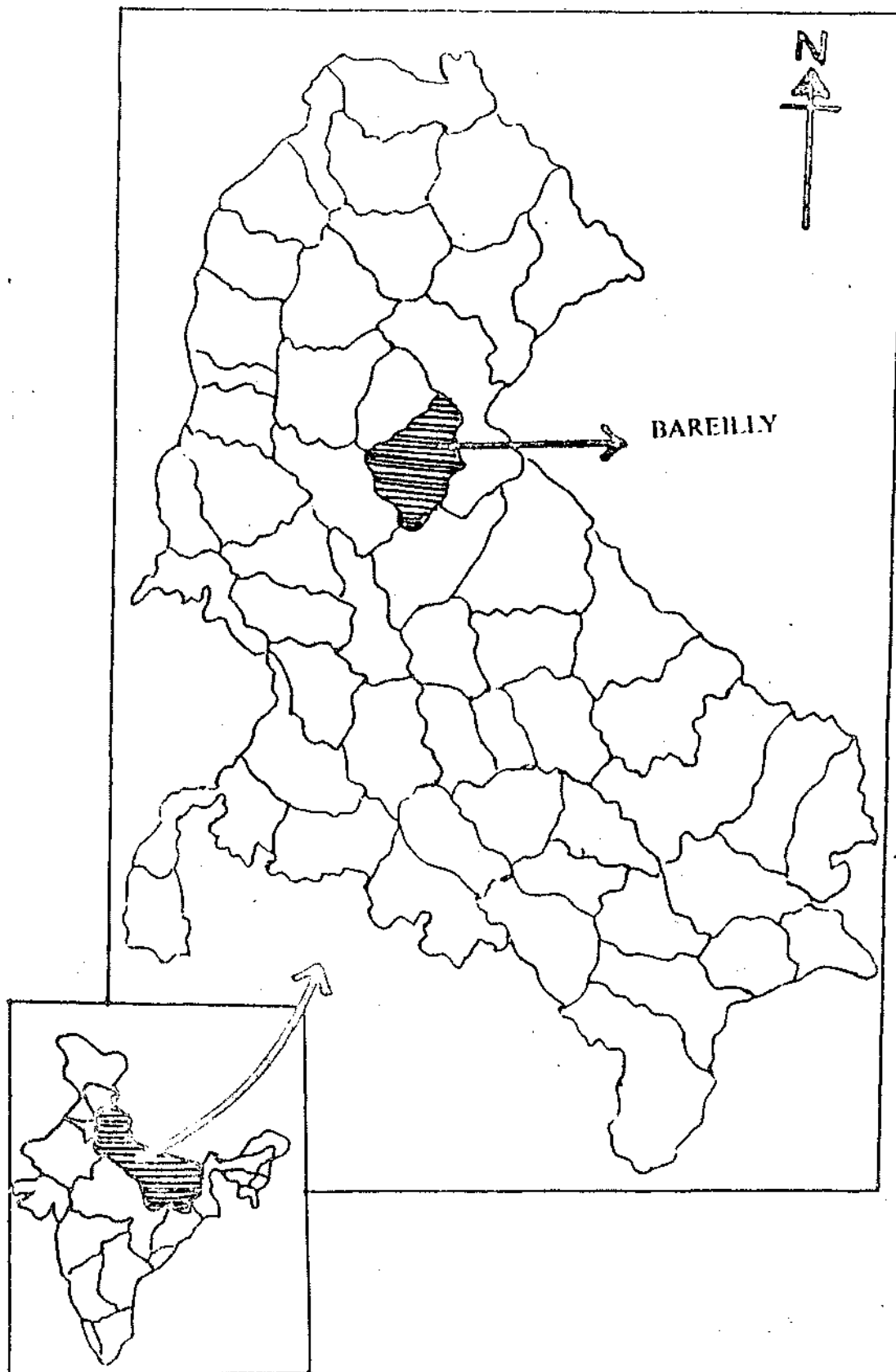
Background information about Bareilly district

Bareilly district is one of the western 'Tarai' district of Uttar Pradesh. It is surrounded by Pilibhit district in the east, Rampur district in the west, Udham Singh Nagar district in the north and Shahajahanpur district in the south. The total geographical area of Bareilly district is 4,120 sq. km., spread over about 150 km. from north to south and about 90 km from east to west, comprising about 3908 sq. km. rural and 212 sq. km. urban area (Fig.3).

Bareilly district has 6 Tehsils, 15 Block, 144 Nyay Pachayats, 192 Panchayat Ghars, 1324 Gram Sabhas and 2072 Villages. The total population of Bareilly district, according to 1991 census is 28,22,988. Thirty three per cent (9,24,465) population live in urban area, whereas the remaining sixty seven per cent (19,05,151) in the rural area. The total population of scheduled caste is 3,58,934 and scheduled tribes is 424. The total number of families is 4,38,207 in the district.

Occupation wise, 52.33 percent are engaged in agriculture, 14.17 per cent in agriculture labour, 0.64 per cent in animal husbandry, 1.47 per cent in family enterprise, 4.53 per cent in non-family enterprise, 7.41 per cent in bussiness and the rest 19.45 per cent are engaged in other occupation.

Fig. 3.1 : Location of Bareilly district in Uttar Pradesh.



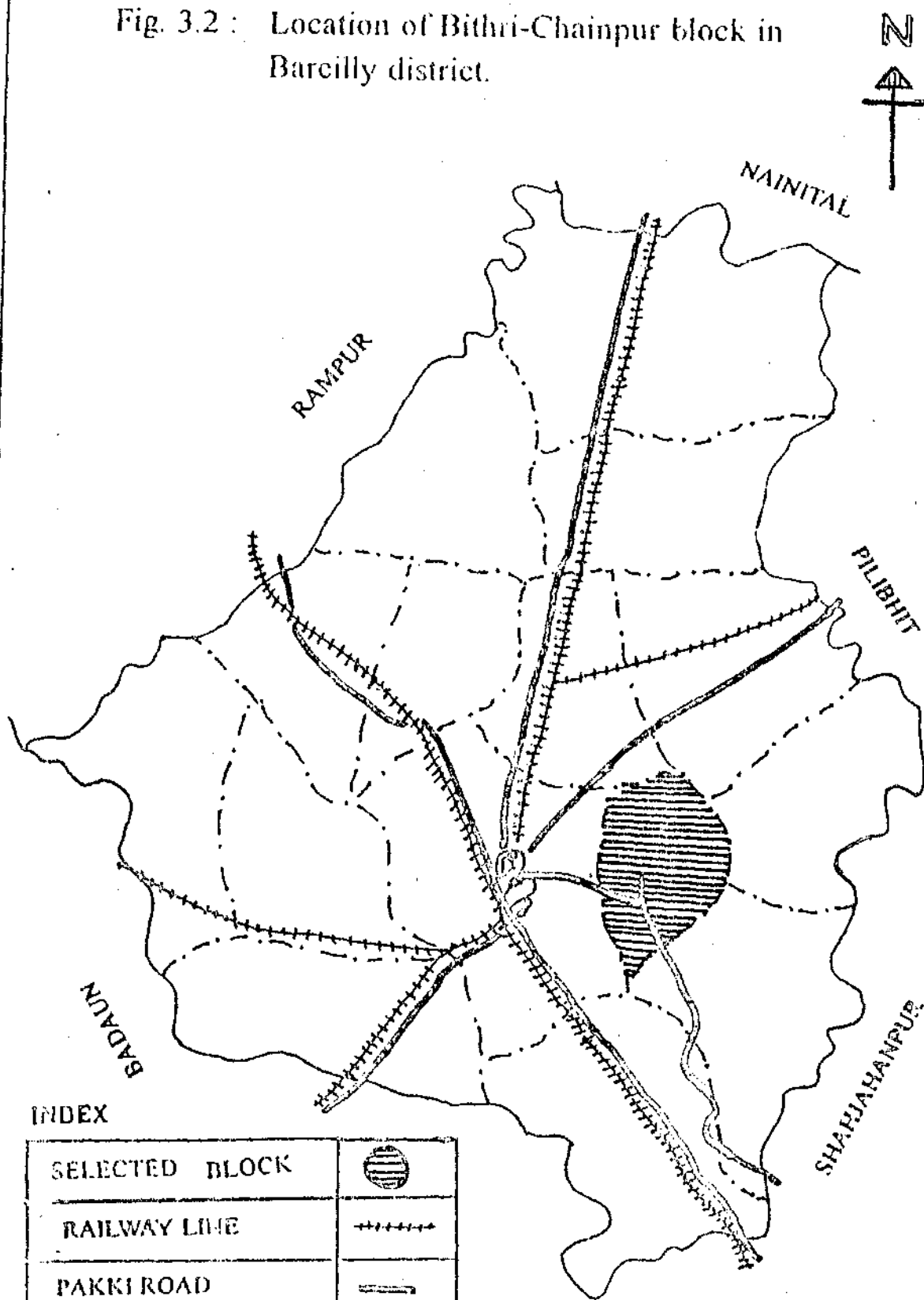
The overall literacy percentage of the district is 32.78. The male literacy is 43.33 per cent, whereas female literacy is 19.85 per cent. The district has 1586 junior Basic Schools, 418 Senior Basic Schools, 95 High Schools and Intermediate Colleges, 5 Degree Colleges, 1 University and 1 Deemed University of Indian Veterinary Research Institute.

Back ground information about Bithari Chainpur Block

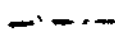
Bithari Chainpur block is located in Bareilly Tehsil of the district (Fig 3.2). The distance of block headquarter from district headquarter is 11 km. It is about 16 km. far from IVRI, campus. The total geographical area of the block is 22350 hectares. The net sown area is 18047 hectares and irrigated area is 14486 ha. of which 2988 (20.63%), 6691(46.19%), 1508(10.41%), 182(1.25%), 3117(21.51%) hectares area is irrigated by canals, tubewells, wells, ponds and other sources, respectively. Thus 80.26% of sown area is irrigated. There are about 19643 farm families.

There are 124 villages in the block, out of which 94 villages are electrified. The Block has 12 Nyay Panchayat, 64 Gram Sabhas. It is served with eight Post Offices, four Public Call Office, and ninety Telephones. There are three branches of Kshetriya Gramin Bank and one branch of cooperative Bank in the block. There are 108 Junior Basic Schools, 27 Senior Basic Schools, two Higher Secondary Schools. It has one Allopathic hospital, three Primary health centres, four Ayurvedic hospital and two Homeopathic hospitals. The total population of block (1991 census) is 1,34,401 of which 73,121 are males and 61,280 are females. Out of total population, 10,496 are scheduled caste and

Fig. 3.2 : Location of Bithri-Chainpur block in Bareilly district.



INDEX

SELECTED BLOCK	
RAILWAY LINE	
PAKKI ROAD	
BLOCK BOUNDARY	

scheduled tribes. There are 28,974 literates, of which 23,560 are males and 5,414 are females. Total literacy percentage in the block is 27.7, 40.0 per cent in males and 11.6 per cent in females. Out of total population 19,643 are females and 10,716 are agricultural labourers.

SAMPLING PROCEDURES

Technology users/farmers are the main unit of this study which were selected purposively from those villages where-in the selected technologies disseminated by KVK Scientists, Parag Dairy officers and State Govt. Extension Agency. Researcher's familiarity with the study area and acquaintance with the norm and culture of society and dialect of the area were added advantages. Selection of blocks, cluster of villages and respondents were done as follow.

Selection of respondents

The study was confined to the profitability and sustainability of animal husbandry technologies. Hence, a comprehensive list of technology users were prepared from the selected six villages of a cluster who had been using the selected technology which have been advocated by various agencies, such as KVK Scientist from IVRI, Parag Dairy officers from Sahakari Dugdh Sangh, Bareilly, V.Os. of State Govt. and other livestock extension workers of the state deptt. during the period of 1995-1999. These technology users were main units of our study. From each village of a cluster of six villages a maximum of 40 respondents and minimum of ten were selected purposively (Table 3.1). In addition, 50 scientists/extension professionals were also selected purposively as

respondents to study their own perception of indicators of profitability and sustainability.

Table 3.1 : Village-wise Distribution of respondents

Name of village (Bitharichainpur Block)	Marginal	No. of farmers		Total
		Small	Large	
Mudia-Ahmed Nagar	19	14	7	40
Mohanpur	22	7	5	36
Kalapur	18	14	6	38
Indiranagar	13	8	5	26
Aspura	11	9	6	26
Khata	15	11	8	34
Total	90	73	37	200

TOOLS FOR DATA COLLECTION

In order to measure the various dimensions and indicators of the study, a structured interview schedule was developed which was used for data collection. In support of this, observational and case study data were also collected.

Construction of the Schedule

The structured interview schedule was developed keeping in mind the objectives of the study for collection of data from the farmers and scientists. The schedule included the tools for the measurement of different variables. The schedule was pre-tested and proper modification were made on the basis of the results and observations of the pretesting. A copy of the final schedule is given in appendix.

VARIABLES AND THEIR MEASUREMENTS

Number of Family Workers in Animal Husbandry

It refers to the number of those family members who are living together and act to perform the work in the area of animal husbandry.

Family Size

It refers to the total number of family members living in a single house or under the same roof at the time of enquiry. Family size was measured by directly asking the respondent the total number of they have in their respective family members. Each member in the family was given one score. The respondents, were categorised accordingly to their family size as:

Up to 4	Small
5-7	Medium
8 and above	Large

Family type

In Indian Societies, two types of family exist, i.e. nuclear and joint. Nuclear family refers to that family in which husband, wife and their children live together as one unit. Joint family refers to that group of persons in which two or more conjugal pairs with their children live together under one shed, cook and eat together and the earning from all source are pooled together and managed by one family head. In the present study. It was measured by assigning two scores to joint family and one to nuclear family.

Family Educational Status

It refers to academic qualifications of all the family members acquired through formal schooling, in the present study, the family education status was calculated by using following formula:

$$\text{Family Educational Status Score} = \frac{\text{Total of education score of all the family members}}{\text{Total number of eligible family members (i.e. above 6 years)}} \times 100$$

The scoring pattern of Trivedi (1963) for assigning the education score to the individual family member was used which is as follows:

Illiterate	-	0	Middle education	-	4
Can read only	-	1	High School/ Intermediate	-	5
Can read and write	-	2	Graduation and above	-	6
Primary education	-	3			

The respondents were categorized into three categories according to the family education status as follows:

Low	:	Mean - S.D.
Medium	:	Mean $\pm$ S.D.
High	:	Mean + S.D.

Operational Size of land holding

It refers to the actual area of land in hectares under cultivation with the respondents at the time of investigation. It includes leased-in area and excludes leased-out area. In the present study, it was expressed in hectare.

The size of land holding for this study was categorised as follows:

Land less	Having no land
Marginal	Having less than one hectare of land
Small	Having between 1-2 hectare of land
Large	Having above 2 hectare of land

Herd size

Generally, rural house holds of different categories maintain various types of animals for milk production, draught and meat purposes. The herd size refers to the total number of animals possessed by the respondents on the date of investigation. Different types of animals have different requirements and are of different economic values. To study this variable, the actual number of cows, heifers, buffaloes, sheep, goats, pigs and poultry kept by a farmer were converted into cattle equivalent scores as followed by National Accounts Statistics (1961), Central Statistical Organisation, New Delhi which are as follows:

1. **Cow-in-milk**

Indigenous	-	1.00
Cross-bred	-	1.19

2. **Dry-adult-cow**

Indigenous	-	0.65
Cross-bred	-	0.85

3. **Cow-Heifer**

Indigenous	-	0.65
Cross-bred	-	0.85

4.	Cow-young stock		
	Indigenous	-	0.40
	Cross-bred	-	0.45
5.	Oxen and bulls	-	1.26
6.	Buffalo-in-milk	-	1.26
7.	Buffalo-heifer	-	0.69
8.	Dry adult buffalo	-	1.01
9.	Buffalo bulls & working stock	-	1.26
10.	Goats/Sheep/Pigs	-	0.10
11.	Horses/Camels	-	2.67
12.	Poultry(100 adult birds)	-	0.005

Respondents were categorized into three categories on the basis of their herd size.

Small	:	Mean - S.D.
Medium	:	Mean $\pm$ S.D.
Large	:	Mean + S.D.

Age

It is one of the basic characteristic of an individual linked with his maturity, physical well being, productivity level and work efficiency. In this study an individuals' age was considered as the extent to which he was old. Respondents were asked to indicate their age in terms of number of full years, they complete at the time of interview. Respondents were categorised as:

Old	:	Mean + S.D.
Medium	:	Mean $\pm$ S.D.
Young	:	Mean - S.D.

Caste

Caste being a complex phenomenon is difficult to define. This is because, there are various theories regarding origin of caste system such as traditional, occupational etc. and none explains adequately.

Lundberg *et al*, (1988) defined caste as a social category, whose members are assigned a permanent status with in a given hierarchy and whose contacts are restricted.

Caste denotes hierarchial status conferred upon a member of a society from the time immemorial. This variable was measured by direct questioning about their caste. The respondents were classified into three categories.

- | | | |
|-------------------------------|---|-------------------------------|
| 1. General castes | - | Rajput, Brahmin. |
| 2. Other backward caste (OBC) | - | Kurmi, Saxena, Yadav |
| 3. Schedule caste | - | Jatav, Harizan, Dhobi, Khatik |

Occupation

It refers to the main source of income for the family. Only the occupation of head of household was considered for this study. The respondents were categorized into five occupational groups for the purpose of present study.

- | | |
|-----------------|----------------------|
| (1) Labour | (2) Caste occupation |
| (3) Cultivation | (4) Business |
| (5) Service | |

Animal Science Technologies

It refers to identified important animal science technologies which have been disseminated by research organisations and which were being adopted by farmers since last five years in the cluster of six villages of Bithri Chainpur block. This is the main base of the study.

Accessibility to Technology

It refers to the extent to which farmers were accessible to accept and adopt the animal husbandry technology for development of their own avocation. Respondents were asked direct questions to what extent they perceive the technology is accessible to them.

Extent use of Technologies

Farmers were asked to state the extent to which they were using the animal science technologies. They were asked to indicate both technologies which were being used regularly and those which were being used occasionally.

Availability of Additional Required Inputs

Adoption of any technology requires some additional inputs. For example, artificial insemination requires good quality of semen as well as services of trained inseminator. Non-availability of inputs does not permit the farmers to use the technology. Hence, it was intended to know whether such inputs are available to the farmers. The farmers were asked direct question in this respect for each of the input required for the selected animal science technology.

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Area under Fodder Crops

It was intended to find out the total area under fodder crops in the selected six villages. Availability of fodder crops provided better scope of livestock production and thus better ground for use of improved animal science technologies.

Cropping Intensity

It refers to the proportion of the total annual cropped area to the size of the operational holdings expressed in terms of percentage. The area under each crop was obtained and then summed up to obtain the total cropping intensity.

Productivity of Milch Animals

It refers to the average milk yield per animal per day, produced at the farm of a respondent. Average per day milk yield of an animal was calculated on the basis of total lactation yield of that animal. It was measured by determining the average milk produced daily from all the animals considering peak and slack periods and then multiplying it by 300 days to obtain per day average milk during lactation.

PROFITABILITY

The profitability of technology is operationalized as the farmer's or expert's perception of profit occurring or is likely to occur from the adoption of that particular technology. To quantify the farmer's or expert's perception of profitability of each technology, the respondents were asked to state as to how much profitable they consider to make

use of that technology. The response was be taken on a 5-point scale, viz. highly profitable, profitable, some what profitable, least profitable and not at all profitable.

SUSTAINABILITY

Sustainability has been defined in many ways. However, they can broadly be categorised in three distincts :

1. *Agro-ecology* - Sustainability in agro-ecological sense deals with the ability of an agriculture system to maintain its productivity when subjected stress of perturbation.
2. *Ethics* - In ethical sense, sustainability is interpreted in terms of equity, generational or inter generational and the rights of non-human-species.
3. *Sustainable growth* - sustainability is sustainable growth in agricultural productivity without degrading the ^{source} ~~research~~ quality, keeping in view the increasing demand of agricultural product.

It is proposed to study the sustainability on 14 dimensions suggested by Dr. M.S. Swaminathan (1991). The operational definitions of these dimensions are given below :

Technical Appropriability

Refers to how far the technology, be it an Artificial Insemination, vaccination against (HS, FMD & RP), cultivation and use of green fodder and use of anti-parasitic drugs and feeding suits the social and infrastructural situation of end users.

Economic Feasibility

Refers to capacity of farmers to afford to incorporate the technology in his farm within his realm of financial status and position.

Economic Viability

Refers to the returns to investments of every rupee counts.

Environmental Soundness

Refers to whether the technology results in enriching the environment or atleast does not harm the existing agro-ecological conditions.

Temporal Stability

Refers to whether the positive aspect of the technology remain stable over the long run.

Local Adaptability

Refers to the extent to which the technology is adaptable to the existing local conditions of the farmers.

Resource Use Efficiency

Refers to how efficiently the technology can utilize the inputs to convert them into useful, productive and ecofriendly outputs.

Social Acceptability & Social Sustainability

Social Acceptability refers to the extent to which the technology is acceptable by the different sectors of the society, whereas **Social Sustainability** means it has to fulfil the personal needs of the farmers.

Normally, farmers prefer to grow crops which are needed for their home consumption, whether or not those crops are desirable from the ecological stand point. Even today farmers in the higher altitude of the Himalayans as well as the western and eastern ghats grow annual crops instead of trees or perenial shrubs in highly erodable soil to meet their domestic requirements.

Political Tacitness

Refers to wheather the technology can be used unhampered in the exsisting intricacies and implications of political set-up.

Administrative Manageability

Refers to the extent to which the technlogy can be practically implemented under the existing bureaucratic structure.

Cultural Desirability

Refers to the extent to which the technology fits with the cultural patterns and values of the society.

Renewability

Refers to the extent to which the technology can be used again or reused without much additional efforts and inputs.

Equity

Is a measure of how evenly the products of the agro-eco-system are distributed among the local producers and consumers.

Productivity

Is a quantitative measure of the rate and the amount of production per unit of land or input. In ecological term, production refers to the amount of yield or end product, and productivity is the process for achieving that end product. Yield per unit area can be one of the dimensions of sustainable agriculture, it can also be expressed in other ways such as per unit of labour input or per unit of cash investment or as energy efficiency ratio.

Eco-friendliness

The eco-friendliness of each technology is operationalized as the degree to which farmers perceive that particular technology as friendly to the eco-system. In other words the degree to which the technology is harmless to the environment and does not have negative effect on soil, water and other production resources.

DEVELOPMENT OF SUSTAINABILITY INDEX

It was proposed to develop a sustainability index on the basis of 14 parameters suggested by Dr. M. S. Swaminathan (1991). In all 74 items/statements were prepared representing these 14 parameters with the help of experts. These 74 items were sent to 60 judges to classify these items into "important" and "not important" categories. It was finally decided to select all those items for the index which were considered as "important" by at least 50 judges. Thus in the final index the following 63 statements/items were included.

Kindly give your opinion/response on following statements which were enlisted under different dimensions of sustainability :

Sl. No.	Statement of each dimensions	Important	Not Important
1.	TECHNICAL APPROPRIABILITY		
a.	Technology is simple to use.		
b.	Technology is relevant and essential intervention.		
c.	Technology is effective in solving the problems.		
d.	Technology is need based.		
e.	Technology is physically compatible to the farmers.		
f.	Technology is culturally compatible to the farmers.		
g.	To what extent technology is suitable at your farm.		
h.	Technology is useful		
2.	ECONOMIC FEASIBILITY		
a.	Technology is workable at different farms.		
b.	Technology is to provide higher production per unit cost.		
c.	Technology will help to generate employment opportunities.		
d.	Technology is value added.		
e.	Technology will open more market avenues.		
f.	Technology will help to make effective use of family members.		
3.	ECONOMIC VIABILITY		
a.	Technology is economically viable and cost effective.		
b.	Resource-poor can afford the technology.		
c.	Technology will help to enhance present production and productivity.		

Sl. No.	Statement of each dimensions	Important	Not Important
d.	Technology will help to generate more income.		
4.	ENVIRONMENTAL SOUNDNESS		
a.	Technology is eco-friendly		
b.	Technology may disturb (Plant-animal-man relationship) eco-system.		
c.	Technology may have hazardous effect on environment.		
d.	It may have residual effect and in long terms may create problems for animal and human life.		
e.	Consequences may lead to destroy existing resources.		
f.	It may replace original things		
5.	TEMPORAL STABILITY		
a.	Technology consistantly performing well on the farm.		
b.	Technology does not get affected by any extragenous factors.		
c.	There is no effect on its result over the long run.		
d.	Continue to be a source of additional income and livelihood without being affected by any other factor.		
e.	Since long this technology is yielding something at my farm		
6.	LOCAL ADAPTABILITY		
a.	The technology is adaptable to the farmers socio-economic conditions.		
b.	The technology is adaptable to the resource base of the farmers.		
c.	Locally available resources could be utilized in a better way through this technology.		
d.	The technology is well fit to farmers environment/situations.		

Sl. No.	Statement of each dimensions	Important	Not Important
e.	The technology is adaptable to physical and climatic factors at the farm such as soil, water, air, temperature and other physical factors.		
7.	RESOURCES USE EFFICIENCY		
a.	With this technooogy the available inputs/resources are effectively utilized.		
b.	The resources use efficiency on my farm is better with this technology.		
c.	Resource mobilization is not a constraint with this technology.		
d.	All the inputs/resources are better way utilized and not to incur much expenditure on inputs.		
e.	Use of available inputs/resources is helping to yield better.		
8.	SOCIAL ACCEPTABILITY AND SOCIAL SUSTAINABILITY		
a.	Technology is acceptable to different sectors of the society.		
b.	Technology is well acceptable even amongst socially and economically weaker sections of the society.		
c.	Technology is resisted by some sections of the society.		
d.	Technology has viewed local problems needs and aspirations of members of society.		
e.	There is an immediate impact of technology in a society.		
f.	Technology has helped in fulfilling personal needs of society members.		
9.	POLITICAL TACITNESS		
a.	The technology is used unhampered in existing political set up.		

Sl. No.	Statement of each dimensions	Important	Not Important
b.	There is no interference by politicians in the use of technology.		
c.	The technology is not affecting regional, state or national policies set forth.		
d.	Technology gives support to push forward in the existing political set up.		
e.	Local or opinion leaders have legitimized technology by their approval.		
f.	Technology can not work in the existing intricacies and implications of the political set up.		
10. ADMINISTRATIVE MANAGEABILITY			
a.	Practically it is possible to implement the technology		
b.	There is no hinderence to implement technology under the existing bureucratic structure.		
c.	The technology implementation is administratively manageable.		
d.	The technology implementation is achievable.		
11. CULTURAL DESIRABILITY			
a.	Technology fits with the cultural patterns and values of the society.		
b.	Technology is not consistent with the tradition and cultural pattern of some sections of the society.		
c.	It is no way deviation from the existing cultural pattern and values of the society.		

Sl. No.	Statement of each dimensions	Important	Not Important
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- d. Members of society are helply with this technology.

12. RENEWABILITY

- a. Technology can be used for longer duration without much additional effort and input.
- b. Technology can be reused for time and again.
- c. Even after a long time, the technology is found to perform well on the farm.
- d. Technology is found to perform equally well at any given time and place.
- e. Even constant use of technology has not effort on its impact.
- f. Members of a society prefer to continue to make further use of the technology.

13. EQUITY

- a. The products of technology can evenly be distributed among the local producers and consumers.
- b. The products available at farm are better way utilized in practising crops/livestock enterprises.
- c. The products of one enterprise are used in another enterprise practised on the same farm.
- d. Technology is useful in evenly distributing the products among the users.
- e. Technology permits to better way utilize available products of agro-eco-system.

Sl. No.	Statement of each dimensions	Important	Not Important
14. PRODUCTIVITY			
a.	The technology is yielding as per the expectation and its potentials on farm.		
b.	The technology is superior over existing (traditional) one in respect of per unit production.		
c.	Technology has more relative advantages over existing one in respect of quantity and quality of products.		
d.	Technology has helped in saving time and money.		

TECHNOLOGY MEANS

Technology is a technique, input or tool used for performing an operation. It may be old and traditional or new generation or regenerated at the research station. Technology may be hardware as well as software. It is obvious that the technologies are generated for making their use for increasing production and reducing the cost of production in the field. In case a technology developed at research farm is not used in the field, the efforts made for its generation go waste. Generation of technology in animal science is the costliest in comparison to other Sciences (Arya, H.P.S.).

HISTORICAL PERSPECTIVE OF SELECTED A.H. TECHNOLOGIES

Artificial Insemination (AI)

AI is the process by which semen is deposited inside the reproductive tract of the female by means of instruments. In natural mating the male ejaculates semen directly into the vagina or near the

osuteri of the female. With the technique of artificial insemination semen is collected into an artificial vagina exteriorly. It is evaluated for its qualities and is ~~intended~~^{ex} and preserved with suitable media prior to use. The processed semen is inseminated in to the reproductive tract of receptive females.

AI is the technique in which semen with living sperm is collected from the male and induced into the female reproductive tract at the proper time with the help of instruments. this has been found to result in a normal offspring.

History

AI in mammals was tried for the the first time by the Italian physiologist lazzard Spallanzani in 1780. He inseminated a bitch, which conceived and gave birth to three pups. The use of AI as a regular method of breeding was developed and revolutionised in Russia by Ivanoff at the begining of the twentieth century. He used the technique in horses and sheep. The first large scale use of AI in Russia was done in 1930, when nearly one lakh of sheep and twenty thousand cows were bred artificially. In India the first use of this techneque, as claimed by Kumaran, was done in 1939 at palace Dariy Farm, Mysore. Implementation of AI as a means of cattle and buffalo breeding was first began at IVRI, Izatnagar (Bareilly) in 1942 under the auspicious of Dr P. Bhattacharya. Since then this technique has come into general use and now in all the states it has become a regular practice of breeding of cattle and buffaloes.

Analysis of the results of artificial insemination of cow at five centres at Montgomery (Now in Pakistan), Izatnagar, Patna, Calcutta and Bangalore gave encouraging results (Bhattacharya and Prabhu, 1952 & 1954) and paved the way for the use of the technique as a satisfactory livestock development technique in India. The technique was then propagated to all corners of the country through Key village scheme, Community development blocks, Artificial Insemination centres and Intensive Cattle Development Programmes.

Vaccine and Vaccination

One of the great discoveries in the history of medical science, introduced at the end of the 18th century by Edward Jenner, is, strictly speaking, the artificial implantation of the living virus of cowpox (vaccinia) in a person to protect him against small pox (q.v.).

In 1881 Louis Pasteur demonstrated immunization against anthrax by the injection of a comparatively harmless attenuated culture of the bacillus causing that disease. He then used the terms "Vaccine" and vaccination for prophylactic inoculation, as homage. Four years later Pasteur developed rabies vaccine. His work led to wide extension of immunizing methods against many diseases with correspondingly widened meanings of the terms "Vaccination" and "Vaccine".

Vaccination with cow pox virus was introduced by Jenner to supersede the old inoculation, or variolation, which meant the artificial implantation of the smallpox (varriola) virus itself.

Jenner, believed that cow pox, and perhaps small pox, originated in an infection of the heels of horses. The evidence accumulated, however, that the natural occurrences of cowpox started from the hands of milkers affected with smallpox when the latter disease was widely prevalent. The infection was disseminated through dairy herds by other milkers on whose hands it took the changed form of cowpox.

Increased global travel, the presence of virulent strains of the disease in various parts of the world, its great contagiousness, and the fact that no population is sufficiently vaccinated to be proof against the introduction of smallpox are sufficient reasons for keeping up vaccination in spite of the remarkable decline in small pox cases.

Vaccination Schedules

Although, it is not possible to give exact schedules for each of the veterinary vaccines available, certain principles are common to all methods of active immunization.

Since, newborn animals are passively protected by maternal antibodies, it is not usually possible to vaccinate animals successfully early in life. If simulation of immunity is deemed necessary at this stage, the mother may be vaccinated during the later stages of pregnancy, the vaccination being timed so that peak antibody levels are achieved at the time of colostrum formation.

Second injection is given at about 15 weeks of age in small animals and at six month in large animals to ensure successful vaccination.

Green Fodder Cultivation

Indian agriculture is oriented towards crop cultivation. Livestock dairy and poultry farming are the least developed branches of Indian Agriculture. Perhaps the reason for lesser attention towards these branches is the character of the season and natural vegetation. Which can provide a very small proportion of nutrients to animals in terms of quality and quantity. The optimum grazing season does not extent for more than 4-5 months in a year and the natural herbage does not provide a full feed for quality livestock.

Owing to pre occupation of agricultural scientists with food crops for human consumption, very little attention had been paid in the past to the forage and fodder crops. The sporadic information available could not make an effective impact on the nation wide efforts for increased animal production. In this context the establishment of the Agrostology section in 1947 at the IARI, New Delhi, meant for studies on forage and fodder crops.

The tremendous livestock population, the huge gap between the supply and demand for all types of animal food, the preparation of a high percentage of land for food, fibre and cash crops leaving only about 4.4% of the total cultivated area to fodder production the highly deteriorated condition of the natural grasslands due to overgrazing and faulty management for ages and general lack of interest on forage and fodder crops from farmers arising out of neoessity for human food, all constituted a formidable and challenging situation to the researcher.

Technology Development

A number of varieties have been released or identified for release in different areas.

Higher accumulation of chlorophyll-b has been found to indicate shade tolerance in *Cenchrus ciliaris*, *Dichanthium annulatum*, *Panicum antidotale* and range legume like *Stylosanthes hamata* and *Macroptilium atropurpureum*.

Highest seed yield of berseem (474 kg/ha) was observed when last fodder cut was taken in March, and irrigations were given at 7 days interval after last cut.

In forage sorghum, CSH 13, a recently released dual-purpose hybrid, gave higher green forage yield than single-cut variety HC 6. As seed supply of single-cut varieties is a limitation in spread of improved varieties, cultivation of dual-purpose hybrid CSH 13 and variety CSV 15 needs to be popularized.

Fodder Crop Management

Fodder sorghum productivity enhanced significantly with nitrogenous fertilizer and *Azotobacter* inoculation. Green fodder yields were 28.0 and 30.6 tonnes/ha under uninoculated and inoculated conditions.

In oat, 20-40 kg S/ha application through soil in combination with full recommended dose of NPK increased forage yield by 20%. In this crop, manual weeding at 4-week crop stage, followed by post emergence

application of 2, 4-D at 0.37 kg a.i./ha at 6-week-crop stage has been found economically viable to control weeds and increase fodder yield. In fodder maize and sorghum, use of Pendimethalin at 1.0 kg a.i./ha as pre-emergence (PE) + one hand weeding 21 days after sowing (DAS) or Atrazine at 0.75 kg a.i./ha/PE + one hand-weeding 30 DAS gave maximum yield of green fodder.

Break through of new varieties for fodder crops

Crop	Variety	Salient Features
Oats	Bundel Jai 851	Multicut, uniform growth habit, resistant to major pests and diseases including crown-rust, and suitable for all oat-growing regions.
Pearl Millet	FMH 3	Multicut forage hybrid having high forage productivity and resistance to downy mildew.
Guar	Bundel guar 3	Forage-cum-seed type with high forage and seed yield, high protein & gum content
Cowpea	UPC 9202	Suitable for Central Zone of the country, shows 10% higher forage productivity and crude protein than check.
Berseem	JHB 89-4	Suitable for temperate region of the country with moderate resistance to root-rot and stem-rot.
Sorghum	FS 92079	Multicut hybrid with high yield.
Pearl millet	DRSB 2	High forage yield, responsive to agronomical inputs.

Fodder Crop Protection

Berseem varieties BL 131 and BL 142 proved resistant to stem-rot. Oat varieties UPO 253 and JHO 96-5 were found resistant to leaf blight.

Integrated pest management in sorghum + cowpea through neem cake at 1% w/w + *Trichoderma* and spray of neem-seed-kernel extract at 3% at 45 day old crop managed effectively crop diseases, insect pests and nematodes.

Salient Features of Fodder Crops

1. Observed highest seed yield of berseem when last fodder cut was taken in March and irrigation were given at 4 days interval after last cut.
2. Three varieties (one each of oat, pearl millet and guar) were released, and 4 varieties (one each of cowpea, berseem, sorghum and pearl millet) were identified for release in different agro-ecological situations.
3. Sorghum productivity enhanced significantly with nitrogenous fertilizer and *Azotobacter* inoculation.
4. Guinea-grass + cowpea-berseem sequence gave maximum berseem equivalent yield (108.5 tonnes/ha).
5. In saline-sodic soils, *Leptochloa fusca* recorded maximum survival (97%).

Use of Anti Parasitic Drugs

A parasitic is an organism which lives of at the expenses of another organism. In most of the cases there is matabolism dependance of one organism (Parasite upon the other organism).

Knowledge about Parasite

Because of the size of large parasites worms were among the first agent notice and studied as probable cause of disease. The famous ebers papirus about 1600 BC contains some earliest records of the previous pathogenic worms.

Izraelies kneow relationship of helminths to human disease which was also acquired by the Egyptian person, Greek and Comes physician were also familier with various parasite worms. Hepocrates and others described method for the removal of hydatid cysts. The arabian physician and philospher, Avicenna, 979 to 1037 AD separated helminths in to long, small, flat and round worm.

Modern parasitology dates from 1379 when Jehan de Brie discovered the liver fluke, *Fasciola hepatica* in sheep during the eighteenth century. Many parasitic worm and arthropodes were discribed but there was little progress untill the general use of the compound microscope which made possible the study of small protozoan parasites and of the life cycles and detailed structure of larval form.

First protozoan parasite of man recognised were *Trichomonas vaginalis*, *Entamoeba gingivalis*, *Balantidium coli* and *Giardia lamblia*. In 1880 Charles Laveran observed malaria parasite and in 1900 *Leishmania donovani* the cause of kala-azar and *Trypanosoma gambiense* were discovered.

History

Very little scientific information was available about 60 years ago on the parasites of domestic animals. Hippocrates (430 BC) mentioned the occurrence of pin worm (nematode) of Horses, Aristotle (384 to 322 BC) referred about round worm and flat worms specially in dogs. Celsus (100 AD) is said to have first observed an Ascarid from calf and Vegetius (400 AD) (an ascarid from the Horse). Modern Veterinary Helminthology probably started with discovery of live fluke sheep in 1379. Amphistomes present in rumen were first mentioned by Zeder in 1789.

In general parasitic chemotherapy or use of drugs is the only method to control parasitic infection in man as well as domestic animals. Ehrlich and co-worker in Germany at the end of 1900 contrived to develop the idea that drugs could selectively destroy pathogens but leave the host cell. His approach was most successful with disease caused by parasites.

To day all common parasitic disease of human and domestic animals can be treated atleast in part by drugs.

Name of popular drugs against protozoans.

- Suramin
- Diminazine aceterate
- Tinidazole
- Clopidol
- Primaquine
- Quinapramin
- Metronidazole
- Amprolium
- Chloroquine

Drugs against Helminth Parasites

- Rafoxanide
- Niclosanide
- Praziquantel
- Thiabendazole
- Oxyclozanide
- Mebendazole
- Piperazine
- Albendazole

Merits and Demerits if Parasitic drugs

The only method to control parasitic infection, resently is use if anti-parasitic drugs.

It is only method which cure the infected man or animal since there are no vaccine which are highly efficacious and available to give 100% protection till any vaccine is developed the reliance of farmers would be on these drugs.

Acquired drugs resistance often use of anti-parastic drugs has been a problem since long time. It has been already reported in case of chicken cuccidiosis and trypanosaniasis drug resistance. In case of malaria, chloroquine has been a major problem in the control if nemododes infection in animals has been a similar problem.

Sustainability of Parasitic

From the conception view most of the anti-parasitic drugs has been used since long time. For instance piperazine, oxyclozanide, niclosamide some new drugs were formulated which were highly effective against endo and ecto parasites and Triclabendazole which is also highly effective against liverfleke are available for use but reports of resistance are coming in case of even triclabendazole in European countries, therefore, in most of cases were resistance against these drugs, interference with sustainability and demand for new drugs.

DATA COLLECTION

All the 200 farmer respondents were personally interviewed with the help of structured schedule. Before starting actual data collection rapport was established with the farmers in the selected villages. The data were collected from January to April, 1999. Data from Scientists were also collected personally. But in their case, the schedule was given to them to indicate their responses on relevant items and then was collected on the next day or so.

STATISTICAL ANALYSIS

The collected information were tabulated, classified and analysed in the light of the objectives of the study. The analytical techniques used in the study were percentage, frequency, mean, standard deviation, coefficient of correlation, 't' test and analysis of variance (ANOVA). The data were processed the computer section at IVRI, Izatnagar. Before feeding the data into computer, the schedule data was codified and

transferred on data sheet, which was then fed into the computer. The significance of difference between the mean values of selected variables viz, caste and land holding category with sustainability and profitability of technologies were tested by analysis of variance. The group means were subjected with their interactions at a time by the use of F-test with the following formula :

$$F = \frac{\text{Mean sum of square}}{\text{Degree of freedom}} = \frac{\text{Mean square for 'between' groups}}{\text{Mean square for 'within' groups}}$$

The observed value of F was compared with the value given in the analysis of variance alongwith the degree of freedom table at 0.01 and 0.05 per cent level of probabilities.

Wherever the F-value was significant at the desired probability level the critical differences was calculated and compared to see whether the groups means differencing significantly from each other or not, for this purpose, the following C.D. formula was used.

$$\begin{aligned} \text{CD} &= (\text{SE}) \text{ differences} \times t \\ &= \sqrt{\frac{2 \text{ ve}}{n}} \times t \end{aligned}$$

Degree of freedom for t = error degree of freedom and 2 = $\sqrt{\frac{2 \text{ ve}}{n}} \times t$ ve critical difference of tools.

Correlation coefficients were computed to find out the degree of relationship between each selected variables and the dependent variables, i.e. profitability and sustainability of animal science technologies.

In this study, there were two categories of the respondents scientist and farmers to study their perception of sustainability and profitability of selected technologies. It was highly essential to find out the difference in the perception of these different groups. In order to test the difference between the means of two groups, 't' test was applied as per the formula given below :

$$t = \frac{\text{Differences between two means}}{\text{S. E. of difference}}$$

The significance of 't' value obtained was checked by referring to a 't' table. If the observed value of 't' was equal to or greater than table value of 't' at $n_1 + n_2 - 2$ degree of freedom under 0.05 level of probability, it was considered significant. The significance was tested at 0.01 and 0.05 level of probability.

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Chapter-4

RESULTS AND DISCUSSION

The chapter deals with results of study along with appropriate discussion. The whole chapter has been organised under the following sections.

- 4.1. Identification of animal husbandry technologies prevalent since last many years in the selected cluster of villages.
- 4.2. Socio-economic profile of selected farmers where the identified animal husbandry technologies are in use.
- 4.3. Perception of scientists and farmers about the profitability of selected animal husbandry technologies.
- 4.4. Perception of scientists and farmers about the sustainability of selected animal husbandry technologies in different dimensions.
- 4.5. Analysis of variance (ANOVA) of different animal husbandry technologies for sustainability and profitability.
- 4.6. Relationship between the farmers characteristics and their perception on sustainability and profitability of animal husbandry technologies.
- 4.7. An opinion of farmer's for sustainable livestock production.

4.1 IDENTIFICATION OF ANIMAL HUSBANDRY TECHNOLOGIES PREVALENT SINCE LAST MANY YEARS IN THE SELECTED CLUSTER OF VILLAGES

The present study required to identify the prevalent animal husbandry technologies in the selected villages to study their profitability and sustainability. A list of all the prevalent animal husbandry technologies was prepared by visiting the villages and contacting the resource persons maintaining the livestock. The list was prepared through interview and discussions and verified through triangulation method. The list included the following technologies which are being used or have been used in the villages.

1. Artificial Insemination
2. Animal vaccination against - H. S., FMD, RP
3. Use of anti-parasitic drugs.
4. Cultivation and use of green fodder for feeding.
5. Care and management of new born calf and pregnant animal.
6. Clean milk production.
7. Safety measures for mastitis control.
8. Heat detection in female animals.

The seven specific technologies from the first four of the above viz. AI, vaccination against HS, vaccination against FMD, vaccination against RP, deworming technology, tick control technology and cultivation of green fodder technology were finally selected for this study on the basis of their most prevalence in the area.

EXISTING SITUATION/PERSPECTIVE OF SELECTED ANIMAL HUSBANDRY TECHNOLOGIES

Artificial Insemination (AI)

AI is a tool and technique of insemination in an artificially manner. This enables the livestock owners/breeders to choose the semen of their choice even from far distant place. The practice was recommended about 50 years back and is being implemented in the village through Veterinary Hospital/ AI Centres. It was intended to know the present status of AI practice in the villages. The information was collected through meetings and group discussions with progressive farmers and verified through triangulations. A.I. is the only alternative left with the farmers in case of cattle since all the cattle bulls have been scrapped/castrated by the Government to prohibit inbreeding through natural mating. But, this has aggravated the problems as the conception rate of AI in the field is only 12-15%. This is because of the following constraints.

1. Use of infertile/spoiled semen.
2. Lack of freezing facilities of semen at the AI centre.
3. Lack of skilled trained personnel like VOs, stockmen etc.
4. Poor heat detection by farmers and untimely insemination.
5. Imbalanced feeding of animals under fed/malnutrition.
6. Animal health centres located at far way places and farmers face problems in taking their animal again and again.
7. Farmers believe that AI produces more male calf than female. Accordingly, they do not take interest to go for AI.

Vaccination

Epidemic diseases like HS, FMD, etc. are deadly diseases which have no control after they are spread in an area. Thanks to the Scientists who have invented vaccines to use as prophylactic measures. Vaccination against major epidemic diseases, like HS, FMD and RP was specifically recommended for healthy livestock as prophylactic measures. Since then RP has been claimed to have been eradicated. Vaccination against HS and FMD is being recommended at present.

It was intended to know the existing situation of vaccination in the villages. It was found that :-

- (i) Vaccination against HS is done mostly in the months of June - July every year. Sometimes, it is done in the months of August - September, in case it could not be done in June - July.
- (ii) The villagers are not aware about the various diseases for which vaccination is being done. They are aware of only HS vaccination. No mass vaccination is done against FMD or other diseases.
- (iii) Mass vaccination against HS is done as a campaign by development officials jointly. Farmers are informed and motivated in advance.
- (iv) Normally, only 60-70% animals are vaccinated in village.
- (v) Many villages are left unvaccinated every year.
- (vi) Pregnant animals are not vaccinated. Calves are given half dose of vaccine.

Use of Anti-parasitic drugs

Villagers are aware of many diseases of animals and they take utmost care to save their animals from these diseases. Majority of the people (60-70%) consult Veterinary Doctor on serious disease of animals. However, they do not take much care for simple, mild and non-serious diseases. About 10% of the livestock owners use indigenous medicines to treat their animals. Unproductive and incurable animals are left untreated.

25-30% livestock owners, specially progressive and rich farmers use deworming of their animals on the advice of Veterinary Doctor. Deworming is not done regularly, but is done when the animals suffer from the disease. Normally, albandazole, piperazine, penacure, etc. are used in deworming. Indigenous medicines like butter milk, *Hirankhuri*, etc. are also used by some villagers.

Ectoparasitic infection is a major problem in the livestock of this area. Different types of ticks are found on animals. Still only about 15% farmers use one or the other insecticide to control ticks. Usually, the old insecticides like BHC and DDT are used to control ticks which are now banned. Only a few (innovative) farmers use Butox in consultation with Veterinary Doctor.

Green fodder cultivation

Livestock requires adequate quantities of green fodder including leguminous not only for optimum production but also for meeting their

vitamin requirement. An average milking cow or buffalo requires 15-20 kg of green fodder. Green fodder cultivation has direct competition with food grain crops which have their own priority for the villagers specially the small holders who are in bulk. Green fodder cultivation has increased manifold during last 15 years. At present, almost every farmer grows green fodder in little or more area. In Kharif season, most of the farmers grow chari while in winter (Rabi) they grow berseem. Some of the progressive farmers also grow cow pea during Kharif and oat during Rabi. Green fodder is not available during summer. No one grows summer maize or summer chari. This adversely affects the health and production of the animals. Farmers have started growing improved varieties of berseem and chari with the adoption of other improved agronomic practices.

Above mentioned technologies were listed based upon the basic information collected from the different groups of farmers who were using the technologies regularly. The secondary sources of information were also used.

4.2 SOCIO-ECONOMIC PROFILE OF SELECTED FARMERS WHERE THE IDENTIFIED ANIMAL HUSBANDRY TECHNOLOGIES ARE IN USE.

Socio personal factors have strong bearing on the adoption process to accept or reject a particular animal husbandry technology. The objective of this section, therefore, is to examine some of the basic characteristics of the selected farmers that may have an influence on sustainability and profitability of animal husbandry technologies.

4.2.1. Distribution of selected respondents

The data were obtained from a cluster of six villages which were situated at 12-14 km distance from IVRI Campus, Izatnagar (Bareilly). To provide a clear picture of the sample size frequency distribution of farmers of six villages has been presented in the table - 3.1.

It appears from Table 3.1 that out of a total of 200 selected farmers, 40 were from Mudia Ahmed Nagar, 36 from Mohanpur, 38 from Kalapur, 26 each from Indra Nagar and Aspura and 34 from Khata village of Bithrichainpur Block of Bareilly district. The marginal, small and large farmers across the selected villages were 90, 73 and 37 respectively.

4.2.2. Age of the farmers

The working capacity at farm is influenced by the age of farmers. Experience derived in farm practices/business is commonly reflected through age.

The age wise distribution of technology users is presented in Table 4.1, Majority of the technology users (57.5%) belong to middle age group

Table 4.1 : Distribution of respondents according to their age

Sl. No.	Age Group	No. of Respondents	Percentage (%)
1.	Young (0-30 years)	46	23.0
2.	Middle (31-50 years)	115	57.5
3.	Old (51 years & above)	39	19.5
Total		200	100.0
Mean±SD		40.46±11.97	-

(i.e., 31-50), while 23.0 percent technology users were from young age group (i.e., 0-30) and only about 19.5 percent were above 51 years of age. The average age of the users of the selected technologies was 40.46 years.

4.2.3 Effective family workers involved in animal husbandry

The effective size of family involved in animal husbandry work is one of the vital factors influencing labour availability in daily animal practices livestock enterprises.

Table 4.2 Depicts the distribution of respondents according to their effective family size. It can be noted that a large majority of the household (63.0%) had less than 4 animal husbandry workers in their families. Only 2.5 percent respondents had more than 7 effective family

Table 4.2 : Distribution of respondents according to the number of family workers in their families involved in A.H.

Sl. No.	Family Worker	No. of Respondents	Percentage (%)
1.	less than 5	126	63.0
2.	5-7	69	34.5
3.	More than 7	5	2.5
	Total	200	100.0
	Mean±SD	4.39±1.28	-

workers in animal husbandry. The average no. of family worker involved in animal husbandry work was 4.39.

4.2.4 Caste

Traditionally, the village social system has been divided into various castes. In the present study the respondents were grouped into three major caste categories. The respondents belonging to Harijan, Jatav, Kori, Dhobi and Khatik were categorized under scheduled caste while Kurmi, Kadhera, Nai, Prajapati under backward castes and Rajput, Brahmin and Pujari under forward castes.

Table 4.3 : Distribution of respondents according to their caste

Sl. No.	Caste Categories	No. of Respondents	Percentage (%)
1.	General	66	33.0
2.	OBC	92	46.0
3.	SC/ST	42	21.0
Total		200	100.0

Table 4.3 indicates that majority of the technology users (46%) were from OBC category while 33% respondents were from general category. Only 21% technology users belonged to SC/ST category.

4.2.5 Size of operational land holding

The size of land holding has an important role in deciding the family status in the village. In the present study table no. 4.4 indicate that majority (45.0%) of the technology users had marginal land (<1 hac) followed by technology users having small land holding (36%) whereas, only 18.5% technology users were having large land holding 2 hac.

Table 4.4 : Distribution of respondents according to the size of their Land Holding

Sl. No.	Size of Land Holding (in Hact.)	No. of Respondents	Percentage (%)
1.	Marginal (<1)	90	45.0
2.	Small (1-2)	73	36.5
3.	Large (>2)	37	18.5
Total		200	100.0
Mean±SD		1.73±0.75	-

4.2.6 Area under fodder crops

Green fodder cultivation is the essential part of mixed farming required for higher productivity from milch animals for the continuance of most of the A.H. technologies and also for the good health of the animals. The area under fodder crops as a proportion of total farm area was studied.

Table 4.5 : Distribution of respondents according to the area under fodder cultivation (in Bigha)

Sl. No.	Area under Fodder Cultivation (in Bigha)	No. of Respondents	Percentage (%)
1.	Less than 4	111	55.5
2.	4-6	67	33.5
3.	More than 6	22	11.0
Total		200	100.0
Mean±SD		4.09±1.74	-

The findings of the study in table no. 4.5 revealed that majority of the respondents (55.5%) had less than 4 bigha of land and fodder cultivation followed by less than 4-6 bigha (33.5) and more than 6 bigha (11.00%) respectively.

4.2.7 Cropping Intensity

In view of scarcity of land, multiple cropping is a major alternative to increase effective area under crop production. The extent of multiple cropping as reflected in the intensity of cropping may influence overall farm productivity of different land holding.

Table 4.6 : Distribution of respondents according to the Cropping Intensity

Sl. No.	Cropping Intensity (in Percent)	No. of Respondents	Percentage (%)
1.	Low (<220)	4	2.0
2.	Medium (221-240)	13	6.5
3.	High (>250)	183	91.5
Total		200	100.0
Mean±SD		287.46±21.82	-

Table 4.6 depict the cropping intensity (in percentage) per farm. It is clearly evident from the table that majority of the respondents (91.5%) had high cropping intensity i.e. 221%-240%. Only 2 percent respondent had low cropping intensity i.e. below 220 percent.

4.2.8 Herd Size

The livestock enterprise is an integral part of agricultural farming and farmers/ village people who keep milch animals and bullock consider it mostly a secondary occupation for them. Now a days the livestock farming is gaining importance as an occupation in the rural areas. The herd size is gradually becoming an indicator of prosperity. As such, the distribution of respondents according to their herd size is shown in table 4.7.

Table 4.7 : Distribution of respondents according to their Herd Size

Sl. No.	Herd Size (in Number)	No. of Respondents	Percentage (%)
1.	Small (< 3)	103	51.5
2.	Medium (4-7)	88	44.0
3.	Large (> 8)	9	4.5
Total		200	100.0
Mean±SD		5.05±3.14	-

Note : Number of total animals have been converted into equal number of cattle.

Table 4.7 clearly depicts that majority (51.50%) of the respondents had small herd size followed by 44 per cent with medium herd size. Only 4.5 per cent respondents had large herd size.

4.2.9 Family Educational Status (FES)

Education is one of the important factors which can accelerate growth of technology users and farm business. The standard of family education moulds the farmer's response to improved technology and

Table 4.8 : Distribution of respondents according to the Family Education Status (FES)

Sl. No.	Family Education Status (FES score)	No. of Respondents	Percentage (%)
1.	Low (<2)	128	64.0
2.	Medium (3-4)	62	31.0
3.	High (>5)	10	5.0
Total		200	100.0
Mean $\pm$ SD		2.65 $\pm$ 1.07	-

helps in shaping an enterprise and understanding the uses of animal husbandry technologies. Table 4.8 depicts the distribution of respondents according to their family education status.

The data presented in table 4.8 pointed out that majority of the respondents (64%) were having low family education status followed by medium (31.0%) and high family education status score (5.0%). It means in general, the families had low educational status.

4.2.10 Milk productivity

The productivity of milch animals varies considerably depending upon the type of breeds maintained. It was, therefore, considered appropriate to study the productivity of milch animals according to the different breeds of cattle and buffaloes available in the area. The available breeds of cattle can be classified into Desi and Crossbred. Similarly, the breeds of buffaloes can be classified into Desi and improved.

4.2.10.1 Milk productivity of desi cattle

It is clear from the Table 4.9 that the cattle with majority of respondents (58.4%) were medium producers producing 4 to 5 lit. of milk per day followed by 34.5 percent owners having low producing

Table 4.9: Distribution of respondents according to the milk Productivity of Desi-Cattle

Sl. No.	Milk Productivity * of Desi Cattle (in letter)	No. of Respondents	Percentage (%)
1.	Low (<3)	39	34.5
2.	Medium (4-5)	66	58.4
3.	High (>5)	8	7.1
Total		113	100.0
Mean $\pm$ SD		3.95 $\pm$.69	-

* Milk productivity means average milk production per animal per day in a lactation.

cattle (less than 4 lit per day). Only 7.1 percent respondents had cattle, producing more than 5 lit. of milk per day. The average milk production of desi cattle was 3-5 lit per day in the study area.

4.2.10.2 Milk produced by cross bred cattle

With regards to the productivity of crossbred cattle table no. 4.10 indicates that the animals of majority of respondent (57.4%) comes under high milk producer (i.e. 8 lit per day and above) category while had animals which 27.7% fall in medium category (i.e., 6-7) and only 14.9 percent farmers were having crossbred cattle producing less than 5 lit milk per day.

Table4.10: Distribution of respondents according to the Milk Productivity of Cross bred Cattle

Sl. No.	Milk Productivity * by Crossbred cattle (in Litters)	No. of Respondents	Percentage (%)
1.	Low (<5)	7	14.9
2.	Medium (6-7)	13	27.7
3.	High (>8)	27	57.4
Total		47	100.0
Mean±SD		7.49±1.04	-

* Milk productivite means average milk production per animal per day in a lactation.

4.2.10.3 Milk productivity of buffalo (desi)

Most of the farmers have Desi buffaloes. Desi buffaloes have more adaptability to the local environment and are disease resistant as well as stress resistant.

Table no. 4.11 revealed that majority (87.4%) of farmers had medium producing Desi buffaloes (4-5 lit. per day) followed by 6.8

Table4.11: Distribution of respondents according to the Milk Productivity of Desi (Local) Buffalo

Sl. No.	Milk Productivity * by Buffalo - Desi (in Litters)	No. of Respondents	Percentage (%)
1.	Low (<3)	6	5.8
2.	Medium (4-5)	90	87.4
3.	High (>6)	7	6.8
Total		103	100.0
Mean±SD		5.03± .69	-

* Milk productivity means average milk production per animal per day in a lactation.

Table 4.12 : Extent of accessibility of selected A. H. technologies by the farmers.

Name of the \ Extent of Technologies \ accessibility (score)	Fully Accessible (4)	To a greater extent (3)	To some extent (2)	To a little extent (1)	Total
Artificial Insemination	18 (9.00)	47 (23.50)	79 (39.50)	56 (28.00)	200 (100.00)
Vaccination	19 (9.50)	59 (29.50)	61 (30.50)	61 (30.50)	200 (100.00)
Cultivation and use of green fodder	34 (17.0)	64 (32.00)	94 (49.00)	4 (2.7)	200 (100.00)
Use of anti-parasitic drugs for deworming & tick control	5 (2.50)	65 (32.50)	72 (36.00)	58 (29.00)	200 (100.00)
Total for four technologies	76 (9.50)	235 (29.37)	310 (38.75)	179 (22.37)	

Figures in parenthesis indicate percentage

percent having high producing buffaloes i.e. more than 7 lit per day and only 5.8 percent farmers had low producing buffaloes, i.e. less than 3 lit per day.

4.2.11 Accessibility of technologies

Technology can only be adopted if it is easily accessible or obtainable to the farmers. It was intended to know as to what extent each of the selected technologies are accessible to the users. These technology were perceived by the respondents on a four point continuum on the basis of their accessibility. The four point continuum were : fully accessible, to a greater extent, to some extent, to a little extent, not at all accessible.

It is clear from the Table 4.12 that all the selected technologies were accessible only to some extent by majority of respondents followed by those for whom these technologies are accessible only to a little extent. However, cultivation and use of green fodder technology is quite accessible to the farmers. Seventeen farmers reported that this technology is fully accessible to them.

Table 4.13 : Distribution of respondents according to the extent of accessibility of the selected A. H. technologies.

Sl. No.	Extent of accessibility (scores)	No. of Respondents	Percentage (%)
1.	Low (0-6)	58	29.0
2.	Medium (7-11)	81	40.5
3.	High (12-16)	61	30.5
4.	Total	200	100.0

Data pertaining to the overall accessibility of all the technologies presented in Table 4.13 further revealed that the majority (40.5%) of the respondents had medium accessibility of technologies followed by 30.5 percent with large accessibility to technology. Only 29% respondents had low accessibility to technologies.

4.2.12 Use of technologies

The respondents were asked to indicate to what extent they are using the selected technologies, viz. A.I., vaccination, deworming and use of anti parasitic drugs cultivation and use of green fodder. They were asked to respond on three point continuum viz., at full scale, to some extent but regular and occasionally. The data are presented in the following two tables.

Table4.14: Extent of use/adoption of the selected A. H. technologies by the farmers.

Name of\ Extent of use Technologies\ (Score)	Full Scale (3)	To Some extent (2)	Occasionally (1)	Total
Artificial Insemination	55 (27.50)	73 (36.50)	72 (36.00)	200 (100)
Vaccination	55 (27.50)	87 (43.50)	58 (29.00)	200 (100)
Cultivation & use of green fodder	100 (50.00)	88 (44.00)	12 (6.00)	200 (100)
Use of anti-parasitic drugs for deworming & Tick control	29 (14.50)	101 (50.50)	70 (35.00)	200 (100)
Total for four technologies	239 (29.87)	349 (43.62)	212 (26.50)	(100)

Figures in parenthesis indicate percentage

It is clear from the table 4.14 that majority of the farmers were using the A.I. and vaccination technologies to some extent but regularly (36.5% and 43.5% respectively). On the other hand half of the farmers used the fodder cultivation technology at full scale. Only one technology i.e. use of anti -parasite drugs was used occasionally by majority (35%) of the farmers.

Table4.15: Distribution of respondents according to the extent of use the selected A. H. technologies

Sl. No.	Extent of use of the selected A.H. technologies (scores)	No. of Respondents	Percentage (%)
1.	Low (0-4)	12	6.0
2.	Medium (5-8)	88	44.0
3.	High (9-12)	100	50.0
4.	Total	200	100.0

The findings of table 4.15 further indicate that majority (50%) of the farmers were using the technologies to a large extent followed by 44.0 percent using them at medium level. Only 6% respondents had low use of technologies.

4.2.13 Ability of the respondents in procuring additional input required for adoption of A.H. technologies

Inaccessibility of the required input is the major constraint in adoption of most of the scientific technologies in animal science. The technology use requires some additional inputs. If these are not available or accessible to the farmer, he will not be able to adopt that technology.

In view of this it was intended to know to what extent the required inputs are accessible to the farmers.

Artificial Insemination (AI)

Seven additional inputs were delineated that are required for the effective use of A.I. technology. These additional inputs were scaled on a three point continuum on the basis of the farmers ability to procure it. The three point continuum was easily/conveniently procured, partly/some times only and not able to procure at all.

Data presented in table 4.16 indicate that only the two inputs, viz., green fodder and veterinary medicines were considered to be easily accessible by more than 50% farmers. These two inputs are not required directly for A.I., but, are required to make the results of A.I. fruitful. On the other hand, the proper quality semen is the direct requirement of A.I. which was considered either partly accessible or was not at all available by majority of the respondents. More than one third of the respondents were not able to get the proper semen for A.I. The rest of the inputs like Veterinary doctor, Vaccines, concentrate feed and money were partly accessible to majority of the farmers.

Vaccination

For vaccination, three inputs were considered essential, viz., proper vaccine, vaccinator or Veterinary Doctor and the cost (money). Majority of the respondents felt that all these three inputs were partly accessible to them. Vaccine was also considered to be easily accessible

Table 4.16: Ability of the respondents to procure additional inputs required for adoption of A. H. technologies

Input required	Ability to Procure (N = 200)			Total
	Easily & conveniently	Partly/ some time only	Not able to procure	
	(2)	(1)	(0)	
ARTIFICIAL INSEMINATION				
1. Proper Semen	51 (25.50)	79 (39.50)	70 (35.00)	200 (100)
2. Vety. Doctor	50 (25.00)	121 (60.50)	29 (14.50)	200 (100)
3. Vaccines	52 (26.00)	121 (60.50)	27 (13.50)	200 (100)
4. Vety. Medicines	101 (50.50)	73 (36.50)	26 (13.00)	200 (100)
5. Green Fodder	117 (58.50)	69 (34.50)	14 (7.00)	200 (100)
6. Concentrate Feed	82 (41.00)	101 (50.50)	17 (8.50)	200 (100)
7. Money	73 (36.50)	107 (53.50)	20 (10.00)	200 (100)
VACCINATION				
1. Vaccine	86 (43.00)	82 (41.00)	32 (16.00)	200 (100)
2. Vety. Doctor/Vaccinator	35 (17.50)	125 (62.50)	40 (20.00)	200 (100)
3. Money	49 (24.50)	104 (52.00)	47 (23.50)	200 (100)
CULTIVATION & USE OF GREEN FODDER FOR FEEDING				
1. Green Fodder Seed	136 (68.00)	51 (25.50)	13 (6.50)	200 (100)
2. Fertilizer for fodder	94 (47.00)	71 (35.50)	35 (17.50)	200 (100)
3. Irrigation Water	105 (52.50)	55 (27.50)	40 (20.00)	200 (100)
4. Money	123 (61.50)	69 (34.50)	8 (4.00)	200 (100)
USE OF ANTI-PARASITIC DRUGS : DEWORMING AND TICK CONTROL				
1. Dewormer	59 (29.5)	103 (51.50)	38 (19.00)	200 (100)
2. Insecticide	44 (22.00)	89 (44.50)	67 (33.50)	200 (100)
3. Vety. Doctor	30 (15.00)	107 (53.50)	63 (31.50)	200 (100)
4. Sprayer/Duster	24 (12.00)	102 (51.00)	74 (37.00)	200 (100)
5. Money	33 (16.50)	152 (56.00)	15 (7.50)	200 (100)

Figures in parenthesis indicate percentage

to them. Less than one-fourth of the respondents perceived non-availability of money as a major constraint for vaccination.

Cultivation and use of green fodder

Four major inputs were considered necessary for the cultivation and use of green fodder, viz., green fodder seed, fertilizer, irrigation water and money. Majority of the respondents perceived all these inputs as easily and conveniently accessible to them. One third of them, however, felt that the fertilizer and money were partly available. One fifth of the respondents felt that non-availability of irrigation water is the major constraint in growing green fodder.

Use of anti-parasitic drugs

Five major inputs were considered as essential for using the antiparasitic drugs, viz. dewormer, insecticide, Veterinary Doctor for advice, sprayer/duster and money. It is evident from the data that majority of the respondents perceived that all these required inputs to be partly accessible for them to procure. Still one-third of the respondents felt that they were not able to procure insecticide, sprayer/duster and the Veterinary Doctor.

It can be concluded from the Table 4.16 that inaccessibility of the additional required inputs might be one of the major constraints in adoption of these selected seven technologies. Most of these inputs were partly accessible or not accessible at all to the farmers. Only the inputs required for green fodder cultivation were quite accessible to them.

4.3 PERCEPTION OF SCIENTIST AND FARMERS ABOUT THE PROFITABILITY OF SELECTED ANIMAL HUSBANDRY TECHNOLOGIES

The profitability of animal husbandry technologies can be judged through their better utilization at the farm and giving higher net income to the farmers from the crop and livestock avocation. The extent to which the farmers efficiently and effectively utilize these technologies under available resources in crop and livestock farming is reflected in the income/profit.

With regards to the profitability of the selected animal science technologies viz. AI, vaccination against HS, FMD, RP, Fodder Cultivation, Deworming and Tick Control, the farmer's perceived view

Table4.17: Extent of profitability of A.H. technologies by scientists

Sl. No.	Extent of Profitability	High Profitable	Profitable	Some What Profitable	Least Profitable
1.	AI	27 (54.00)	16 (32.00)	3 (6.00)	4 (8.00)
2.	HS	30 (60.00)	15 (30.00)	2 (4.00)	3 (6.00)
3.	FMD	30 (60.00)	14 (28.00)	3 (6.00)	3 (6.00)
4.	RP	32 (64.00)	13 (26.00)	3 (6.00)	2 (4.00)
5.	Green Fodder Cultivation	26 (52.00)	17 (34.00)	3 (6.00)	5 (10.00)
6.	Deworming	30 (60.00)	15 (30.00)	2 (4.00)	2 (4.00)
7.	Tick Control	31 (62.00)	15 (30.00)	2 (4.00)	2 (4.00)
Total for Seven Technologies		206 (58.85)	105 (30.00)	18 (5.14)	22 (6.28)

Figures in parenthesis indicate percentage

was obtained on a five point continuum were : highly profitable, profitable, some what profitable, least profitable and not at all profitable.

Extent of perceived profitability of A.H. technologies by scientists in Table 4.17 indicate that majority of scientists (52.00 to 64.00%) perceived all the technologies as highly profitable. It was only in case of green fodder cultivation that about 50 percent of the scientists perceived it as less profitable. It is quite obvious that the sample scientists being from the discipline of animal science perceive all the technologies as highly profitable.

A critical observation of the table 4.18 further support that majority (58.00 to 66.00%) of scientists had high perceived profitability score in different A.H. technologies. Vaccination against RP was considered highly profitable by maximum no. of scientists followed by AI, vaccination against HS and FMD, deworming and tick control. 20 to 28 percent of the scientists fell in the category who perceived these technologies as medium profitable. Here again, the green fodder cultivation was considered less profitable by the scientists.

The distribution of farmers according to their perceived profitability of animal husbandry technologies presented in Table 4.19 indicate a little different picture than that of scientists. Majority of farmers (60%) perceived A.I. as least profitable. Only 10% perceived it as 'some what profitable'. Only green fodder cultivation was considered to be highly profitable technology by the farmers. Vaccination against

Table4.18: Distribution of scientists according to their score on perceived profitability of different animal science technologies

Sl. No.	Categories perceived profitability (Score)	No. of Scientists N = 50					
		AI	HS	FMD	RP	Fodder	Deworming Tick Control
1.	Low (<1)	6 (12.00)	8 (16.00)	8 (16.00)	7 (14.00)	12 (24.00)	7 (14.00)
2.	Medium (2-3)	12 (24.00)	11 (22.00)	11 (22.00)	10 (20.00)	12 (24.00)	13 (26.00)
3.	High (>4)	32 (64.00)	31 (62.00)	31 (62.00)	33 (66.00)	26 (52.00)	30 (60.00)
4.	Total	50 (100.00)	50 (100.00)	50 (100.00)	50 (100.00)	50 (100.00)	50 (100.00)

Figures in parenthesis indicate percentage

Table 4.19: Extent of perceived profitability of A.H. technologies by farmers

Sl. No.	Extent of Profitability	High Profitable	Profitable	Some What Profitable	Least Profitable
1.	AI	25 (12.50)	35 (17.50)	20 (10.00)	120 (60.00)
2.	HS	53 (25.50)	110 (55.00)	21 (10.50)	16 (8.00)
3.	FMD	50 (25.00)	114 (57.00)	19 (9.50)	17 (8.50)
4.	RP	52 (26.00)	103 (51.50)	24 (12.00)	21 (10.50)
5.	Green Fodder Cultivation	129 (64.50)	60 (30.00)	07 (3.50)	04 (2.00)
6.	Deworming	90 (45)	81 (40.50)	14 (7.00)	15 (7.50)
7.	Tick Control	81 (40.50)	94 (47.00)	13 (6.50)	12 (6.00)
Total for seven Technologies		480 (34.28)	597 (42.64)	118 (8.42)	209 (14.92)

Figures in parenthesis indicate percentage

HS, FMD and RP as well as tick control were considered to be profitable by majority of the farmers.

A perusal of data presented in Table 4.20 support the above view that majority of farmers had low score on perceived profitability of A.I. Only green fodder cultivation was perceived as highly profitable as majority of the farmers had high score on this technology. Deworming and tick control were also perceived as highly profitable by more than 47% farmers. In case of vaccination against HS, RP and FMD majority of the farmers perceived them as either medium or highly profitable.

A perusal of table 4.21 indicates that the difference in the perception of scientists and farmers was more, in case of tick control

Table 4.20: Distribution of farmers according to their score on perceived profitability of different animal science technologies

Sl. No.	Categories of Perceived profitability (Score)	No. of Respondents N = 200						
		AI	HS	FMD	RP	Fodder	Deworming	Tick Control
1.	Low (<1)	108 (54.00)	45 (22.50)	45 (22.50)	47 (23.50)	31 (15.50)	28 (14.00)	28 (14.00)
2.	Medium (2-3)	55 (27.50)	76 (38.00)	76 (38.00)	78 (39.00)	52 (26.00)	77 (38.50)	77 (38.50)
3.	High (>4)	37 (18.50)	79 (38.50)	79 (39.50)	75 (37.50)	117 (58.50)	95 (47.50)	95 (47.50)
4.	Total	200 (100)	200 (100)	200 (100)	200 (100)	200 (100)	200 (100)	200 (100)

Figures in parenthesis indicate percentage

Table4.21: Profitability score of animal husbandry technologies by scientist and farmers - A comparison

Sl. No.	Name of the technologies	Max. possible Score	Perceived profitability Score		t-test
			Scientists	Farmers	
1.	Artificial Insemination	4	2.88	1.98	7.339**
2.	Vaccination against-HS	4	3.96	2.46	10.645**
3.	FMD	4	3.92	2.46	10.314**
4.	RP	4	3.92	2.08	13.576**
5.	Cultivation & use of nutritious protein-rich green fodder for feeding	4	3.78	2.97	7.610**
6.	Deworming	4	3.70	2.48	9.380**
7.	Tick Control	4	3.76	1.97	16.486**

***Significant at $P < 0.01$.*

and vaccination against RP and lowest in case of green fodder cultivation and AI. In other words the farmers differed from the scientists on tick control and vaccination against RP most and on green fodder and AI least.

Perceived profitability score on all the animal husbandry technologies for scientists was significantly ($P < 0.01$) higher (based on 't' value) than those of farmers as indicated in the table.

4.4 PERCEPTION OF SCIENTISTS AND FARMERS REGARDING SUSTAINABILITY OF ANIMAL HUSBANDRY TECHNOLOGIES ON DIFFERENT DIMENSIONS

The sustainability of AH technologies were measured through the perception of scientists and farmers on different dimension. Perceptions on a five point continuum viz. strongly agree, agree, some what agree,

PERCEIVED PROFITABILITY SCORES OF ANIMAL HUSBANDRY TECHNOLOGIES BY SCIENTISTS & FARMERS

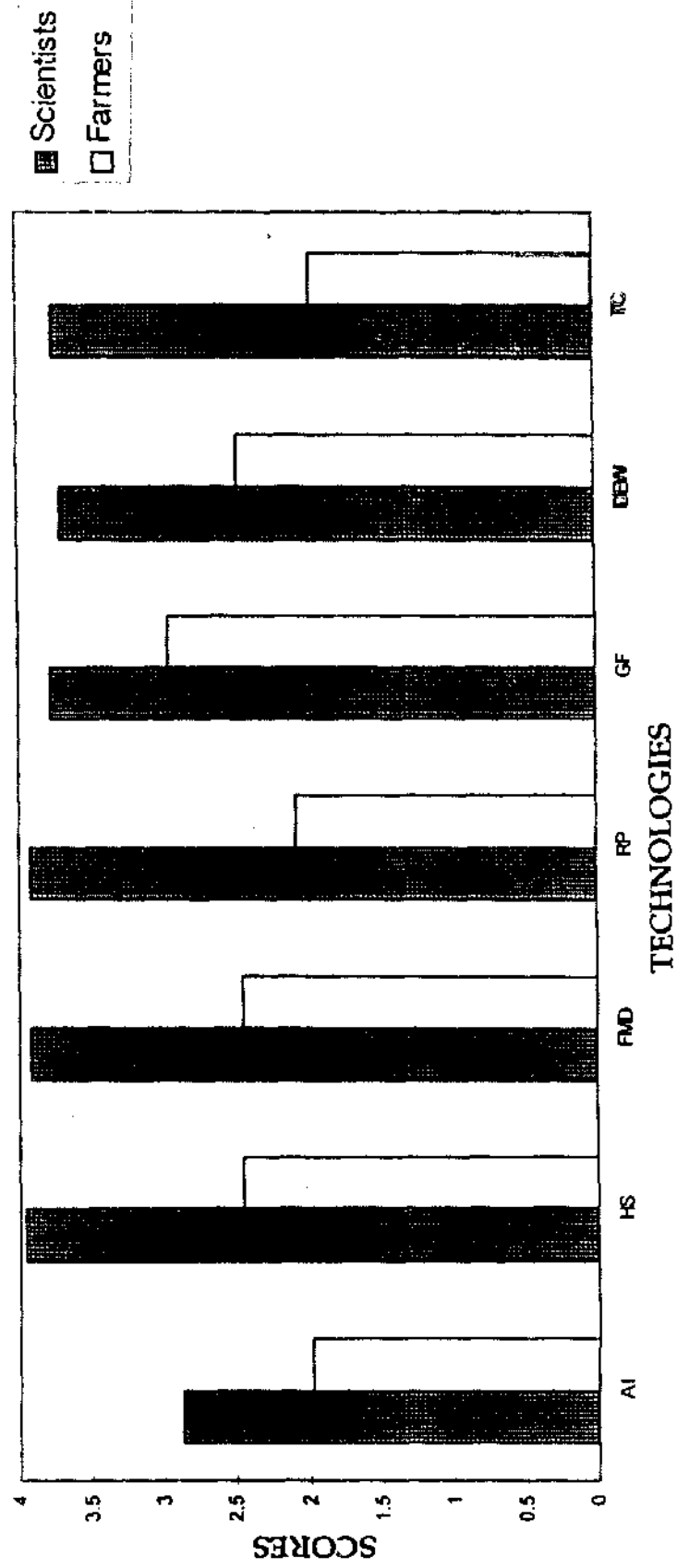


Table 4.22: Distribution of scientists according to their overall perceived score on Sustainability of different animal science technologies

Sl. No.	Categories of Perceived Sustainability of A.H. Technology (Scores)	No. of Scientists					
		AI	HS	FMD	RP	Fodder	Deworming Tick Control
1.	Low (0-84)	8 (16.00)	9 (18.00)	9 (19.00)	6 (12.00)	13 (26.00)	7 (14.00)
2.	Medium (85-170)	14 (28.00)	11 (22.00)	12 (24.00)	12 (24.00)	13 (26.00)	14 (28.00)
3.	High (171-252)	28 (56.00)	30 (60.00)	29 (58.00)	32 (64.00)	24 (48.00)	29 (58.00)
4.	Total	50 (100.00)	50 (100.00)	50 (100.00)	50 (100.00)	50 (100.00)	50 (100.00)

Figures in parenthesis indicate percentage

least agree and not at all agree were obtained on various items of each dimension of sustainability.

A persual of table 4.22 indicated that majority of the scientists had high perceived sustainability score ranging from 171-252 for all the animal husbandry technologies. About one-fourth of the scientists, however, had medium profitability perception score on almost all the technologies. It is interesting to note that one-fourth of the scientists perceived green fodder cultivation as a less sustainable technology.

The data presented in table 4.23 indicate that majority of the farmers (52.50%) perceived AI with low sustainability followed by 28% perceiving it as medium sustainable. On the other hand almost equal number of farmers perceived vaccination against HS, FMD and RP as well as deworming and tick control as highly sustainable and medium sustainable technologies. It was green fodder cultivation technology which was considered as highly sustainable by majority of the farmers.

Perceived sustainability scores of animal husbandry technologies for the scientists were significantly ($P < 0.01$) higher (based on 't' value) than those of farmers as indicated in the table 4.24.

A further observation of table 4.24 reveals that the differences in the perception of scientists and farmers were more in case of vaccination against RP and FMD and lowest in case of green fodder cultivation and

Table4.23: Distribution of farmers according to their over all score on perceived Sustainability of different animal science technologies

Sl. No.	Categories of Perceived Sustainability of A.H. Technology (Score)	No. of Respondents						Tick Control
		AI	HS	FMD	RP	Fodder	Deworming	
1.	Low (0-84)	105 (52.50)	47 (23.50)	47 (23.50)	45 (22.50)	32 (16.00)	29 (14.50)	28 (14.00)
2.	Medium (85-170)	56 (28.00)	77 (38.50)	77 (38.50)	79 (39.50)	53 (26.00)	76 (38.00)	78 (39.00)
3.	High (171-252)	39 (19.50)	76 (38.00)	76 (38.00)	77 (38.50)	115 (57.50)	95 (47.50)	94 (47.00)
4.	Total	200 (100.00)	200 (100.00)	200 (100.00)	200 (100.00)	200 (100.00)	200 (100.00)	200 (100.00)

Figures in parenthesis indicate percentage

Table 4.24: Perceived sustainability scores of animal husbandry technologies by scientists and farmers

Sl. No.	Name of the technologies	Max. possible Score	Perceived sustainability Score		t-test
			Scientists	Farmers	
1.	Artificial Insemination	252	206.94	148.46	7.74**
2.	Vaccination against-HS	252	216.78	150.53	9.55**
3.	FMD	252	218.54	150.64	9.65**
4.	RP	252	214.74	148.81	9.57**
5.	Cultivation & use of nutritious protein-rich green fodder for feeding	252	223.54	165.94	7.79**
6.	Deworming	252	205.76	150.12	7.90**
7.	Tick Control	252	206.24	148.64	8.29**

**Significant at $P < 0.01$.

AI. In other words the farmers differ from the scientists on RP and FMD vaccination most and on green fodder cultivation and AI least.

ARTIFICIAL INSEMINATION (AI)

Perception of scientists on sustainability of AI technology on all dimensions was significantly ($P < 0.01$) higher than those of farmers as indicated in the table ('t' values significant at 0.01 level), except for SA&SS where 't' values are significant only at $P < 0.05$. A critical observation of the table further reveals that the difference in the perception of scientists and farmers were more in case of TA and EF and lowest in case of SA & SS and TS. In other words the farmers differs from the scientists on TA and EF most and on SA & SS and TS least.

PERCEIVED SUSTAINABILITY SCORES OF ANIMAL HUSBANDRY BY
SCIENTISTS & FARMERS

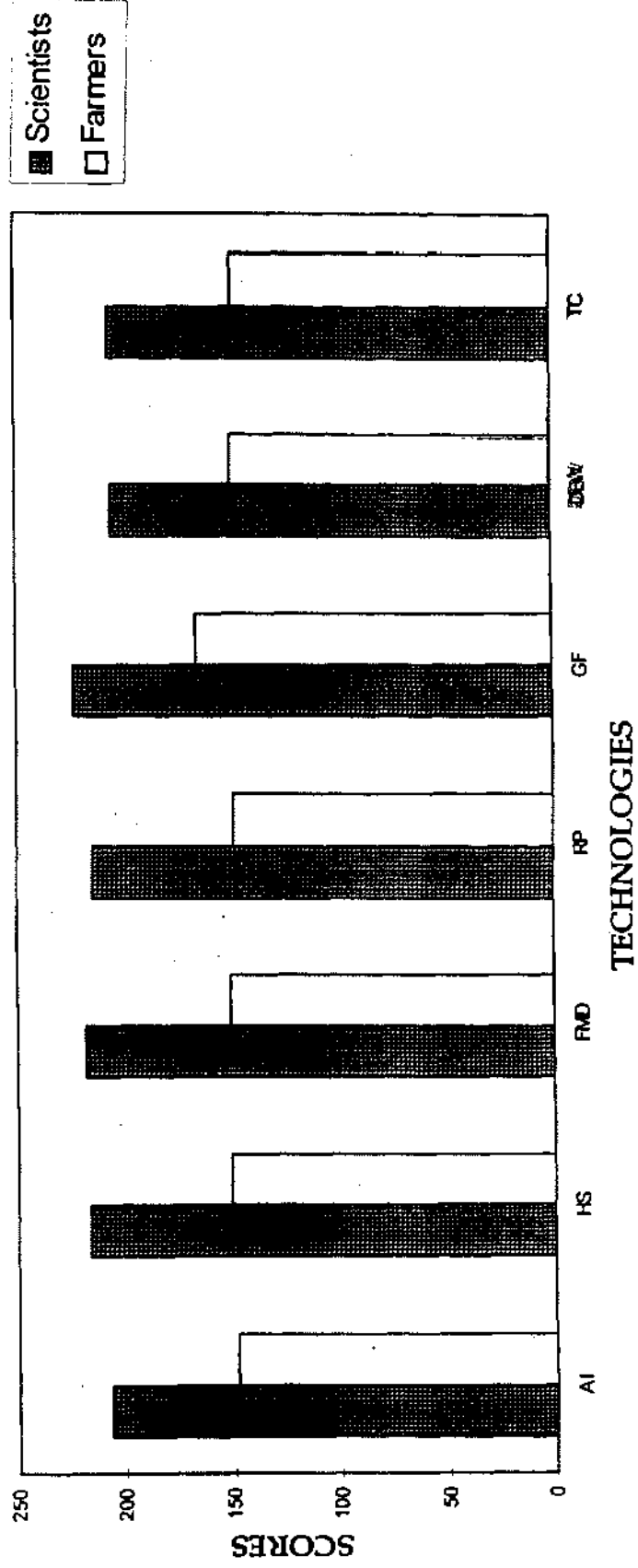


Table4.25: Perceived sustainability scores of A.I. by scientists and farmers on different dimensions

Sl. No.	Dimensions	Max. possible Score	Average Perceived Sustainability Score				t-test
			Scientists		Farmers		
			Mean	SD	Mean	SD	
1.	Technical Appropriability	24	20.38	2.49	13.18	12.7	9.55"
2.	Economic Feasibility	20	18.02	1.64	11.64	1.03	10.03"
3.	Economic Viability	16	14.58	1.05	10.01	0.70	9.74"
4.	Environmental Soundness	20	17.54	2.44	11.05	1.06	9.24"
5.	Temporal Stability	16	12.32	1.96	10.14	0.71	4.13"
6.	Local Adaptality	20	16.26	1.78	11.56	1.09	6.92"
7.	Resources Use Efficiency	16	12.92	1.84	10.13	0.76	5.11"
8.	Social Acceptability & Social Sustainability	16	11.72	1.24	10.10	0.70	3.36'
9.	Political Tacitness	24	20.08	3.09	13.44	1.38	8.00"
10.	Administrative Managebility	16	13.32	1.78	10.11	0.73	6.18"
11.	Cultural Desirability	12	9.72	1.32	7.41	0.57	4.87"
12.	Renewability	20	15.94	2.63	11.34	1.06	6.46"
13.	Equity	16	11.90	1.63	9.57	0.66	4.74"
14.	Productivity	16	13.46	1.30	9.72	0.66	8.09"
15.	Overall		206.59	75.85	148.46	43.05	7.74"

*Significant at $P<0.05$

**Significant at $P<0.01$

HAEMORRHAGIC SEPTICIMIA (HS)

Table 4.26 reveals that the perception of scientists on sustainability of HS technology on all the dimensions were significantly ($P<0.01$) higher, than those of farmers as indicated by 't' values in the table.

The table further reveals that the difference in the perception of scientists and farmers were more in case of technical appropriability

PERCEIVED SUSTAINABILITY SCORES OF A.I. BY SCIENTISTS & FARMERS ON DIFFERENT DIMENSIONS

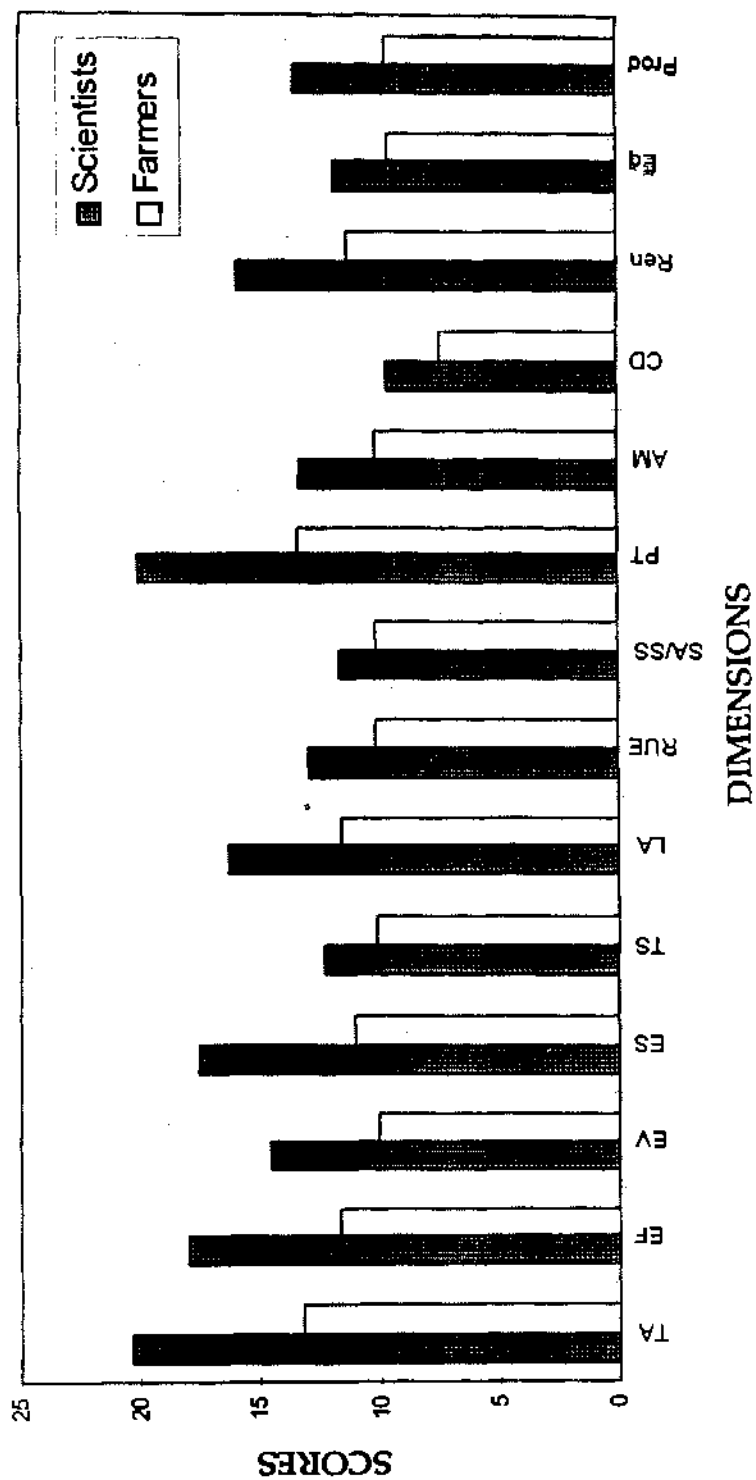


Table 4.26: Perceived sustainability scores of H.S. by scientists and farmers on different dimensions

Sl. No.	Dimension	Max. possible Score	Average Perceived Sustainability Score				t-test
			Scientists		Farmers		
			Mean	SD	Mean	SD	
1.	Technical Appropriability	24	21.94	1.84	13.26	1.23	12.31**
2.	Economic Feasibility	20	17.98	1.93	12.21	1.00	9.33**
3.	Economic Viability	16	14.68	1.49	10.44	0.74	8.53**
4.	Environmental Soundness	20	18.20	1.79	10.54	0.78	14.54**
5.	Temporal Stability	16	12.52	1.34	10.31	0.72	4.51**
6.	Local Adaptality	20	16.72	1.49	11.43	0.95	8.95**
7.	Resources Use Efficiency	16	13.98	1.67	10.22	0.75	7.23**
8.	Social Acceptability & Social Sustainability	16	13.52	1.55	10.07	0.65	7.45**
9.	Political Tacitness	24	19.84	3.06	13.29	1.25	8.49**
10.	Administrative Managebility	16	14.40	1.35	9.99	0.67	9.45**
11.	Cultural Desirability	12	9.58	0.73	7.18	0.50	6.05**
12.	Renewability	20	17.70	1.87	11.98	1.04	8.93**
13.	Equity	16	12.20	1.31	9.99	0.68	4.67**
14.	Productivity	16	14.86	0.95	9.96	0.66	11.13**
15.	Overall		216.78	61.55	150.53	40.51	9.55**

*Significant at $P < 0.05$

**Significant at $P < 0.01$

and environmental soundness and lowest in case of temporal stability and equity. In other words the farmers differ from the scientists on technical appropriability and environmental soundness most and on temporal stability and equity least.

FOOT AND MOUTH DISEASE (FMD)

The data in Table 4.27 reveal that the perception of scientists on sustainability of FMD vaccination technology on different dimension were significantly higher, as indicated by 't' values, than those of farmers.

PERCEIVED SUSTAINABILITY SCORES OF H.S. BY SCIENTISTS & FARMERS ON DIFFERENT DIMENSIONS

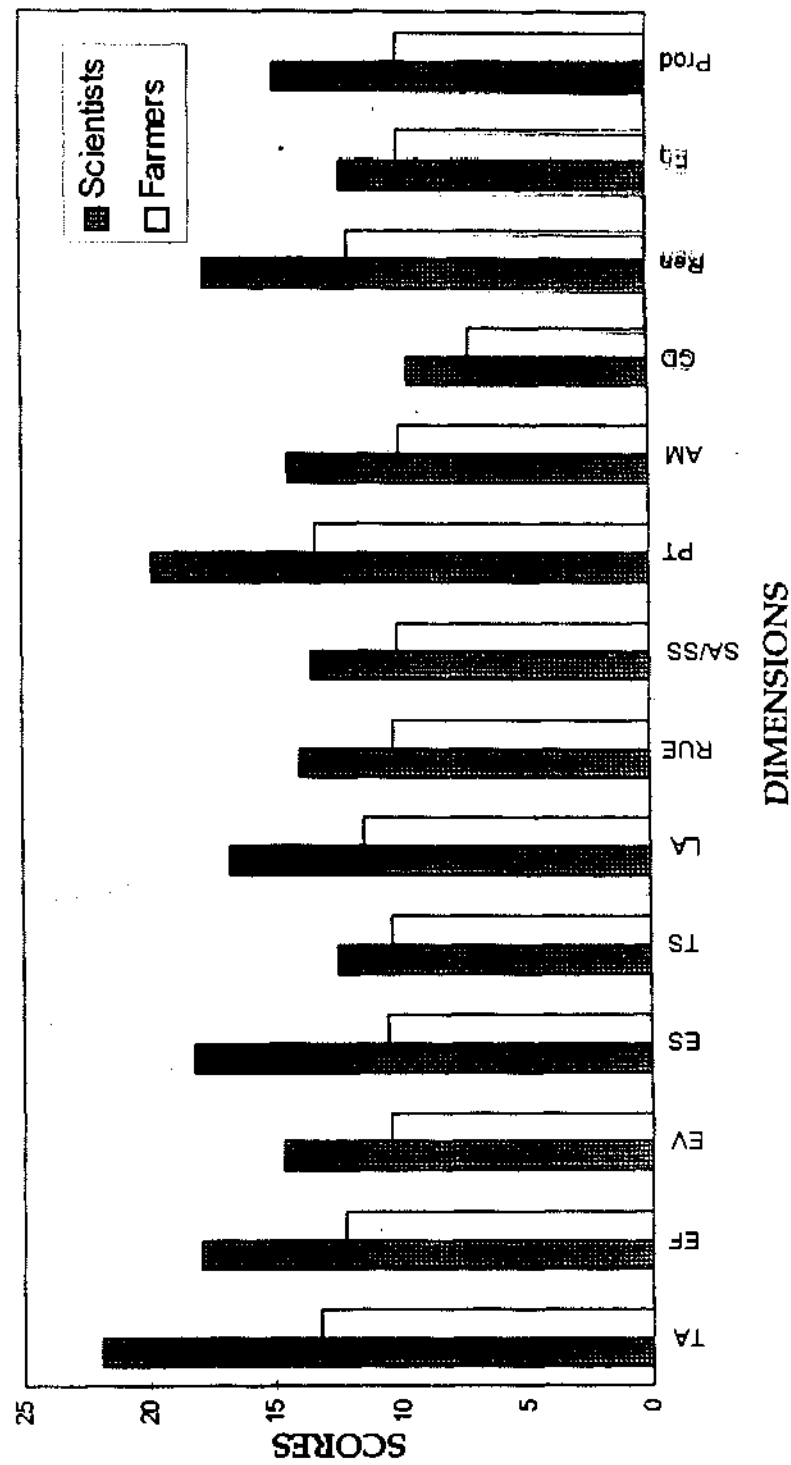


Table4.27: Perceived sustainability scores of FMD by scientists and farmers on different dimensions

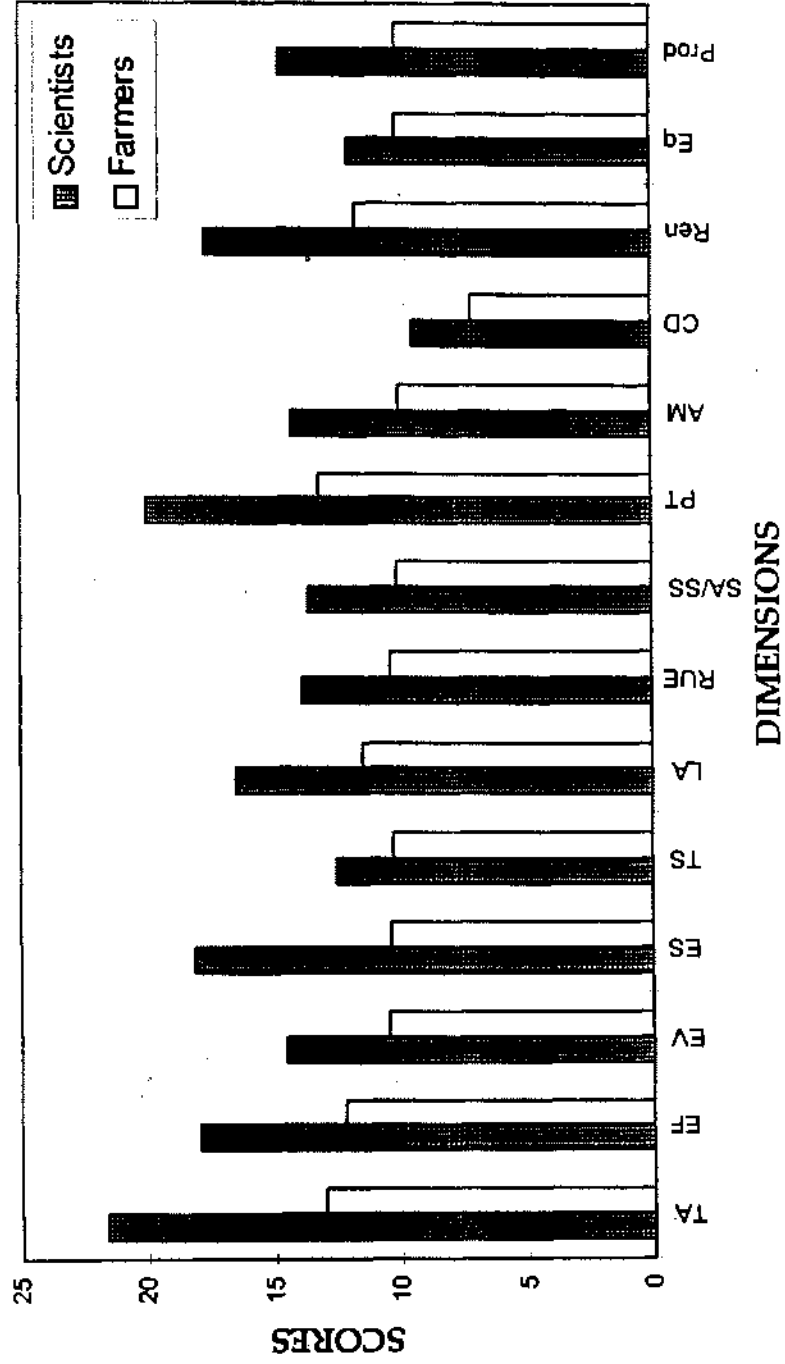
SL No.	Dimension	Max. possible Score	Average Perceived Sustainability Score				t-test
			Scientists		Farmers		
			Mean	SD	Mean	SD	
1.	Technical Appropriability	24	21.68	2.03	13.04	1.12	13.05**
2.	Economic Feasibility	20	18.00	1.94	12.17	0.98	9.57**
3.	Economic Viability	16	14.50	1.77	10.48	0.71	8.06**
4.	Environmental Soundness	20	18.16	1.79	10.40	0.76	14.89**
5.	Temporal Stability	16	12.52	1.33	10.32	0.71	4.53**
6.	Local Adaptability	20	16.54	1.59	11.45	0.94	8.61**
7.	Resources Use Efficiency	16	13.90	1.65	10.35	0.72	7.07**
8.	Social Acceptability & Social Sustainability	16	13.62	1.50	10.09	0.63	7.84**
9.	Political Tacitness	24	20.00	2.94	13.15	1.24	9.01**
10.	Administrative Manageability	16	14.26	1.60	10.01	0.75	8.13**
11.	Cultural Desirability	12	9.50	0.75	7.14	0.49	6.00**
12.	Renewability	20	17.68	1.91	11.72	1.01	9.37**
13.	Equity	16	12.04	1.22	10.08	0.69	4.14**
14.	Productivity	16	14.74	0.93	10.09	0.69	10.26**
15.	Overall		218.54	75.09	150.64	40.22	9.65**

*Significant at $P < 0.05$

**Significant at $P < 0.01$

The table further reveals that the difference in the perception of scientists and farmers were more in case of technical appropriability and environmental soundness and lowest in case of temporal stability and equity. In other words the farmers differ from the scientists on technical appropriability and environmental soundness most and on temporal stability and equity least.

PERCEIVED SUSTAINABILITY SCORES OF FMD BY SCIENTISTS & FARMERS ON DIFFERENT DIMENSIONS



RINDER PEST (RP)

The perception of scientists on sustainability of RP vaccination technology on different dimensions were significantly ($P<0.01$) higher, as revealed from 't' values, than those of farmers as indicated in the table 4.28.

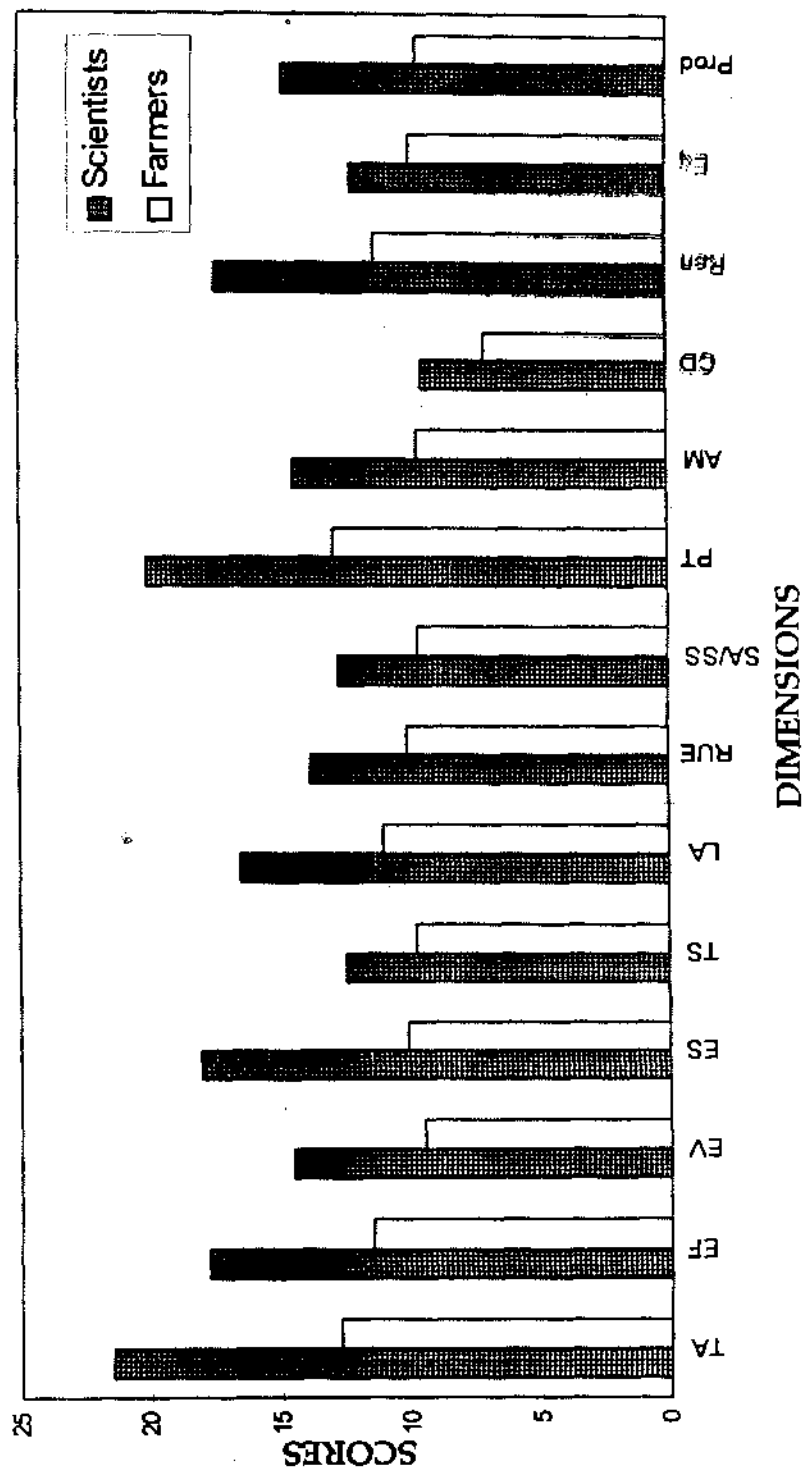
Table 4.28: Perceived sustainability scores of Rinder Pest (RP) by scientists and farmers on different dimensions

Sl. No.	Dimension	Max. possible Score	Average Perceived Sustainability Score				t-test
			Scientists		Farmers		
			Mean	SD	Mean	SD	
1.	Technical Appropriability	24	21.48	2.41	12.69	1.12	12.86**
2.	Economic Feasibility	20	17.80	2.09	11.43	0.96	10.20**
3.	Economic Viability	16	14.56	1.62	9.45	0.64	10.77**
4.	Environmental Soundness	20	18.02	1.93	10.11	0.82	14.00**
5.	Temporal Stability	16	12.50	1.37	9.75	0.66	5.85**
6.	Local Adaptability	20	16.54	1.58	11.04	0.95	9.08**
7.	Resources Use Efficiency	16	13.80	1.68	10.10	0.76	6.96**
8.	Social Acceptability & Social Sustainability	16	12.70	1.22	9.65	0.62	6.99**
9.	Political Tacitness	24	20.14	2.94	12.88	1.23	9.53**
10.	Administrative Manageability	16	14.40	1.35	9.68	0.66	10.21**
11.	Cultural Desirability	12	9.46	0.76	7.06	0.50	5.99**
12.	Renewability	20	17.40	1.91	11.30	0.96	9.88**
13.	Equity	16	12.16	1.26	9.89	0.69	4.76**
14.	Productivity	16	14.78	0.96	9.62	0.63	12.08**
15.	Overall		214.74	62.55	148.81	39.88	9.57**

*Significant at $P<0.05$

The table 4.28 further shows that the difference in the perception of scientists and farmers were more in case of technical appropriability and environmental soundness and lowest in case of temporal stability

PERCEIVED SUSTAINABILITY SCORES OF RP BY SCIENTISTS & FARMERS ON DIFFERENT DIMENSIONS



and equity. In other words the farmers perception differs from the scientists on technical appropriability and environmental soundness most and on temporal stability and equity least.

CULTIVATION OF GREEN FODDER

The perceptions of scientists on sustainability of green fodder cultivation technology were significantly higher than those of farmers as indicated from the 't' value in the table.

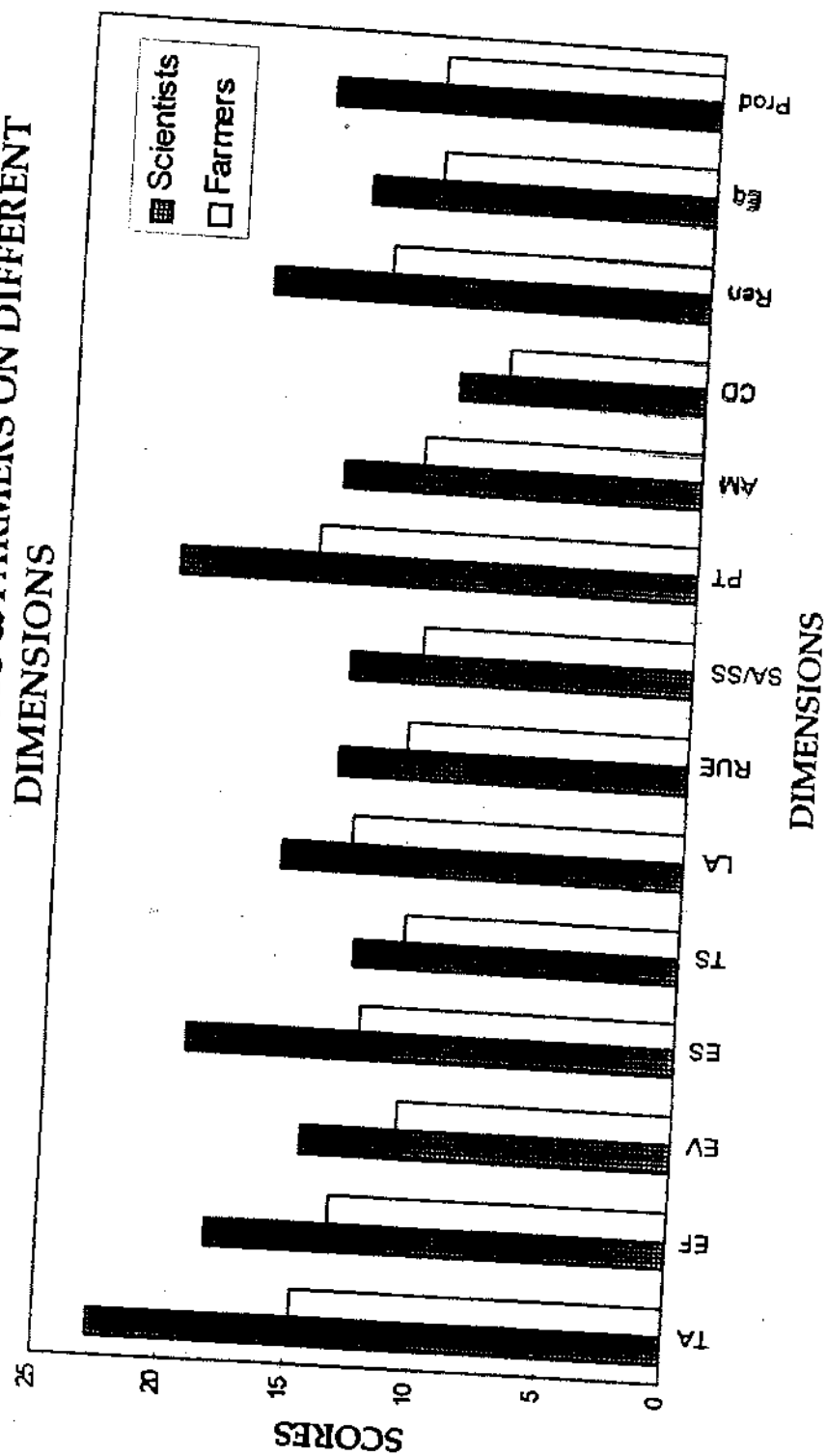
Table4.29: Perceived sustainability scores of Green Fodder cultivation by scientists and farmers on different dimensions

Sl. No.	Dimension	Max. possible Score	Average Perceived Sustainability Score				t-test
			Scientists		Farmers		
			Mean	SD	Mean	SD	
1.	Technical Appropriability	24	22.82	1.67	14.76	13.0	11.47**
2.	Economic Feasibility	20	18.28	1.97	13.49	1.12	7.71**
3.	Economic Viability	16	14.68	1.14	10.89	0.75	7.86**
4.	Environmental Soundness	20	19.44	1.19	12.52	1.00	11.00**
5.	Temporal Stability	16	12.94	1.15	10.95	0.76	4.08**
6.	Local Adaptability	20	15.98	1.92	13.18	1.19	4.00**
7.	Resources Use Efficiency	16	13.90	1.52	11.15	0.82	5.13**
8.	Social Acceptability & Social Sustainability	16	13.62	1.36	10.75	0.69	6.16**
9.	Political Tacitness	24	20.58	2.72	15.06	1.44	6.85**
10.	Administrative Manageability	16	14.22	1.30	11.11	0.79	6.09**
11.	Cultural Desirability	12	9.84	0.637	7.83	0.57	4.75**
12.	Renewability	20	17.38	1.39	12.73	1.14	7.01**
13.	Equity	16	13.68	0.91	10.94	0.78	5.61**
14.	Productivity	16	15.36	0.72	10.98	0.74	9.47**
15.	Overall		223.54	51.89	165.94	46.23	7.79**

*Significant at $P < 0.05$

**Significant at $P < 0.01$

PERCEIVED SUSTAINABILITY SCORES OF GREEN FODDER CULTIVATION BY SCIENTISTS & FARMERS ON DIFFERENT DIMENSIONS



The table 4.29 further indicates that the difference in perception of scientists and farmers were more in case of environmental soundness and technical appropriability and lowest in case of local adaptability and temporal stability. In other words the farmers differ from scientists on perception of environmental soundness and technical appropriability most and on local adaptability and temporal stability least.

DEWORMING

A persual of table 4.30 shows that on the basis of 't' values the perception of scientists on sustainability of deworming technology, on

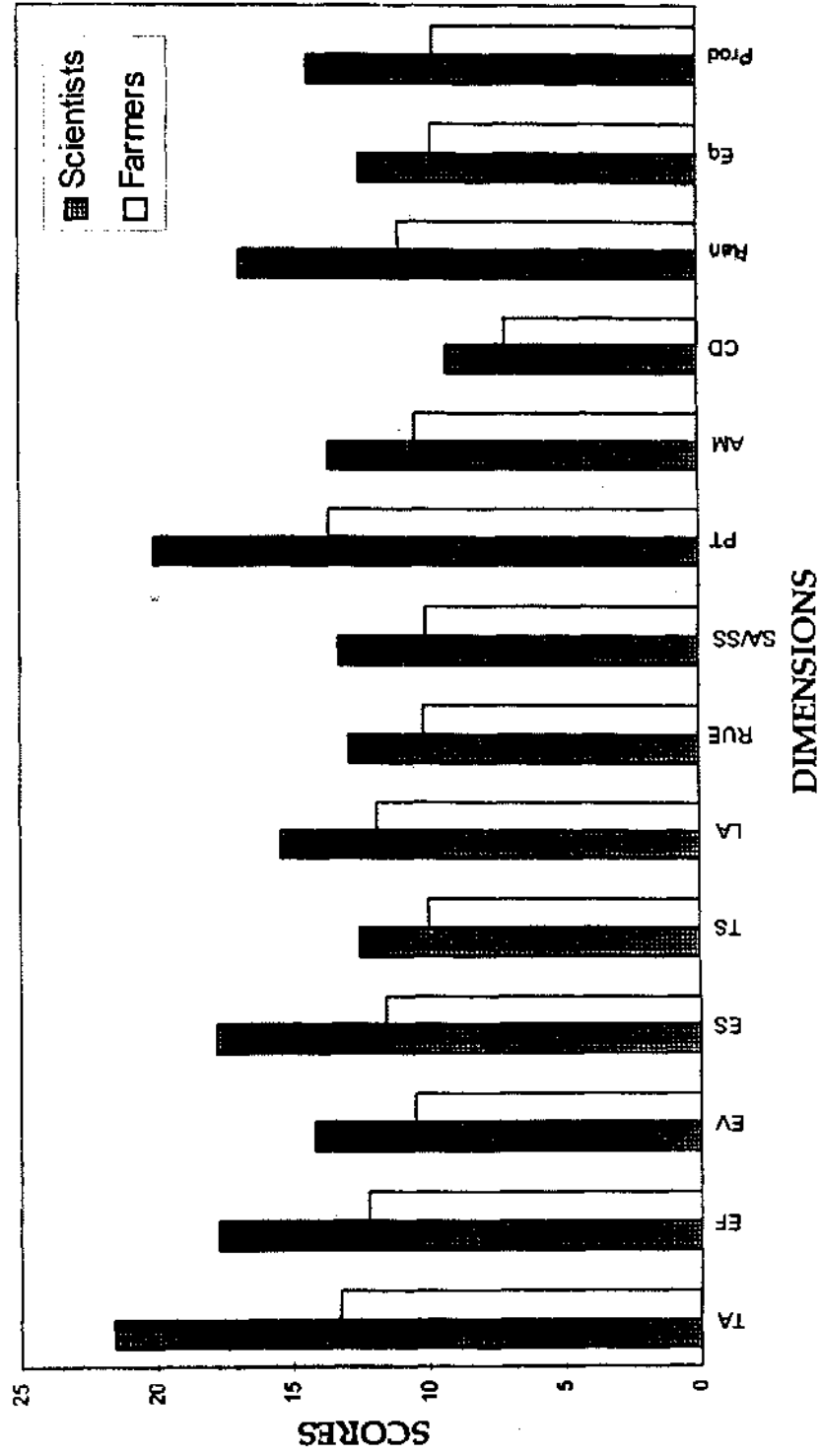
Table4.30: Perceived sustainability scores of Deworming by scientists and farmers on different dimensions

Sl. No.	Dimensions	Max. possible Score	Average Perceived Sustainability Score				t-test
			Scientists		Farmers		
			Mean	SD	Mean	SD	
1.	Technical Appropriability	24	21.58	21	13.27	1.14	12.43"
2.	Economic Feasibility	20	17.74	1.79	12.25	0.98	9.14"
3.	Economic Viability	16	14.18	1.38	10.51	0.80	6.94"
4.	Environmental Soundness	20	17.86	1.93	11.59	0.94	10.37"
5.	Temporal Stability	16	12.54	1.31	9.97	0.67	5.48"
6.	Local Adaptability	20	15.42	1.81	11.87	0.98	5.75"
7.	Resources Use Efficiency	16	12.88	1.57	10.13	0.69	5.59"
8.	Social Acceptability & Social Sustainability	16	13.26	1.66	10.08	0.70	6.35"
9.	Political Tacitness	24	20.06	3.18	13.63	1.31	8.08"
10.	Administrative Manageability	16	13.64	1.76	10.44	0.76	6.05"
11.	Cultural Desirability	12	9.24	0.78	7.13	0.48	5.45"
12.	Renewability	20	16.92	1.89	11.02	1.00	9.92"
13.	Equity	16	12.46	0.98	9.75	0.68	5.91"
14.	Productivity	16	14.34	1.27	9.69	0.66	10.15"
15.	Overall		205.76	54.58	150.12	41.47	7.90"

*Significant at $P < 0.05$

**Significant at $P < 0.01$

PERCEIVED SUSTAINABILITY SCORES OF DEWORMING BY SCIENTISTS & FARMERS ON DIFFERENT DIMENSIONS



different dimensions were significantly ($P<0.01$) higher than those of farmers.

The table 4.30 further indicated that the differences in perception of scientists and farmers were more in case of environmental soundness and technical appropriability and lowest in case of cultural desirability and resources use efficiency. In other words the farmers perception differs from scientists in environmental soundness and technical appropriability most and on cultural desirability and resources use efficiency least.

TICK CONTROL

Perception of scientists on sustainability of tick control technology on different dimensions were significantly ($P<0.01$) higher based on 't' values, than those of farmers as indicated in the table 4.31.

A critical observation of the table 4.31 further reveals that the differences in the perception of scientists and farmers were more in case of environmental soundness and technical appropriability and lowest in case of cultural desirability and equity. In other words the farmers differ from the scientists on their perception about environmental soundness and technical appropriability most and cultural desirability and equity least.

Table 4.31: Perceived sustainability scores of Tick Control by scientists and farmers on different dimensions

Sl. No.	Dimensions	Max. possible Score	Average Perceived Sustainability Score				t-test
			Scientists		Farmers		
			Mean	SD	Mean	SD	
1.	Technical Appropriability	24	21.46	2.09	12.66	1.1	13.32**
2.	Economic Feasibility	20	17.52	1.90	11.83	0.95	9.43**
3.	Economic Viability	16	13.98	1.47	9.97	0.74	7.83**
4.	Environmental Soundness	20	18.04	1.99	11.34	3.16	11.04**
5.	Temporal Stability	16	12.56	1.28	9.54	0.59	7.04**
6.	Local Adaptability	20	15.38	1.83	11.60	0.96	6.17**
7.	Resources Use Efficiency	16	13.04	1.63	9.77	0.67	6.67**
8.	Social Acceptability & Social Sustainability	16	13.24	1.68	9.79	0.69	6.89**
9.	Political Tacitness	24	20.26	3.01	13.34	1.33	8.58**
10.	Administrative Manageability	16	13.66	1.81	09.97	0.76	06.78**
11.	Cultural Desirability	12	09.26	0.79	07.09	0.51	05.28**
12.	Renewability	20	16.70	2.04	11.01	0.95	09.07**
13.	Equity	16	12.44	0.95	09.62	0.67	06.15*
14.	Productivity	16	14.24	1.41	09.52	0.68	09.77**
15.	Overall		206.24	52.21	148.64	40.79	8.29**

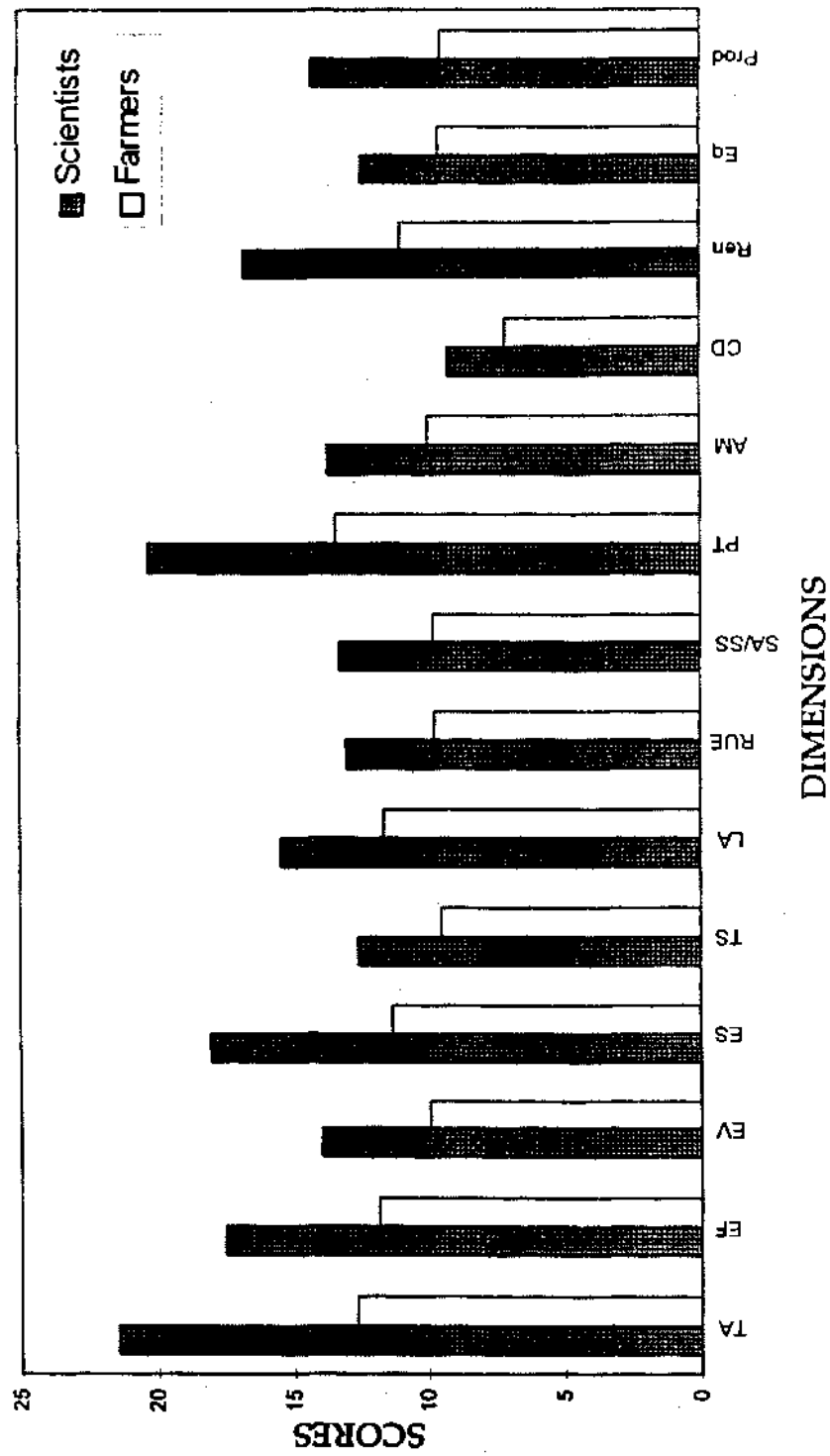
*Significant at $P < 0.05$

**Significant at $P < 0.01$

4.5 ANALYSIS OF VARIANCE (ANOVA) OF DIFFERENT ANIMAL SCIENCE TECHNOLOGIES FOR SUSTAINABILITY AND PROFITABILITY BETWEEN CASTE AND LAND HOLDING

The farmers responded in this study were classified on the basis of caste and land holding pattern. Different class of caste were general, OBC and SC/ST and those for land holding were marginal small and large.

PERCEIVED SUSTAINABILITY SCORES OF TICK-CONTROL BY SCIENTISTS & FARMERS ON DIFFERENT DIMENSIONS



4.5.1 Effect of caste on sustainability of technologies

There were significant ($P<0.01$) differences about perception towards sustainability of all seven animal science technologies studied in different caste groups (Table 4.32).

Table 4.32: ANOVA for showing the effect of caste groups on sustainability of different technologies

Sl. No.	Technologies	Mean Sum of Squares		F Value
		Between Caste	Within Caste	
1.	Artificial Insemination	28534.84	2233.04	12.77**
2.	Vaccination against-HS	30374.69	1894.64	16.03**
3.	FMD	28579.99	1879.50	15.20**
4.	RP	28780.21	1866.44	15.41**
5.	Cultivation & use of green fodder	29793.30	2300.14	12.95**
6.	Deworming	35115.57	1958.44	17.93**
7.	Tick Control	34554.25	1910.67	18.08**

**Significant at $P<0.01$

Mean perception score of sustainability was highest for farmers belonging to SC & ST caste, followed by those for OBC and general caste as indicated from the values (Table 4.33) for perceived sustainability score for A.I., H.S., FMD and RP vaccination green fodder production, deworming and tick control given in table. This could be due to the fact that SC/ST farmers are mostly landless labourers and solely dependent on animal husbandry vocation. Hence, this category of farmers had highest perception of sustainability of these animal science technologies. The

Table 4.33 : Caste wise Mean and SD for sustainability of different animal science technologies

SL No.	Technologies	Categories of Caste					
		General		OBC		SC/ST	
		Mean	SD	Mean	SD	Mean	SD
1.	Artificial Insemination	130.60 ^a	84.47	147.90 ^b	47.64	177.73	89.15
2.	Vaccination against H.S.	131.37 ^a	76.70	150.81 ^b	45.40	180.02 ^c	83.50
3.	FMD	131.98 ^a	77.12	151.01 ^b	45.19	179.16 ^c	81.38
4.	RP	130.01 ^a	75.83	149.26 ^b	44.59	177.35 ^c	80.95
5.	Fodder Production	148.63 ^a	93.42	164.34 ^b	49.36	196.64 ^c	93.82
6.	Deworming	131.18 ^a	78.63	148.54 ^b	46.72	183.33 ^c	80.27
7.	Tick Control	129.77 ^a	77.21	147.17 ^b	45.90	181.52 ^c	79.19

Mean across the rows bearing different superscripts are significant.

farmers belonging to OBC had medium perception in this regard. Among the technologies studied sustainability of fodder production was highest for all category of farmers and lowest sustainability was for tick control.

4.5.2 Effect of caste on profitability of different technologies

The farmers belonged to different castes significantly differed in their perception towards the profitability of the seven animal science technologies.

Perception of farmers towards profitability of animal science technologies also showed highest for SC/ST category and lowest for farmers belonging to general caste. The values (4.34) of profitability for technologies viz. AI, HS, FMD and RP vaccination green fodder production, deworming and tick control as perceived by the farmers of SC/ST, OBC and general caste are presented in table 4.34.

Table 4.34: ANOVA for showing the effect of Caste groups on profitability of different technologies

Sl. No.	Technologies	Mean Sum of Squares		F Value
		Between Caste	Within Caste	
1.	Artificial Insemination	13.65	.45	29.6**
2.	Vaccination against-HS	19.70	.77	25.4**
3.	FMD	19.03	.78	24.3**
4.	RP	24.86	.63	38.9**
5.	Cultivation & use of green fodder	12.15	.39	30.8**
6.	Deworming	12.69	.64	19.7**
7.	Tick Control	8.72	.44	19.45

**Significant at $P < 0.01$.

Table 4.35: Caste wise Mean and SD for profitability of different animal science technologies

Sl. No.	Technologies	Categories of Caste					
		General		OBC		SC/ST	
		Mean	SD	Mean	SD	Mean	SD
1.	Artificial Insemination	1.54 ^a	0.11	2.02 ^b	0.09	2.57 ^c	0.16
2.	Vaccination against H.S.	1.95 ^a	0.15	2.50 ^b	0.13	3.19 ^c	0.25
3.	FMD	1.95 ^a	0.15	2.51 ^b	0.13	3.16 ^c	0.25
4.	RP	1.59 ^a	0.11	2.03 ^b	0.10	2.97 ^c	0.27
5.	Fodder Production	2.57 ^a	0.12	2.98 ^b	0.11	3.54 ^c	0.17
6.	Deworming	2.06 ^a	0.14	2.53 ^b	0.11	3.04 ^c	0.25
7.	Tick Control	1.65 ^a	0.11	1.96 ^b	0.09	2.47 ^c	0.17

Mean across the rows bearing different superscripts are significant.

Among the technologies studied fodder production technology was perceived at highest profitability and tick control at lowest (4.35). The farmers belonged to SC/ST perceived highest profitability for all the seven technologies studied which could be attributed to their dependency on the animal husbandry for their livelihood. Among the technologies studied, the order of profitability perception by the farmers from high to low were green fodder production, HS and FMD vaccination, deworming, RP vaccination, AI and tick control. The perception of profitability of vaccinations were similar. The technologies studied could be clubbed into three (i) Green fodder production, (2) HS, FMD and RP vaccination and deworming and (3) AI and Tick control. If we look at the livestock population, the reason for these differential perception could be explained. About 92 percent of the population of livestock is desi and are adaptive to harsh climatic conditions and resistant to certain diseases. Therefore, perception of lower profitability of disease related technologies as well as of AI could be explained. The only technology i.e. fodder production was perceived by all section of farmers and for all types of livestock reared because the nutrition remained a major constraint for the animal husbandry practices in India.

4.5.3 Effect of land holding pattern on sustainability of different technologies

The ANOVA table (4.36) indicated that effect of holding pattern of farmers was highly significant ($P < 0.01$) on the perception of the farmers towards the sustainability of all seven technologies studied.

Table 4.36: ANOVA for showing the effect of land holding groups on sustainability of different technologies

Sl. No.	Technologies	Mean Sum of Squares		F Value
		Between landholding	Within landholding	
1.	Artificial Insemination	32582.77	2191.95	14.86**
2.	Vaccination against-HS	31047.86	1887.80	16.44**
3.	FMD	29763.53	1867.48	15.93**
4.	RP	30855.92	1845.36	16.72**
5.	Cultivation & use of green fodder	44735.10	2148.44	20.82**
6.	Deworming	39257.57	1916.39	20.48**
7.	Tick Control	38907.70	1866.48	20.84**

**Significant at $P < 0.01$.

The mean perception of sustainability of technologies studied viz., AI, HS, FMD and RP vaccination, green fodder production, deworming and tick control were highest for large farmers, followed by those of small and marginal farmers. The values of mean and SD of the perceived profitability score for large, small and marginal farmers have been given in table 4.37 separately.

The marginal farmers reared livestock on traditional husbandry practices and the type of livestock they reared were of low producing. Rearing of high producing animals amounted to higher risk involved. Thus, the marginal and/or small farmers, though depend to certain extent on animal husbandry for their livelihood, had shown a perception of lower sustainability of these technologies studied. For them, accessibility and procurement of vaccine and anti-parasitic drugs for their poor producing cattle/buffalo were difficult as compared to these

Table4.37: Land holding wise Mean and SD for sustainability of different animal science technologies

Sl. No.	Technologies	Categories of Land Holding					
		Marginal		Small		Large	
		Mean	SD	Mean	SD	Mean	SD
1.	Artificial Insemination	136.70 ^{ab}	60.83	144.08 ^b	67.00	185.70 ^c	84.50
2.	Vaccination against H.S.	139.25 ^{ab}	56.43	145.97 ^b	63.56	186.97 ^c	77.96
3.	FMD	139.67 ^{ab}	56.38	146.06 ^b	63.30	186.35 ^c	76.10
4.	RP	137.43 ^{ab}	55.35	144.45 ^b	62.18	185.08 ^c	78.34
5.	Fodder Production	153.44 ^{ab}	63.41	159.01 ^b	71.95	210.02 ^c	81.62
6.	Deworming	137.68 ^{ab}	56.07	144.63 ^b	64.31	191.18 ^c	79.74
7.	Tick Control	135.94 ^{ab}	54.92	143.64 ^b	63.12	189.40 ^c	76.51

Mean across the rows bearing different superscripts are significant.

for large farmers. Large farmers considered crop husbandry as the major avocation, however, used to adopt newer technologies when they were involved to animal husbandry as well. Thus, their perception towards those new technologies studied were higher.

4.5.4 Effect of land holding pattern of farmers on the profitability of different animal science technologies

The effect of land holding size was highly significant ($P < 0.01$) on the perception of farmers towards profitability of all the seven animal science technologies studied (4.38).

Table 4.38: ANOVA for showing the effect of land holding groups on profitability of different technologies

Sl. No.	Technologies	Mean Sum of Squares		F Value
		Between landholding	Within landholding	
1.	Artificial Insemination	17.65	.41	42.8**
2.	Vaccination against-H.S.	30.14	.66	45.1**
3.	FMD	30.90	.65	46.8**
4.	RP	34.82	.53	64.7**
5.	Cultivation & use of green fodder	15.45	.35	42.9**
6.	Deworming	16.36	.60	27.0**
7.	Tick Control	18.78	.34	54.2**

**Significant at $P < 0.01$

Farmers with large land holding had higher perception of profitability towards these technologies studied and marginal farmers had the lowest (4.39). The mean values ($\pm$ SD) of perception of

profitability of technologies like AI, HS, FMD and RP vaccination, green fodder production, deworming and tick control for marginal, small and large farmers have been presented in table 4.39.

It was clearly observed that fodder production technology was ranked highest by all category of farmers. The technologies which were perceived as low profitable were A.I. and tick control. Possibly these two technologies were disregarded by the farmers due to different reasons; first one might be due to lower accessibility to AI, inherent complexity and lower success rate than natural service under prevailing situation. The low profitability of tick control by the farmers could be attributed to the fact that the desi cow were more resistant to tick infestation. Thus, the net economic saving due to tick control as observed in exotic or crossbred cows were not appreciated by the farmers rearing mostly buffaloes and indigenous cattle.

It was also evident from the table that all categories of farmers knew about vaccination and deworming as profitable technologies. It was evident from the results that farmers had a thorough knowledge about the economic loss caused by FMD, HS and RP and internal parasites. Therefore, they voted for these technologies as profitable. However, out of the three vaccine technologies, RP vaccination had the low profitability which would primarily be due to the reason that recently this disease was declared as eradicated from India. Thus, the quantum of economic loss the farmers suffered due to RP had been reduced substantially and thereby their perception about the profitability was reduced.

Table 4.39: Land holding wise Mean and SD for profitability of different animal science technologies

Sl. No.	Technologies	Categories of Land Holding					
		Marginal		Small		Large	
		Mean	SD	Mean	SD	Mean	SD
1.	Artificial Insemination	1.67 ^{ab}	0.09	1.91 ^b	0.10	2.83 ^c	0.13
2.	H.S.	2.05 ^{ab}	0.13	2.41 ^b	0.14	2.56 ^c	0.21
3.	FMD	2.03 ^{ab}	0.13	2.43 ^b	0.14	3.56 ^c	0.21
4.	RP	1.68 ^{ab}	0.10	1.95 ^b	0.11	3.29 ^c	0.40
5.	Fodder Production	2.64 ^{ab}	0.10	2.98 ^b	0.12	3.73 ^c	0.16
6.	Deworming	2.23 ^{ab}	0.13	2.37 ^b	0.13	3.32 ^c	0.21
7.	Tick Control	1.68 ^{ab}	0.09	1.86 ^b	0.08	2.86 ^c	0.13

Mean across the rows bearing different superscripts are significant.

4.6 RELATIONSHIP BETWEEN THE FARMERS CHARACTERISTICS AND THEIR PERCEPTION ON SUSTAINABILITY AND PROFITABILITY OF ANIMAL HUSBANDRY TECHNOLOGIES

The relationship between selected independent variables and perception of animal husbandry technologies for their sustainability and profitability were analysed through contribution of correlation (r) values which are presented in table 4.40 and 4.41 respectively.

All the animal husbandry technologies were found equally sustainable across to different types of farmers studied. The correlation between the perception of technologies and the variables related to the attributes of farmer and his family (age of farmers, no of family workers and education status) were not significant (r - ranged from 0.00 to 0.11). Thus, the perception of different classes of farmers according to their age, education and family size were similar.

Certain variables like cropping intensity milk produced from desi and crossbred cows also did not have significant correlation with the perceived sustainability of these technologies. In other words, the perceived sustainability of animal husbandry technologies were not influenced by the cropping intensity of the farmers and the quantity of milk produced by the cattle with them.

The variables like area under green fodder, herd size, accessibility/ extent of use of green fodder, vaccine, AI or anti-parasitic drugs and milk produced by improved buffaloes gave significant correlation with

Table4.40: Correlation between selected independent variables and sustainability of animal science technologies.

Sl. No.	Independent Variables	'r' Value of following Technologies(N=200)						
		AI	HS	FMD	RP	Fodd.	Dewo.	TC
1.	Age	.09	.09	.09	.09	.10	.11	.11
2.	No. of Family worker in AH	.00	.01	.01	.01	.01	.04	.04
3.	Family Education Status	.07	.08	.08	.09	.05	.07	.08
4.	Area under green fodder	.22**	.25**	.25**	.25**	.26**	.27**	.28**
5.	Cropping Intensity	-.08	-.08	-.09	-.09	-.12	-.13	-.13
6.	Herd Size	.16*	.16*	.16*	.16*	.18*	.20**	.20**
7.	Milk Produced by desi cattle	-.03	-.07	-.08	-.10	-.13	-.11	-.12
8.	Milk Produced by Crossbreed cattle	-.08	-.08	-.09	-.08	-.09	-.06	-.06
9.	Milk Produced by desi buffalo	.14	.10	.09	.08	.06	.04	.04
10.	Milk Produced by Improved buffalo	.27**	.22**	.22**	.22**	.17*	.17*	.16*
11.	Accessibility to AI	.18*	.19**	.18*	.18*	.21**	.19**	.18*
12.	Accessibility to Vaccination	.20**	.20**	.20**	.20**	.21**	.20**	.20**
13.	Accessibility to Fodder cultivation	.18*	.21**	.21**	.21**	.22**	.20**	.20**
14.	Accessibility to Anti-Parasitic drugs	.21**	.23**	.22**	.23**	.23**	.21**	.21**
15.	Extent of use of AI	.16*	.18*	.18*	.18*	.18*	.18*	.17*
16.	Extent of use of Vaccination	.22**	.23**	.23**	.22**	.24**	.22**	.22**
17.	Extent of use of Fodder cultivation	.13	.13	.13	.12	.18*	.15*	.15*
18.	Extent of use of Anti-Parasitic drugs	.15*	.15*	.15*	.15*	.17*	.16*	.16*

*Significant at $P < 0.05$

**Significant at $P < 0.01$

Table4.41: Correlation between selected independent variables and profitability of animal science technologies.

Sl. No.	Independent Variables	'r' Value of following Technologies(N=200)						
		AI	HS	FMD	RP	Fodd.	Dewo.	TC
1.	Age	.12	.18	.18	.23**	.21**	.23**	.24**
2.	No. of Family worker in AH	.21*	.26**	.26**	.23**	.21**	.27**	.32**
3.	Family Education Status	.26**	.20**	.20**	.30**	.21**	.19**	.29**
4.	Area under green fodder	.39	.47	.48	.49	.45	.44	.50
5.	Cropping Intensity	-.30**	-.06**	-.06**	-.13**	-.22**	-.16**	-.08**
6.	Herd Size	.46**	.34**	.35**	.40**	.46**	.41**	.40**
7.	Milk Produced by desi cattle	.33**	.23**	.23**	.24**	.41**	.29**	.28**
8.	Milk Produced by Crossbreed cattle	.11	.19**	.24**	.23**	.14*	.10	.14*
9.	Milk Produced by desi buffalo	.07	.01	.02	.00	.16	.01	.04
10.	Milk Produced by Improved buffalo	.19**	.19**	.21**	.21**	.27**	.35**	.29**
11.	Accessibility to AI	.36**	.40**	.39**	.34**	.35**	.33**	.33**
12.	Accessibility to Vaccination	.47**	.44**	.44**	.38**	.37**	.37**	.37**
13.	Accessibility to Fodder cultivation	.42**	.40**	.40**	.38**	.38**	.32**	.38**
14.	Accessibility to Anti-Parasitic drugs	.44**	.38**	.37**	.34**	.36**	.31**	.33**
15.	Extent of use of AI	.42**	.42**	.42**	.32**	.31**	.33**	.31**
16.	Extent of use of Vaccination	.40**	.41**	.40**	.34**	.34**	.36**	.33**
17.	Extent of use of Fodder cultivation	.34**	.40**	.40**	.30**	.31**	.38**	.26**
18.	Extent of use of Anti-Parasitic drugs	.34**	.40**	.39**	.37**	.30**	.35**	.37**

*Significant at $P < 0.05$

**Significant at $P < 0.01$

the perception of sustainability of animal science technologies. The farmers who cultivated fodder and had large herd size and use the technologies were supposed to be progressive and innovative and wanted to make the A.H. practices more viable and adopted. Thus, their perception towards the sustainability of these technologies were high. Accessibility of the inputs like green fodder, A.I., Vaccination and anti-parasitic drugs also improved the perception of the farmers towards the sustainability of these technologies.

Almost all the independent variables showed significant and positive correlation with the perceived profitability of the animal science technologies. In other words higher the values on these variables higher was the profitability as perceived by the farmers. The correlation between the profitability and age of the farmer, milk produced by desi buffalo with the farmer and cropping intensity were however, not significant indicating that these variables have no influence on the perceived profitability.

The variables that were found to have positive and significant relationship with profitability were indicative of the farmers' progressiveness. For example, more the family education more progressive the farmer would be. Similarly, more the milk production, better the accessibility to animal husbandry technologies and more the use of these technologies, more progressive will be the farmer. Consequently, more progressive the farmer is more profitable he will perceive for all animal husbandry technologies.

4.7 AN OPINION OF FARMER'S FOR SUSTAINABLE LIVESTOCK PRODUCTION.

Table 4.42 : Some suggestion for sustainable livestock production

Sl. No.	Farmer's opinion for sustainable livestock production	No. of farmer's opinion	Rank
1.	Technologies should be simple in use	168	I
2.	Technologies should be cheap, so that we farmers are able to procure easily.	164	II
3.	Market facilities should be available for livestock and livestock production.	161	III
4.	Our Traditional Farming Systems and Indigenous Technical Knowledge (ITK) were more sustainable and should be encouraged.	159	IV
5.	Before dissimination of technologies participation of the end users (farmers) should be included in technology development.	157	V
6.	Technology dissimination service should reach to all the farmers and biasness of extension system towards well off and progressive farmers must be avoided.	151	VI
7.	"Technology Dessimination Camps" should be arranged once a month at a Public place	149	VII
8.	Technologies should be dessiminated only after proper field testing and refinements.	109	VIII
9.	Technology should be free from side-effects.	98	IX

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SUMMARY AND CONCLUSION

Sustainability is defined as using the natural resources meeting the present needs without jeopardizing the future potential, increasing per capita productivity without causing degradation of soil and water resources and enhancing profitability without reducing total production and reducing excessive dependence on off farm. Thus, the holistic view of sustainability is an approach which is ecologically sound, economically profitable and socially equitable. Theoretically this is an ideal concept and of very recent origin. But the real danger to sustainability is from the compelling needs of increasing population for food, fuel, fodder on one hand and limited natural resources base of land and water on the other.

The panel on food security, agriculture, forestry and environment of the World Commission on Environment and Development (WCED) in 1986 was very much concerned with the problem of sustainability and suggested a 7-point plan for safe guarding the human race hunger on a ecologically sustainable basis. The components of 7 point action plan are :

1. Development of international code for sustainable and equitable use of life support system.
2. Include sustainable livelihood for all in the UN declaration of human rights.
3. Initiate a new agricultural system for nutrition security.
4. Ensure equal opportunity for access to technology.
5. Organic skills for sustainable livelihood security.
6. Reorient international action and assistance, so that it is to be consistent with integrated national conservation and sustainable livelihood strategies.
7. Promote political commitment and accountability.

The meaning of sustainable agricultural technologies is not only restricted to terms such as organic, regenerative, ecological, alternative or low input but also refers to the capacity of the system to sustain the production level at a desired level. Thus, the criteria of sustainability have to be seen in terms of capacity to produce adequate food, be environmentally safe, protect the resource base as well as profitable. The sustainable agriculture should be economically viable system which minimises the use of external inputs such as pesticide, fertilizer and heavily relies on or off farm renewable resources.

Animal husbandry is an important component of agricultural science in India. It provides milk, meat, wool, skin and work as a flexible reserve throughout the year even during crop failure. It also plays a

critical role in the agricultural intensification process by providing draft power and manure for crop production. With increasing human population and economic change, the cultivated area has been expanded on to marginal land and fallow period is being shortened. As a result, large areas of land have been degraded and crop and animal yields have fallen. Improved crop-livestock production system and technologies are currently being developed in response to growing demand for food and degradation of natural resource base. A lot of work has been done and is being done on the aspect of sustainable agriculture specially on the crop production aspects and soil health aspects, but nothing is heard of sustainability in animal husbandry or livestock development.

Keeping the above points in view the present study was designed to find out the sustainability and profitability of selected animal husbandry technologies.

OBJECTIVES :

1. Identification of animal husbandry technologies being recommended and introduced in specific area.
2. To study the prevailing situation where these technologies are being recommended.
3. To study the perceived profitability of recommended animal husbandry technologies.
4. To study the perceived sustainability of selected animal husbandry technologies.

METHODOLOGY

The study was confined to the animal husbandry technology users of a cluster of six villages of Bareilly district of U.P. From each selected village, a maximum of 40 and minimum of 10 respondents viz. 40 from Mudia Ahmed Nagar, 30 from Mohanpur, 39 from Kalapur, 26 from Indra Nagar, 26 from Aspura and 34 from Khata villages, were selected purposively from among those who are using the selected animal husbandry technologies since last five years. In addition to the users, 50 scientists were also selected purposively as respondents to obtain their perception.

Data were collected through personal interview schedule on 18 independent and two dependent variables viz. profitability and sustainability of animal husbandry technologies. All the variables were measured using available scale and indices towards sustainability. Data were collected during January to April, 1999. Interviews were conducted personally.

Prior to data collection through personal interview on structured schedule, the information on prevailing animal husbandry technologies and the situations where they are being used was collected through group meetings and PRA techniques.

Data generated through personal interviews as well as through PRA and group meetings were analysed by different statistical methods, viz., frequency, percentage, analysis of variance (ANOVA), student 't' test and correlation (r). The findings of the study are summarized as follows :

MAJOR FINDINGS OF THE STUDY

Existing Situation of Selected A.H. Technologies

1. The major animal husbandry technologies being used in the area are - Artificial insemination, Vaccination against H.S, FMD and RP, Cultivation and use of green fodder production and Use of antiparasitic drugs : Deworming and tick control.
2. Result of the study indicate that majority (75.80%) of AI users had low conception rate of AI in their animals i.e. only 12-15%. The possible reasons might be (i) use of infertile/ spoiled semen, (ii) lack of freezing facilities of semen at the AI centre, (iii) lack of skilled trained personnel like VOs and stockmen, (iv) poor heat detection by farmers and untimely insemination, (v) imbalanced feeding of animals or under fed malnutrition, (vi) animal health centres located far way places and farmers face problems in taking their animals again and again, and (vii) farmers belief that AI produces more male calf than female and accordingly, they do not take interest to go for AI.
3. Present status of vaccination showed that majority (65-70%) of the animals are vaccinated in the village. Vaccination is done mostly in the month of June - July every year. Villagers are not aware about the various diseases for which vaccination is being done. They are aware of only HS vaccination. Mass vaccination against HS is done as a campaign by development officials jointly. Pregnant animals are not vaccinated and calves are given half dose of vaccine.
4. Majority of the people/villagers consult Vety. Doctor on serious condition of animal. About 10% of the livestock owners

use indigenous, remedies to treat their animal. Unproductive animals and those which are incurable are left untreated.

5. Only 20-30% of livestock owners use deworming in their animals on the advice of Vety. Doctor. Normally, Albendazole, Piperazine, Penacure etc. are used in deworming. Butter milk and Hirankhuri are also used as indigenous medicines by some villagers. About 15% farmers used DDT and BHC for the control of ticks. Only a few innovative farmers use Butox in consultation with Vety. Doctor.
6. Majority (95.0%) of the farmers grow green fodder round the year. Only 8-10% farmers grow leguminous mixed fodder crops like Bajra + Cow pea, Bajra + Guar, etc. Due to lack of pasture, only 5-10% farmers are able to take their animals for grazing at the corners of rivers, water tank and bunds of fields. The entire sowing of fodder crops is done by broadcast method.

Profile of the Respondents

7. Majority (57.5%) of animal husbandry technology users belonged to middle age group ranging from 31-50 years of age.
8. Majority (46.0%) of respondents/animal husbandry technology users belonged to other backward castes (OBC).
9. Most of the animal husbandry technology users had agriculture as their main occupation and livestock rearing as subsidiary family occupation.

10. Majority of farmer respondents (63.0%) had less than 5 workers in their families involved in animal husbandry operations.
11. Majority (64.0%) of the respondents were illiterates with low family education status (FES).
12. Majority (45.0%) of animal husbandry technology users (45.0%) were found to possess one hac. of land and belonged to marginal farmer category.
13. Majority of the technology users (55.5%) had less than 4 bigha (0.25 hec.) of land under fodder cultivation.
14. Majority of the technology users (91.50%) had high cropping intensity i.e. >250. The average cropping intensity was as high as 287.46.
15. Majority of animal husbandry technology users (51.5%) had small herd size i.e. <3 heads of animals (cattle equivalent).
16. The average milk production in a lactation of desi cattle was found to be 4-5 liters/day among majority (58.4%) of the animal husbandry technology users.
17. The milk production of the crossbred cattle was found to be more than 8 litres/day among majority (57.4%) of the respondents.
18. The average milk production in a lactation of desi buffalo was found to be 4-5 litres/day among majority (87.4%) of the respondents.

19. The average milk production in a lactation of the improved buffalo was found to be 5-6 litres/ day among majority (56.3%) of the respondents.
20. More than half of the selected animal husbandry technologies were accessible to the respondents only to some extent or to a little extent. No technology was fully accessible to all the respondents.
21. More than 25% of the respondents reported low accessibility of animal husbandry technologies to them.
22. Most of the technology users reported that animal husbandry technologies are not used by them all the time. 43.62 percent felt that these are used to some extent while another 26.50 percent felt that these are used only occasionally.
23. Cultivation of green fodder is fully used technology as reported by majority of the farmer respondents.
24. More than 6.0% of the respondents reported low use of animal husbandry technologies by them.
25. All the input required for green fodder cultivation viz. seed, fertilizer, irrigation water and money were easily and conveniently procurable as reported by majority of the respondents.
26. The inputs required for the use of anti-parasitic drugs, viz., deworming, insecticide, vety. doctor, sprayer duster and money were partly or only some times available as reported by majority of the respondents.

27. More than 14.00 percent of the respondents reported low accessibility to procure additional inputs for anti-parasitic drugs.
28. The inputs required for the use of artificial insemination technique viz. proper semen, vety. doctor, vaccine, concentrate food and money were partly or only some time available, except vety. medicines and green fodder which were easily and conveniently available as reported by majority of the respondents.
29. More than 12.5 percent respondents reported low procurement/availability of additional inputs for A.I. technique.
30. The inputs required for the use of vaccination technology against HS, FMD, RP viz., Vety. Doctor/vaccinator and money were partly or only some time available/procurable except vaccine which was easily and conveniently available as reported by majority of technologies users.
31. Comparison between the perception of farmers and scientists regarding the profitability of the selected animal husbandry technologies indicated that the perceived scores of profitability for all the seven technologies were higher in case of scientists than the farmers.
32. A.I. was perceived less sustainable by the majority of the technology users, while fodder cultivation, deworming and tick control were perceived highly sustainable.

33. The scientists perceived all the selected A.H. technologies to be highly sustainable.
34. Comparison between the perception of farmers and scientists regarding the sustainability of the selected animal husbandry technologies shows that the perceived scores of sustainability for all the seven technologies were higher among the scientists than the farmers.
35. Perception scores of scientists on sustainability of different animal husbandry technologies on different dimensions were significantly ($P < 0.01$) higher than those of farmers.
36. Differences in the perception of scientists and farmers, regarding A.I. technology were highest more in case of technical appropriability and viability and lowest in case of temporal stability and equity.
37. Differences in mean value of perception score of scientists and farmers regarding H.S. technology were highest in case of technical appropriability and environmental soundness and lowest in case of temporal stability and equity.
38. Difference in perception score of scientists and farmers on various dimensions of sustainability for FMD technology were higher among ES and TA and lower in case of equity and TS.
39. Difference in the mean value of perception score of scientists and farmers regarding RP technology were more in case of TA & ES and lower among TS and local adaptability dimensions of sustainability.

40. Difference in the mean value of perception score of scientists and farmers regarding cultivation of green fodder technology were more in case of ES & TA and lower in case of local adoptability and TS dimensions sustainability.
41. Difference in the perception of scientists and farmers on various dimensions of selected deworming technology were higher on ES and TA and lower in case of CD and RUE dimensions of sustainability.
42. Difference in the mean values of the perception of scientists and farmers regarding sustainability of tick control technology were more in case of ES and TA and lower on CD and equity dimensions of sustainability.
43. ANOVA showing the effect of land holding groups on profitability and sustainability of different technologies clearly indicated that the respondents from large land holding category perceived all the technologies to be more profitable and sustainable as compared to respondents from marginal and small land holding groups.
44. ANOVA showing the effect of caste groups on profitability and sustainability of different technologies clearly indicated that the respondents from SC/ST category perceived all the technologies to be more profitable and sustainable as compared to respondents from general and OBC caste category/groups.

Impact of independent variables on the dependent variables

45. The independent variables viz. area under fodder, herd size, milk produced by improved buffalo, accessibility to AI, vaccination against HS, FMD and RP, green fodder cultivation, and anti-parasitic drugs and use of AI and vaccines were positively and highly significantly correlated with the sustainability of all seven technologies.
46. No relationship were found between the independent variables viz., age, family worker involved in A.H. practices, family education status milk produced by desi buffalo and the sustainability of the selected A.H. technologies.
47. Variables like cropping intensity and milk produced by desi and crossbred cattle had negative and significant correlation with the sustainability of all the seven technology.
48. The independent variables like family workers involved in animal husbandry, family education status, area under fodder, herd size, milk produced by cross bred cattle, accessibility to AI, vaccination green fodder cultivation and anti parasitic drugs and use of AI, vaccine, green fodder and parasitic drugs were significantly correlated with the profitability of all seven technologies.
49. Variables like cropping intensity, milk produced by desi cattle, desi buffalo and improved buffalo had negative and highly significant correlation with the profitability of all the selected seven technologies.

CONCLUSION

Results of the study indicated that farming was the main occupation and livestock farming was subsidiary occupation of all the respondents. Majority of respondents belonged to OBC caste category, with low family education status, small herd size and marginal land holding. Most of the respondents had less than 3 bigha area under green fodder cultivation. On the other hand, majority of the farmers had high cropping intensity percentage.

Among the seven selected animal husbandry technologies, AI was reported to have least success in the area. Not more than 12-15% conception was reported by the farmers. All the other six technologies were reported to be quite successful and profitable by the farmers. The non-availability of veterinary doctor was one of the major constraint in using vaccination and parasitic control technologies.

Most of the selected animal husbandry technologies were not accessible to the respondents to the desired extent. No technology was fully accessible to all the respondents. Most of the farmers reported that animal husbandry technology were not used by them all the time. Cultivation of green fodder was however, fully used technology as reported by majority of the farmers.

All the input requirement for green fodder cultivation viz. seed, fertilizer, irrigation water and money were easily and conveniently procurable as reported by majority of the respondents. For artificial

insemination proper semen was not able to be procured by the farmers. Similarly, Vety. Doctor, sprayer and money were only partly and some time available to them as reported by majority of respondents.

With regards to the profitability of the selected animal husbandry technologies, it was found that A.I. was less profitable as perceived by majority of the respondents. Vaccination against HS and FMD, green fodder cultivation, deworming and tick control were reported to be highly profitable by majority of the respondents. On the other hand most of the scientists perceived all the selected animal husbandry technologies to be highly profitable.

Perceived profitability and sustainability for all the technologies were higher in case of scientists than farmers. With regards to sustainability, it was found that A.I. was less sustainable according to majority of the respondents while fodder cultivation, deworming and tick control were highly sustainable as reported by farmers. As far as the perceived sustainability it was found that scientists perceived all the selected animal husbandry technologies to be highly sustainable.

The study has indicated that the respondents from SC/ST and large land holding category perceived all the technology to be more profitable and sustainable as compared to respondents from marginal and small land holding groups.

Further, the farmers perception of sustainability and profitability increases with the improvement in their socio-economic conditions as indicated by the significant correlation with the family education, area under fodder, herd size, milk productivity and accessibility to technologies.

IMPLICATIONS

In recent years, sustainability has been the focal point of discussion among agriculturist and extensionist in particular. The negative side effects of conventional approaches to development have generated a need for searching ways and means for achieving the qualitative and quantitative lucrative goal of sustainability. As found in the study, the farmers perception of sustainability, in comparison to scientists, is very low over various dimensions. This alarming gap/ difference appears to be an impediment for adoption of animal husbandry technologies. The appropriate interventions are required to be made so that the differences in the perceptions on profitability and sustainability as observed between the scientists and farmers are minimised. This study has identified various dimensions for selected animal husbandry technologies on which the farmers and scientist differed in their perception on profitability and sustainability.

As such it gives an indication that suitable interventions are required so that the perception of the farmers is improved with regard to the animal husbandry technologies. Once perception is improved the likelihood of the technology adoption can be improved which is very

much needed towards improving the productivity and production of livestock.

The study, on the other hand, draws the attention of the scientists to verify the technologies further in respect of their sustainability and profitability under farmers' situations. On-farm research and on-farm trials are therefore, suggested where the perceived sustainability and profitability for farmers are low.

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MINI ABSTRACT

Sustainability has been popularly defined as using the natural resources for meeting the present needs without jeopardizing the future potential. It refers to the capacity of the system to sustain the production level at a desired level. The production and productivity of our livestock in rural areas is fast improving with the use of newly generated technology, but still it is far below the potentiality. Efforts are being made for rapid transfer of the viable technologies for enhancing production and productivity. It is at this juncture essential to evaluate these technologies from their sustainability and profitability point of view. The study aimed at measuring the profitability and sustainability of selected animal husbandry technologies being adopted in the villages. These included AI, vaccination against HS, FMD and RP, cultivation and use of green fodder, control of parasitic problems through deworming and tick control.

The study was conducted on sample of 200 livestock owners from a cluster of six villages, viz., Mudia Ahmednagar, Mohanpur, Kalapur, Indranagar, Aspura and Khata from those who were using the animal husbandry technologies since last five years at least. The study on profitability and sustainability was based on the perceptions of the livestock owners. Simultaneously, the perception of 50 scientists were also taken for comparison.

The selected livestock owners were using the selected seven animal husbandry technologies but not regularly and not on all animals. A.I. technology is being used uninterestingly by the livestock owners. Their main complaints are that the desired semen of good quality is not available and the conception rate is only 12-15%. Vaccination, deworming and tick control technologies, though profitable and available were not being adopted fully due to lack of availability of Veterinary Doctor. Only the cultivation and use of green fodder technology was considered as profitable and fully sustainable and hence was being used by all.

Though the scientists perceived all the seven technologies as highly profitable and sustainable, the farmers perception was significantly low, more specially for AI technology. The livestock owners, however, perceived the green fodder cultivation technology as highly profitable and sustainable. The progressive and resource-rich farmers perceived these technologies more profitable and sustainable as compared to resource-poor and backward farmers. Similarly, those who were regularly using these technology and having better productivity of animals perceived these technologies more profitable and sustainable.

लघु सारांश

पशुपालन तकनीकों की सम्पत्तिशीलता

किसी नई तकनीक को अपनाना तथा उसे जारी रखना मुख्यतः दो बातों पर निर्भर करता है एक कि वह आर्थिक रूप से कितनी लाभदायक है, दूसरे कि उसके लगातार प्रयोग से पशुओं पर या वातावरण में कहीं कोई बुरा प्रभाव तो नहीं पड़ रहा। पशुपालन के विकास के लिए शोध संस्थानों से अनेकों तकनीकों का विकास हुआ है और उनके प्रयोग से पशु उत्पादन तीव्र गति से बढ़ा भी है। परन्तु इसी समय यह भी आवश्यक हो जाता है कि इन नई तकनीकों को लाभ एवं जारी रख सकने के पैमाने पर नापना आवश्यक हो जाता है। इसी बात को ध्यान में रखकर प्रस्तुत शोध कार्य किया गया जिससे कि कुछ मुख्य पशु पालन तकनीकों की लाभदायकता एवं जारी रख सकने की क्षमता नापी जा सके। शोध का आधार किसानों की सोच एवं उनके विचारों को रख गया। साथ ही किसानों की सोच की तुलना वैज्ञानिकों की सोच से की गयी।

प्रस्तुत शोध के लिए छः गांवों के एक समूह से उन 200 पशुपालकों को छांटा गया जो पिछले पांच वर्ष से छोटी गयी सात पशु पालन तकनीकों की अपना रहे थे। ये सात तकनीकें थी-कृत्रिम गर्भाधान, गलाघोंटू, खुरपका-मुंहपका पोंका बीमारियों के टीके, हरा चारा उत्पादन एवं पारजैविक रोगों के निवारण हेतु दवा पिलाकर तथा जूं व किलनी मारना। इन्हीं तकनीकों के विषय में उनसे पूछा गया कि वे इन्हें कितना लाभकारी तथा लगातार अपनाने योग्य समझते हैं। शोध से यह पाया गया कि पशुपालक कृत्रिम गर्भाधान तकनीक को कम लाभप्रद तथा लगातार प्रयोग में न आ पाने वाली तकनीक समझते हैं। जब कि अन्य तकनीकों को लाभप्रद व लगातार उपयोगी रहने वाली तकनीक समझते हैं। किसानों की नज़र में हरा चारा उत्पादन तकनीक सबसे अधिक लाभप्रद तथा लगातार प्रयोग में लाई जाने वाली बतायी गयी। दूसरी तरफ तुलना के लिए जब 50 वैज्ञानिकों की राय ली गयी तो उन्होंने सभी सातों तकनीकें को अति लाभकारी एवं सदैव प्रयोग में आने वाली बताया।

REFERENCES

- Abington, J.B. (1992). Sustainable livestock production in the mountain agro-ecosystem of Nepal, FAO Animal Production and Health Paper, Lumle Agricultural Research Centre, Kathmandu, Nepal.
- Ahmed, M. (1997). Fish for the poor under a rising global demand and changing fishery regime, Naga (Philippines). ICLARM Quarterly. International Center for Living Aquatic Resources Management Policy Research and Impact Assessment Programme, Makati City, Manila (Philippines). pp. 73-76.
- Ali, A.B.M. (1994). Sustainable Agriculture Development in Asia (India). Report of an APO study meeting, 23rd February-5th March, 1993. Tokyo, Japan. (1) pp. 243-271.
- Alo, A.M.P. (1997). Impact of participatory communication the sustainability of the small ruminant/coconut systems project. Laguna College (Philippines). Oct., 215 Leaves.
- Anon. (1987). Food 2000 : Global policies for sustainable agriculture. 1987 Zed Book Ltd. London and New Jersey.
- Anon. (1988). Natural resources and sustainability in the developing countries : Meeting the challenge with international research. Report of a meeting held at the Hubert, H. Humphrey Institute of Public Affairs, March 28-30, 1988.

- Arya, H.P.S., Kaul, P.N., Tiwari, Rupasi. (2000). Animal husbandry and Veterinary Extension Education. Compendium, Division of Extension Education IVRI, Izatnagar, Bareilly.
- Bagchi, D.S., Sasmal, T.K. (1995). Resource utilization and constraints in South Bihar Plateau : Need for microlevel planning approach for sustainable agriculture. Agricultural Science Unit, Indian Statistical Institute 203, Bt. Road, Calcutta, India, pp. 468-473.
- Banerjee, B.N.; Mukharjee, A.K. and Hossan, M. (1995). Sustainable agriculture : Methodological issues. Department of Agricultural Economics, Bidhan Chandra Krishi Bishwavidyalaya, Mohanpur, Nadia, India, pp. 450-452.
- Bell, D.E., Clark, W.C., Ruttan, V.W. (1994). Global research system for sustainable development : University of Minnesota Press, Minnesota, USA. pp. 358-379.
- Benchaphun Shinawatra, Phatthanan Wuttikan, Chalerm Sukopong, (1990). Assessment of impact of farming system research. Department of Agricultural Extension. Proceeding of the 7th Thailand National Farming Systems Seminar. Chiang Mai University, Bangkok (Thailand). pp. 49-60.
- Bezuneh, M., Ames, G.C.W., Mabbs-Zeno, C.C. (1995). Sustainable agricultural development using a farming system approach in Zambia Ecological Economics (Amsterdam). Department of Economics, Clark Atlanta university, Atlanta, GA, USA. pp. 149-156.
- Bhardwaj, C., Tara Satyavati, Brhamanand, P.S. and Verma, K., Mahender (1999). Agricultural sustainability in the 21st century, Employment News, 13-19 Nov. 1999 Vol. XXIV No. 33. New Delhi.

- Bishnoi, K.C.; Sardana, P.K. (1994). Factors affecting agricultural sustainability in India. C.C.S. Haryana Agricultural University, Hissar, Haryana (India) pp. 34.
- Brenge, U.T. (1999). Breeding for sustainable Production system. Nordisk Jordrugs-forskning. Department of Animal Science, Agricultural University of Norway.
- Campbell, A. (1994). Landrace in Australia : Spawning new model of inquiry and learning for sustainability. Centre de Research de Toulouse, BP27, Castanet - Tolosan France. pp. 366-370.
- Chakraborti, S. (1995). On measuring sustainability in agriculture : An exploration. Department of Agricultural Extension, Agricultural Economics and Agricultural Statistics, Palli. Siksha Bhavan (Institute of Agriculture), Visva Bharati, Sriniketan, India. pp. 453-458.
- Chambers, Robert. (1988). Sustainable rural livelihood : A key strategy for people, environmental. In Czech Conroy and Miles Litvinoff. The Greening of Aid. Earthscan Publication. London, England.
- Chantalakhana, C. (1994). Sustainable agriculture and the implications on animal production in developing countries. Proceedings of the 7th AAP Animal Science Congress, Bali, Indonesia, 11-16 July, 1994. Vol. I: Plenary papers. Jakarta Selatan, Indonesia; Inkatan Sarjana Ilmuilnu Peternakan Indonesia. Kasetsart University, Bangkok, Thailand.
- Charoenwatana. Terd and A. Terry Rambo. (1988). Sustainable rural development in Asia. Selected papers from the Fourth SUAN Regional Symposium on Agroecosystem Research. Farming System Research Project and Southeast Asian University Agroecosystems Network, Khon Kaen, Thailand.

- Chinnery, L.E. (1991). Ecofarming, agroforestry and sustainable agriculture. Centre for Resource Management and Environment Studies (CERMES). Report on the CIDA/UWI Institutional Strengthening Project Funded Workshop on Sustainable Development. West Indies Univ., Cave Hill (Barbads). pp. 2(24-42).
- Coen Reijntjes, Bertus Haver Kort and Ann Waters - Bayer, (1995). Farming for the future, ILEIA, P.O. Box. 64. NL - 3830 AB, Leusden, Netherlands.
- Consultative Group on International Agricultural Research (CGIAR) (1995). Renewal of the CGIAR : Sustainable agriculture for food security in developing countries, Ministerial level meeting, Lucerne, Switzerland, Feb 9-10, 1995 : Background documents on major issues. Washington, D.C. USA.
- Conway, G.R. (1985). Agro ecosystem analysis. Agricultural administrative 20, pp. 31-55.
- Conway, G.R. (1987). The properties of agroecosystem. Agricultural System, 24. pp. 95-117.
- Dahlberg, K.A. (1999). Prompting sustainable local food systems in the United States. International Development Research Centre. Ottawa, Canada. pp. 41-45.
- Devendra, C. (1994). Resources management for increasing animal productivity and enhancing the environment. Proceeding of the 7th AAAP Animal Science, Congress, Bali, Indonesia, 11-16 July, 1994. Volume I; International Development Research Centre, Tanglin, Singapore, pp. 57-74.
- Deybe, D., Gerard, F., Ouedraogo, S. (1994). Impact of agricultural policies on sustainable development in a village in Burkina Faso. Department of Agricultural Economics, Washington State University, Pullman, WA, USA. pp. 883-887.

- Dolberg, F., Petersen, P.H. (1995). Agricultural Science for biodiversity and sustainability in developing countries proceeding of a workshop, April 3-7, 1995, Tune landboskole, Denmark, University of Aarhus, DK 8000 Arthus C., Denmark, pp. 248.
- Dormaar, J.F., Willms, W.D. (1998). Effect of forty four years of grazing on fescue grasland soils. *Journal of Range Management (USA)*. V. 51(1). pp. 122-128.
- Douglas, G.K. (1984). The meaning of agricultural sustainability in : Agricultural sustainability in a changing world order. Westview Press, Boulder. Colo. USA.
- Ehui, S. and Jabbar, M.A. (1995). Measuring the sustainability of crop-livestock system in subsaharan Africa : Method and data requirement. Volume II : Technical Papers. Proceeding of a conference. Addis Ababa (Ethiopia). ILCA. pp. 453-460.
- Entsua-Mensah, C. (1995). Linking research and extension service for sustainable food production in Ghana : Some optins for achievements quarterly bullatin of IAALD. Energy Information Centre, Ministry of Energy and Mines, PMB Ministries Post Office, Accra, Ghana, pp. 121-125.
- Esterik, P. Van. (1999). Gender and sustainable food system : A feminist Critique. International Development Research Centre, Ottawa, Canada. pp. 157-161.
- Extension Digest. (1996). Sustainable Agriculture Vol.4, No.2. MANAG, Hyderabad.
- FAO. (1989). Sustainable agricultural production implications for international agricultural research. Prepared by the Technical Advisory Conumittee to the consultative group on International Agricultural Research. Food and Agricultural Organization of the United Nation, Rome.

- Fliert, E. Van De (1993). Integrated pest management. Farmer field schools generate sustainable practices. Wageningen Agricultural University Paper No. 93-3, XV+304, Wageningen Agricultural University, Wageningen, Netherlands.
- Fungoh, P.O., Mbadi, G.C.O. (1997). Focus on agricultural research for sustainability development in a changing economic environment. Kenya Agricultural research Institute, Nairobi, Kenya. P. 834.
- Garcia, Gary Wayne (1996). Livestock production in the caribbean : Some issue on sustainability. St. Augustine (Trinidad and Tobago). Faculty of Agriculture UWI. pp. 11.
- Goetz, R.U. (1995). Diversification and sustainable agricultural production the case of soil erosion. USA Working paper Department Agricultural and Resources Economics Division of Agricultural and Natural Resources, University of California, USA. pp. 28.
- Green, J., Thrupp, L.A. (1998). Gender, sustainable development, and improved resources management in Africa. World Resources Institute, Washington, D.C. USA. pp. 269-300.
- Hutson, J.L., Pitt, R.E., Koelsch, R.K., Housen, J.B., Wagenet, R.J. (1998). Improving dairy farm sustainability : Environmental losses and nutrient flows. Flinders University of South Australia, Adelaide, South Australia. Journal of Production Agriculture (USA). VII (2) pp. 233-239.
- Irvin, A.D. (1996). Future approaches to the control of ticks and ticks borne disease in Africa and the role of the food and agriculture organization/Multi-Donor Regional Programme. Food and Agriculture Organization, P.O. Box 3730, Harare, Zimbabwe. pp. 7-14.

- Irvin, A.D. (1996). Future approached to the control of ticks and ticks borne disease in Africa and the role of the food and agriculture organization/ multi - donor regional programme. Proceedings of a workshop. Nairobi (Kenya). ILRI. Food and Agriculture Organization, Harare, Zimbabwe. pp. 7-14.
- Irvin, T. (1998). ILRI's Animal Health Improvement Programme (AHIP) Devendra, C., Smalley, M., Li-Pun, H. (eds.). Proceeding of conference on development of livestock research priorities in Asia. Nairobi, Kenya. pp. 34-35.
- Jasiorowski, H. (1996). Sustainability of the polish beef cattle development programme. Zeszyty Naukowe Akademii Rolniczej-we-Wroclawiv. Konfevecoje (Poland). pp. 11-20.
- Kangara, J.N., Sutherland, A.J., Gethi, M. (1997). Proceeding of the conference on participatory dryland Agricultural research, East of Mount Kenya. KARI regional reserach centre, Embu (Kenya). Dryland applied research and extension project, Embu, Kenya.
- Kar, A. and Mukhopadhyay, S.B. (1995). Economic and technology transfer perspective for sustainable agriculture. Proc. national symposium on sustainable agriculture in sub-humid zone, March 3-5, 1995. Palli-Siksha Bhavan, Institute of Agriculture, Visva Bharati, Sriniketan, West Bengal, India, pp. 492-494.
- Klausner, S.D., Fox, D.G., Rasinussen, C.N., Pitt, R.E., Tylutki, T.P., Wright, P.E., Chase, L.F. and Stone, W.C. (1998). Improving dairy farm sustainabilty : An approach to animal and crop nutrient management planning. Journal of Production Agricultural (USA). Cornell University, Ithaca, New Yark. V. 11(2). pp. 225-233.
- Korte, C.J. (1990). Sustainable agriculture : Issues in high rainfall zone farming. Report on a Workshop on Sustainable Agriculture held at the Regency Hotel House, Glock House, Wellington (New Zealand). pp. 67-78.

- Lassalie, T., Matee, A.Z. (1995). Towards sustainable rural development using the participatory approach the case of mgeta farmers, morogoro rural district. Deptt of Agricultural Education & Extension, Sokoine. University of Agricultural, Morogoro, Tazania pp. 170-191.
- Lawrance, R.P.F. Hendrix and E.P.Odum. (1987). A hierarchical approach to sustainable agriculture. American journal of Alternative Agriculture. 1(4) pp. 169-173.
- Lawrence, A., Garforth, C., Dagoy, S.C., Go, A., Hossain, A., Kashem, M.A., Krishna, K.S., Naika, V. and Vasantha Kumar, T. (1996). Agricultural extension, the environment and sustainability; research in Bangladesh India and Philippines. ODI Agricultural and extension News letter 33 pp. 15-22.
- Lipun, H. (1998) Sustainable production system programme : Current activities and future opportunities. Devendra, C., Smalley, M., Li-Pun, H. (eds.). Proceedings of a conferences on development of livestock research priorities in Asia. Nairobi, Kenya. pp. 36-38.
- Liu, Q. (1993). The economic integration of agricultural animal husbandry and industry in Dongshuantan. Rural economy and society. Nankai University, Tianjin, Chian. No. 6, pp. 44-49.
- Lu Yao, (1999). Evaluation of the sustainability of China's food supply. Chinese Rural Economy, Jianguomen Nei. Ave. Beijing, China. pp. 25-30.
- Mackay, K.T. (1987). Sustainable Agricultural System Issues for Farming Systems Research. Crop Production System and Environment and Research Management. Agriculture food and Nutrition Science, International Development Research Centre, Singapore.

- Macleod, N. (1992). Sustainable grazing practices in Queensland (beef cattle). Commonwealth Scientific and Industrial Research Organisation, St. Lucia (Australia). Vol. 3 (6) pp. 6-9.
- Madden, P. (1987). Can sustainable agriculture be profitable? *Environment* (4) : 18-20, 28-34.
- Martinez Alvarado, Cesar Oscar, Cuevas Reyes, Venancio (1997). Evaluation of sustainability of the agrosilvopastoral system in South Sinaloa. 1995-96. National meeting on livestock Research Veraoruz. Ver. 3-8 Nov. 1997 (Proceeding) Mexico pp. 207.
- McCalla, Alex F. (1989). Sustainable agricultural production implications for international agricultural meeting. FAO Research and Technology. Prepared by TAC to the Consultation Group on International Agricultural Research. FAO of the United Nations Rome.
- Negatu, W., Mawangi, W. (1994). An economic analysis of the response of durum wheat production in the central highlands of Ethiopia International maize and wheat improvement centre (CIMMYT). Debre Zeit Agricultural Research and Alemaya university of Agriculture, Ethiopia.
- Nicolas, Jequir, (1976). Appropriate technology : Problems and promises. Development centre of the organization for economic co-operation and developement, Paris.
- Parmiter, T.G.; Wedderburn, M.E., and Spukerbosch, P.J. (1996). The importance of a participatory approach to resolving issues of sustainable agriculture. Proceeding of the New Zealand Grass Association. Whatawhata Research Centre, Hamilton, New Zealand. pp. 15-19.

- Permsak Makarabhirom (1993). Agroforestry system and land use sustainability. National Forest land Management. Royal Forest Dept. Bangkok (Thailand) pp. 223-250.
- Phillips, A.O., Titola, S.O. (1995) Sustainable development and indigeneous knowledge systems in Nigeria : The role of the Nigerian Institute of Social and Economic Research (NISER). London, U.K. pp. 475-478.
- Power, E.M. (1999). Combining social justice and sustainability for food security. International Development Research Centre, Ottawa, Canada. pp. 30-37.
- Pozy, P. (1995). Technology innovation for small farming system in Burundi highlands. Tropicultura (Belgium). ISABU, Bujumbura. V : 13 (1) pp. 34-38.
- Pretty, Jules N. (1995). Regenerating Agriculture. Earthscan Publication Ltd., London.
- Putt, H.(1999). Present and future profitability of the Northland dairy farm. Proceeding of 51st meeting of dairy farmers, Massey University , New Zealand. pp. 245-222.
- Quintal, O., Gandhinathi. (1993). Networking among resource poor farmers in South India. Intermediate Technology Publication Ltd., Hudumban 7, Ezhil Nagar, Keeranur 622502, Pudukkottai Dt. India. pp. 177-183.
- Ragumamu, W. (1995). Impact of small holder and use practice on sustainable and productivity in semi arid Tanzania. Southern African Development Community Environment and land management sector coordination unit No. 37, University of Dares Sallaam, Dar es Salaam, Tanzania. pp. 59-68.

- Rahman, M.Z. (1999). Agricultural development and sustainability : An inevitable nexus. Journal of the Faculty of Applied Biological science. Hiroshima University, Japan. pp. 1-23.
- Risse, L.M. (1998). Opportunities and impediments for establishing pollution prevention programmes for crop production. Applied Engineering in Agriculture (USA). V. 14(1) : pp. 37-43.
- Roberts, W.S., Swinton, S.M. and Hanson, J.C. (1995). The profitability of sustainable agriculture on a representative grain farm in the mid-Atlantic region, 1981-89 : Comment, Reply. Agricultural and Resources Economics Review. Department of Agricultural Economics, Michigan State university, Michigan, USA. pp. 136-137.
- Sah, A.K. (1998). Environmental protection and sustainable agriculture. Employment News Paper, 29 August to 4 September, 1998. Vol. XXIII No. 22 New Delhi.
- Sayer, J.A., Vanclay, J.K., Byron, N. (1997). Technologies for sustainable forest management : challenges for 21st Century. CIFOR - Occasional Paper (Indonesia). pp. 11.
- Sayre, K.D. (1998). Ensuring the use of sustainable crop management strategies by small wheat farmers in the 21st century. Mexico, DF (Mexico). CIMMYT. pp. 40.
- Senthilvel, T. (1998). Farming system approach for sustainable yield and income under rain fed vertisols. Madras Agricultural Journal. Agricultural College and Research Institute, Tamilnadu Agricultural University, Madurai, India. pp. 65-67.
- Shadbolt, N.M., Morriss, S.D., Kelly, T.C. (1997). Financial indicators of the sustainability of pastoral farms and their relationship when environmental sustainability. Department of Agribusiness and resource management, Massey University, Palmerston North, New Zealand. pp. 199-204.

- Shankariya Chamala. (1999). New approaches to research development and extension for sustainable agriculture and the environment implications for south Asia. *Agricultural Extension and Management*, University of Queens and Australia pp. 257-278.
- Singh, R.P. (1995). Sustainable dryland agriculture. In *sustainable development of dryland agriculture in India*, Jodhpur, India pp. 537-544.
- Singh, V.P., Singh, R.K., Chauhan, V.S. (1993). Developing integrated crop livestock fish farming system for rainfed uplands in eastern India. *Journal of the Asian Farming System Association*. International Rice Research Institute, Manila, Philippines. pp. 523-536.
- Stenholm, C. W., Waggoner, D.B. (1991). Developing future minded strategies for sustainable poultry productions. *Poultry Science (USA)*. V. 70(2). pp. 203-210.
- Stergard, V. and Hansen, J.P. (1995). Indicators a method to describe sustainability of livestock farming system. In *Agricultural Science for biodiversity and sustainability in developing countries*. Proceedings of a workshop, April 3-7, 1995. National Institute of Animal Science, P.O. Box 39, DK 8830 Tjje, Denmark. pp. 108-116.
- Stiles, D. (1995). Social aspects sustainable, dryland management. United Nations Environment Programme, P.O. box 30552, Nairobi, Kenya.
- Stock, T. (1995). Farmer field schools impact for integrated pest management in the Philippines : Implications for sustainable agriculture. *Journal of Extension system*. Agricultural Extension and Rural Development Department, University of Reading, UK. pp. 46-60.

- Swaminathan, M.S. (1990). Indian agriculture : Major challenges. International symposium on natural resources management for sustainable agricultural. Feb. 6-10, 90. Indian Society of Agronomy New Delhi. pp. 13-15.
- Swaminathan, M.S. (1991). Towards sustainable agriculture : Dimensions and components. Employment News, Nov. 18-24, 1995, New Delhi, Vol. XX no. 34 pp. 32.
- Swaminathan, M.S. (1992). Equitable development focus. Sustainable growth. The Hindu Survey of the environment, 1992.
- Swaminathan, M.S. (1994-95). Fifth Annual report, M.S. Swaminathan Research Foundation, III Cross Road, Taramani, Madras, Programme Area 400, pp. 65-83.
- Tisdell, C. (1999). Conditions for sustainable development : Weak and strong . In sustainable and environment globalisation and the impact of trade liberalisation, Cheltenham, UK. pp. 23-36.
- Vavia, M.A. (1996). Sustainability of animal production system : An ecological perspective. Journal of Animal Science (USA). Oregon state University. Burns. pp. 1418-1423.
- Webster, P. (1991). The challenge of sustainability at the farm level : Presidential address. Journal of Agricultural Economics, Wye College, University of London, UK. pp. 371-387.
- Webster, J.P.G. (1995). Analysing the economic consequences of sustainability in farming system. Integrated crop protection towards sustainability proceeding of a symposium, Edinburgh, Farm Bussiness unit, Wye College (University of London), Ashifor, Kent, UK. pp. 3-12.

○○○

Interview Schedule for Farmers

Dated

- | Items : | Adult | | | Child 12 yrs or below | | | G. Total |
|---------|-------|--------|-------|-----------------------|--------|-------|----------|
| | Male | Female | Total | Male | Female | Total | |

Total:

- Illiterate (0), Can Read Only (1), Can Read and Write (2), Primary (3), Middle (4), High School (5), Graduation (6)

12. Family Education Status (FES) :

Status	Score	No. of Family Members
Illiterate	0	_____
Can Read Only	1	_____
Can Read and Write Only	2	_____
Primary	3	_____
Middle	4	_____
High School/Intermediate	5	_____
Graduation	6	_____

13. Size of land holding :

- A. (i) No. of land : _____
- (ii) Up to 1 hectares (Marginal) : _____
- (iii) Up to 2 hectares (Small) : _____
- (iv) Above 2 hectares (Large) : _____

B. Area under Fodder Crop (in bigha)

- (i) In Kharif : _____
- (ii) In Rabi : _____
- (iii) In Summer/Zaid : _____

14. Cropping Intensity :

How many crops you grown on the farm during the year.

Crops Grown**Area Under Crops during Last Year**

Kharif : _____

Rabi : _____

Summer/Zaid : _____

15. Herd Size :

Sl.No.	Animals	Nos.	Breed
1.	Milch Animals under lactation		
	(a) Cow		
	(b) Buffalo		
2.	Dry Animals		
	(a) Cow		
	(b) Buffalo		
3.	Young Stock		
	(a) Cow		
	(i) Upto 2 Yrs	M	
		F	
	(ii) Above 2 yrs	M	
		F	
	(b) Buffalo		
	(i) Upto 2 yrs	M	
		F	
	(ii) Above 2 yrs	M	
		F	
4.	Draft Animals		
	(a) Bullock		
	(b) He-buffalo		
5.	Others : Goat ___ Sheep ___ Pig ___ Poultry ___ Horse ___		

16. Productivity of Milch Animals (in lits) :

Animal	No. of animals in milk	Total perday milk production at present	Perday average milk production at present	Total milk production per animal per lactation (300 days)	Average milk yield/day during lactation
A. Cows					
(i) Crossbred					
(ii) Desi					
B. Buffaloes					
(i) Improved					
(ii) Local					
C. Goat					

17. Enlist the animal science technologies which have been adopted since last five area/ village.

A.	Sl.No.	Technologies	Since when
----	--------	--------------	------------

B. Please mention the technologies adopted by you since last five years.

18. Since when you are using the following technologies :

Technology	Year
1. Artificial Insemination	
2. Vaccination	
3. Cultivation and use of green fodder	
4. Use of anti-Parasitic drugs.	

19. Accessibility to Technology :

Please tell to what extent the following technologies are accessible to your farm.

Name of the Technologies	Fully Accessible	To a greater extent	To some extent	To a little	Not at all
	4	3	2	1	0
1. Artificial Insemination					
2. Vaccination (HS/FMD/RP)					
3. Cultivation and use of green fodder.					
4. Use of anti-parasitic drugs : Deworming & Tick control.					

20. To what extent you are making use of the following technologies :

Name of the Technologies	Full scale	To some extent regular	Occasionally	Not at all
	3	2	1	0
1. Artificial Insemination				
2. Vaccination (HS/FMD/RP)				
3. Cultivation and use of green fodder.				
4. Use of anti-parasitic drugs : Deworming & Tick control.				

21. Enlist the additional inputs required to adopt the following technologies. Also please tell to what extent you are able to procure them.

Technology	Input	Ability to procure		
		Easily & conveniently	Parity/ some time only	Not able to procure
		2	1	0
1. Artificial Insemination	i. Proper Semen			
	ii. Vety. Doctor			
	iii. Vaccines			
	iv. Vety. Medicines			

- v. Green Fodder
- vi. Concentrate Feed
- vii. Money
- 2. Vaccination
 - i. Vaccine
 - ii. Vety. Doctor/
Vaccinator
 - iii. Money
- 3. Cultivation and use of
Nutritious protein rich
green fodder for feeding.
 - i. Green Fodder Seed
 - ii. Fertilizer for Fodder
 - iii. Irrigation Water
 - iv. Money
- 4. Use of anti-parasitic drugs
 - i. Dewormer
 - ii. Insecticide
 - iii. Vety. Doctor
 - iv. Sprayer/Duster
 - v. Money

22. To what extent the following technologies are profitable at your livestock?

Sl. No.	Technologies	Highly profitable	Profitable	Some what profitable	Least profitable	Not at all profitable
1.	Artificial Insemination					
2.	Vaccination against A. H.S. B. FMD C. R.P.					
3.	Cultivation and use of green fodder					
4.	Use of anti-parasitic drugs A. Deworming B. Tick control					

23. Kindly give your opinion on the extent of sustainability of the following technologies related to the mentioned dimensions (Please give scores 0 to 4 as per the following degrees of sustainability):

Degree of Sustainability : Highly Agree-4, Agree-3, Some What Agree-2, Least Agree-1 and Not at all Agree-0

Technological Dimensions	Technologies						
	AI	HS	FMD	RP	Cultivation and use of green fodder	Use of parasitic deworming	Anti drugs tick control

1. TECHNICAL APPROPRIABILITY

- Technology is simple to use.
- Technology is relevant and essential intervention.
- Technology is effective in solving the problems.
- Technology is need based.
- Technology is physically compatible to the farmers.
- Technology is culturally compatible to the farmers.

2. ECONOMIC FEASIBILITY

- Technology is workable at different farms.
- Technology is to provide higher production per unit cost.
- Technology will help to generate employment opportunities.
- Technology is value added.
- Technology will open more market avenues.

3. ECONOMIC VIABILITY

- Technology is economically viable and cost effective.
- Resource-poor can afford the technology.

Technological Dimensions	Technologies					
	AI	HS	FMD	RP	Cultivation and use of green fodder	Use of parasitic deworming

c. Technology will help to enhance present production and productivity.

d. Technology will help to generate more income.

4. ENVIRONMENTAL SOUNDNESS

a. Technology is eco-friendly

b. Technology may disturb (Plant-animal-man relationship) eco-system.

c. Technology may have hazardous effect on environment.

d. It may have residual effect and in long terms may create problems for animal and human life.

e. Consequences may lead to destroy existing resources.

5. TEMPORAL STABILITY

a. Technology consistently performing well on the farm.

b. Technology does not get affected by any extragenous factors.

c. There is no effect on its result over the long run.

d. Continue to be a source of additional income and livelihood without being affected by any other factor.

6. LOCAL ADAPTABILITY

a. The technology is adaptable to the farmers socio-economic conditions.

b. The technology is adaptable to the resource base of the farmers.

Technological Dimensions	Technologies						
	AI	HS	FMD	RP	Cultivation and use of green fodder	Use of parasitic deworming	Anti drugs tick control

- c. Locally available resources could be utilized in a better way through this technology.
 - d. The technology is well fit to farmers environment/situations.
 - e. The technology is adaptable to physical and climatic factors at the farm such as soil, water, air, temperature and other physical factors.
- 7. RESOURCES USE EFFICIENCY**
- a. With this technooogy the available inputs/resources are effectively utilized.
 - b. The resources use efficiency on my farm is better with this technology.
 - c. Resource mobilization is not a constraint with this technology.
 - d. All the inputs/resources are better way utilized and not to incur much expenditure on inputs.
- 8. SOCIAL ACCEPTABILITY AND SOCIAL SUSTAINABILITY**
- a. Technology is acceptable to different secotrs of the society.
 - b. Technology is well acceptable even amongst socially and economically weaker sections of the society.
 - c. Technology is resisted by some sections of the society.
 - d. Technology has viewed local problems needs and aspirations of members of society.

Technological Dimensions	Technologies				
	AI	HS	FMD	RP	Vaccination Cultivation and use of green fodder Use of parasitic deworming Anti drugs tick control

9. POLITICAL TACITNESS

- a. The technology is used unhampered in existing political set up.
- b. There is no interference by politicians in the use of technology.
- c. The technology is not affecting regional, state or national policies set forth.
- d. Technology gives support to push forward in the existing political set up.
- e. Local or opinion leaders have legitimized technology by their approval.
- f. Technology can not work in the existing intricacies and implications of the political set up.

10. ADMINISTRATIVE MANAGEABILITY

- a. Practically it is possible to implement the technology
- b. There is no hinderence to implement technology under the existing bureucratic structure.
- c. The technology implimentation is administratively manageable.
- d. The technology implementation is achievable.

11. CULTURAL DESIRABILITY

- a. Technology fits with the cultural patterns and values of the society.

Technological Dimensions	Technologies					
	AI	HS	FMD	RP	Cultivation and use of green fodder	Use of parasitic deworming

- b. Technology is not consistent with the tradition and cultural pattern of some sections of the society.
- c. It is no way deviation from the existing cultural pattern and values of the society.

12. RENEWABILITY

- a. Technology can be used for longer duration without much additional effort and input.
- b. Technology can be reused for time and again.
- c. Even after a long time, the technology is found to perform well on the farm.
- d. Technology is found to perform equally well at any given time and place.
- e. Even constant use of technology has not effect on its impact.

13. EQUITY

- a. The products of technology can evenly be distributed among the local producers and consumers.
- b. The products available at farm are better way utilized in practising crop/livestock enterprises.
- c. The products of one enterprise are used in another enterprise practised on the same farm.
- d. Technology is useful in evenly distributing the products among the users.

Technological Dimensions	Technologies					
	AI	HS	FMD	RP	Cultivation and use of green fodder	Use of parasitic deworming tick control

14. PRODUCTIVITY

- a. The technology is yielding as per the expectation and its potentials on farm.
- b. The technology is superior over existing (traditional) one in respect of per unit production.
- c. Technology has more relative advantages over existing one in respect of quantity and quality of products.
- d. Technology has helped in saving time and money.

24. In your opinion what is needed for a technology to be sustainable in livestock production.

- 1.
- 2.
- 3.
- 4.
- 5.

प्रसार शिक्षा विभाग

भारतीय पशु चिकित्सा अनुसंधान संस्थान,
इज्जतनगर, यू.पी.-243 122

कृषकों की साक्षात्कार अनुसूची

- अनुसूची संख्या :
1. गांव का नाम :
2. शहर से दूरी :
3. खण्ड विकास का नाम :
4. तकनीकी प्रयोजगता का नाम :
5. आयु :
6. जाति :
7. व्यवसाय : मुख्य व्यवसाय
पूरक व्यवसाय,
8. परिवार : संयुक्त परिवार
एकल परिवार
9. परिवार का आकार

मद संख्या	वयस्क			बच्चे (12 वर्ष)			कुल योग
	पुरुष	स्त्री	योग	पुरुष	स्त्री	योग	
पशु पालन में कार्य करने वाले							
अन्य							
कार्य न करने वाले							
कुल योग							

10. तकनीकी प्रयोगकर्ता की शिक्षा का स्तर :

अनपढ़ (0) केवल पढ़ना (1) केवल पढ़ना और लिखना (2) प्राइमरी (3) आठवीं पास (4) हाईस्कूल (5) स्नातक (6)

12. पारिवारिक शिक्षा का स्तर

स्तर	अंक	परिवार के सदस्यों की संख्या
अनपढ़	0	
केवल पढ़ना	1	
केवल पढ़ना और लिखना	2	
प्राइमरी	3	
आठवीं पास	4	
हाईस्कूल	5	
स्नातक	6	

13. कृषि जोत का आकार (है0में) :

(क) (अ) भूमिहीन :

(ब) 1 हेक्टर तक :

(सीमान्त कृषक)

(स) 2 हेक्टर तक :

(छोटा कृषक)

(द) 2 हेक्टर से ऊपर :

(बड़ा कृषक)

(ख) चारे की फसलों के अन्तर्गत क्षेत्र (बीघा में)

(अ) खरीफ में :

(ब) रबी में :

(द) जायद में (गर्मी) :

14. फसल सघनता :

इस वर्ष आपने कौन कौन से फसले उगाई हैं।

फसलें वर्ष के दौरान उगाई गई फसलों का क्षेत्रफल

खरीद :

रबी :

जायद :

15. पशुधन आकार :

क्र.सं.	पशु	संख्या	प्रजाति
1.	दूध देने वाले पशु		
	(क) गाय		
	(ख) भैंस		
2.	बिना दूध देने वाले		
	(क) गाय		
	(ख) भैंस		
3.	नवजात पशु		
	(क) गाय		
	(अ) 2वर्ष तक बछड़ा बछिया		
	(ब) 2वर्ष के ऊपर बछिया	बछड़ा	
	(ख) भैंस		
	(अ) 2 वर्ष तक बछिया	बछड़ा	
	(ब) 2 वर्ष के ऊपर बछिया	बछड़ा	
4.	भार/वजन वाले पशु		
	(अ) बैल		
	(ब) भैंसा		
5.	अन्य बकरी.....भेड़....., सुअर....., मुर्गी.....,घोड़ा.....		

16. दुग्ध उत्पादकता

पशु	दूध देने वाले पशुओं की संख्या	वर्तमान में दुग्ध उत्पादन प्रति दिन का	औसत दुग्ध उत्पादन प्रतिदिन का	कुल दुग्ध उत्पादन प्रति पशु प्रति लेक्टेशन	लेक्टेशन की अवधि में औसत दुग्ध उत्पादन
क. गाय (अ) संकर (ब) देशी					
ख. भैंस (अ) उन्नत (ब) देशी					
ग. बकरी					

17. पिछले पांच वर्षों के दौरान छः गांवों के एक समूह में अपनाई गयी पशु विज्ञान तकनीक की प्रावधिकी की सूची

क्र.सं.	तकनीकें	कब से

ख. पिछले पांच वर्षों में प्रयोग में लायी गयी तकनीकों का उल्लेख करें

18. निम्नलिखित तकनीकों को आप कब से प्रयोग कर रहे हैं।

तकनीक	वर्ष
1. कृत्रिम गर्भाधान	
2. टीकाकरण	
3. चारा उत्पादन एवं प्रयोग	
4. परजीवी विनाशकारी औषधि दवाओं का प्रयोग	
5. तकनीक	

19. कृपया यह बतायें कि आप निम्नलिखित तकनीकों को अपने फार्मों पर मिल रही है, पहुंच रही हैं।

क्र.सं. तकनीकें	पूर्णतः मिल रही है	मिल रही है	कभी कभार मिल रही है	कम मिल रही है	नहीं मिल रही है
	4	3	2	1	0
1. कृत्रिम गर्भाधान					
2. टीकाकरण					
3. चारा उत्पादन एवं प्रयोग					
4. परजीवी विनाशकारी औषधियों का प्रयोग					

20. निम्नलिखित तकनीकों को किसप्रकार प्रयोग में ला रहे हैं।

क्र.सं. तकनीकें	पूर्णतः	कभी कभार	अवसर/मौका मिलने पर	कभी नहीं
	3	2	1	0
1. कृत्रिम गर्भाधान				
2. टीकाकरण				
3. चारा उत्पादन एवं प्रयोग				
4. परजीवी विनाशकारी औषधियों का प्रयोग				

21. निम्नलिखित तकनीकों के अपनाने में आवश्यक प्रतिपूरकों की सूची और यह भी भी बतायें कि आप इस को उपलब्ध खरीद करने के योग्य हैं

तकनीक	प्रतिपूरक	उपलब्ध कराने की क्षमता		
		आसानी से	कभी कभी	कभी नहीं
1. कृत्रिम गर्भाधान	उचित वीर्य पशु चिकित्सक पशु टीका पशु चिकित्सा दवा राशन धन			
2. टीकाकरण	पशु टीका पशु चिकित्सक धन			
3. चारा उत्पादन एवं प्रयोग हरा चारा	बीज खाद सिचाई पानी धन			
4. परजीवी विनाशकारी औषधियों का प्रयोग	कीड़े मार पशु चिकित्सक दवा फैलाने वाला यंत्र धन			

22. निम्नलिखित प्रौद्योगिकी : क्या आपकी राय से कृषि फार्म पर फायदेमन्द है।

क्र. प्रौद्योगिकी आयाम/घटक सं.	बहुत अधिक है	फायदेमन्द है	कभी कभार फायदेमन्द है	कम फायदेमन्द है	कभी नहीं फायदेमन्द है
1. कृत्रिम गर्भाधान					
2. टीकाकरण एच.एस. (गलाघोंटू) एफ.एम.डी (खुरपका, मुँहपका) रोग आर.पी. (पोंका पोकनी)					
3. पशुओं के चारे हेतु वरसीम उगाना					
4. परजीवी विनाशकारी औषधियों का प्रयोग					

23. निम्नलिखित प्रौद्योगिकी से सम्बन्धित घटकों की तकनीक स्थायित्वता के फैलाव की अपनी राय दीजिये।

क्र. प्रौद्योगिकी आयाम/घटक सं.	बहुत सहमत है	सहमत है	कभी कभार सहमत	कम सहमत	कभी नहीं सहमत है
1. तकनीक उपयुक्त हो।					
1. तकनीक सरल/पूर्ण है।					
2. तकनीक प्रासंगिक है/समय की मांग के अनुसार है।					
3. तकनीक वर्तमान समस्याओं के निदान में उपयोगी है/सक्षम है।					
4. तकनीक आवश्यकतानुसार आधारित है					
5. तकनीक भौतिक आवश्यकताओं के अनुरूप है।					
6. तकनीक सांस्कृतिक आवश्यकताओं के अनुरूप है।					

2. आर्थिक सुगमता/व्यवहार्यता/संभाव्यता

1. तकनीक विभिन्न प्रक्षेत्रों में साध्य है। उपयोग करने योग्य है।
2. तकनीक रोजगार के अवसर उपलब्ध कराने में सहयोग करेगी।
3. तकनीक कम लागत में अधिक उत्पादन करायेगी।
4. तकनीक के उपयोग से उत्पादन की गुणवत्ता बढ़ेगी।

3. आर्थिक जीवनयोग्यता

1. तकनीक आर्थिक दृष्टिकोण से सक्षम है।
2. साधन विहीन भी तकनीक का उपयोग कर सकते हैं।
3. तकनीक से वर्तमान उत्पादन तथा उत्पादकता में वृद्धि होगी।
4. तकनीक आय बढ़ाने में सहयोग करेगी।
1. तकनीक पर्यावरणीय कौलाहल परिस्थिति मित्र है, पर्यावरणीय मित्र है।
2. तकनीक के विनाशकारी परिणाम होंगे। हो सकते हैं।
3. तकनीक से वृक्ष/पशु-मनुष्य सम्बन्ध बाधित होंगे।
4. इसके अवशेष प्रभावित कर सकते हैं जो लम्बे समय में समस्या उत्पन्न कर सकते हैं।
5. तकनीक के अपनाने से वर्तमान साधन धीरे-धीरे समाप्त हो जायेंगे।

5. समया सम्बन्धी स्थायित्व

1. तकनीक लगातार लम्बे समय से अच्छी प्रकार कार्य कर रही है।
2. तकनीक बाह्य प्रभावों से प्रभावित नहीं होती है।
3. लम्बे समय से इसके परिणामों में कोई अन्तर नहीं आ रहा है।
4. जब अन्य तकनीकों से कुछ विशेष प्राप्त नहीं होता है तब यह तकनीक आय के कुछ साधन मुहैया कराती है।

6. स्थानीय व्यवस्था योग्य

1. तकनीक सामाजिक आर्थिक परिस्थितियों के अनुरूप है।
2. तकनीक कृषक के साधनों के अनुरूप है।
3. इस तकनीक के द्वारा स्थानीय उपलब्ध साधनों का बेहतर इस्तेमाल हो सकता है।
4. तकनीक कृषक की परिस्थितियों/ पर्यावरण के अनुकूल है।
5. तकनीक भूमि, जल, वायु, ताप और अन्य भौतिक और जलवायुवीय कारकों के व्यवस्था योग्य है।

7. साधन-उपयोग दक्षता

1. इस तकनीक द्वारा उपलब्ध साधनों का उत्तम उपयोग होता है।
2. इस तकनीक द्वारा मेरे फार्म की साधन उपयोग क्षमता बेहतर हुई है।

3. इस तकनीक के साथ साधनों को गतिमान रखने में कोई समस्या नहीं आती है।
4. समस्त साधनों का बेहतर ढंग से उपयोग होता है, और साधनों पर विशेष खर्चा नहीं करना पड़ता।

8. सामाजिक स्वीकारिता और सामाजिक समगतिशीलता

1. तकनीक समाज के विभिन्न वर्गों द्वारा स्वीकार किये जाने योग्य है।
2. तकनीक सामाजिक तथा आर्थिक रूप से कमजोर वर्गों द्वारा भी स्वीकार किये जाने योग्य है।
3. तकनीक समाज के कुछ वर्गों द्वारा अमान्य है।
4. तकनीक समुदाय की स्थानीय समस्याओं आवश्यकताओं और आकांक्षों का ध्यान रखती है।

9. राजनीतिक मौनता, चुपचापता

1. वर्तमान राजनीतिक परिदृश्य में तकनीक बिना किसी बाधा के उपयोग की जा सकती है।
2. तकनीक के प्रयोग में राजनीतिज्ञों द्वारा कोई रुकावट नहीं है।
3. तकनीक स्थानधी राज्य अथवा राष्ट्र की नीतियों को प्रभावित नहीं करती है
4. तकनीक वर्तमान राजनैतिक व्यवस्था में भी आगे धकेलती हुई सहायता करती है।

5. स्थानीय नेतृत्व वैधानिक तकनीक को प्रयोग करने हेतु अनुमोदित करता है।

6. तकनीक वर्तमान राजनीतिक परिस्थितियों का माहौल में उपयोग नहीं की जा सकती है।

10. प्रशासनिक प्रबन्धता/व्यवस्था/सहनीयता

1. तकनीक का उपयोग प्रायोगिक रूप से सम्भव है।

2. तकनीक का प्रयोग दफ्तरशाही माहौल में भी कोई रुकावट नहीं होती है।

3. तकनीक प्रशासनिक रूप से प्रबन्ध किये जाने योग्य है।

4. तकनीक प्रयोग कर लक्ष्य को प्राप्त करने योग्य है।

11. सांस्कृतिक इच्छा जाग्रता

1. तकनीक सांस्कृतिक ढाँचे तथा सामाजिक मूल्यों के अनुरूप है।

2. तकनीक सांस्कृतिक ढाँचे तथा परम्पराओं या तकनीक अनुरूप रहने वालों के स्तर को ध्यान में रखकर नहीं बनाई गयी?

3. तकनीक के अपनाने से उनके सांस्कृतिक ढाँचे तथा मूल्यों में कोई परिवर्तन नहीं लाता है।

12. पुनः नयापन लाने वाली/नवीन करनी वाली

1. तकनीक बिना किसी अतिरिक्त लागत एवं प्रयत्न के लम्बे समय तक उपयोग की जा सकती है।

2. तकनीक बार-बार उपयोग में लायी जा सकती है।
3. लम्बे समय बाद उपयोग करने पर फार्म पर अच्छे परिणाम देती है।
4. तकनीक किसी भी समय अथवा स्थान पर प्रयोग करने पर अच्छे परिणाम देती है।
5. तकनीक के लगातार लम्बे समय तक प्रयोग से उसके परिणाम पर दुःप्रभाव नहीं पड़ता है।

13. उचित न्याय/पक्षपात्रहीनता

1. तकनीक के उत्पादों/पदार्थों प्रयोग उपभोक्ता और स्थानीय उत्पादनकर्ता के बीच/मध्यस्थ बटवारा बराबर है।
2. व्यावहारिक फसल-पशुधन उद्यम में फार्म पर उपलब्ध उत्पादों का उपयोग अच्छी तरह से होता है।
3. एक उद्यम के उत्पाद दूसरे उद्यम में उपयोग में लाये जा रहे हैं।
4. तकनीक उपभोक्ताओं के मध्य उत्पाद को समान रूप से वितरित करने में उपयोगी है।

14. उत्पादकता

1. तकनीक पूर्वानुमान एवं अपनी पूर्ण उत्पादकता क्षमता के अनुसार उत्पादक है।
2. तकनीक पारम्परिक विधि से बेहतर है।
3. तकनीक से अधिक लाभ प्राप्त हो रहे हैं।
4. तकनीक समय तथा लागत कम करने में मददगार है।
24. पशुधन उत्पादन में समगतिशील तकनीक के लिये आपके राय में क्या आवश्यक है।

DIVISION OF EXTENSION EDUCATION

INDIAN VETERINARY RESEARCH INSTITUTE

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Interview Schedule for Scientists

1. Name of Scientist :
2. Discipline Name :
3. Background :
 - (a) Rural
 - (b) Urban
4. Age :
5. Education Qualification :
6. Professional Experience :
 - (a) Teaching & Research
 - (b) Field
22. To what extent the following technologies are profitable at your livestock?

Sl. No.	Technologies	Highly profitable	Profitable	Some what profitable	Least profitable	Not at all profitable
1.	Artificial Insemination					
2.	Vaccination against A. H.S. B. FMD C. R.P.					
3.	Cultivation and use of green fodder					
4.	Use of anti-parasitic drugs A. Deworming B. Tick control					

23. Kindly give your opinion on the extent of sustainability of the following technologies related to the mentioned dimensions (Please give scores 0 to 4 as per the following degrees of sustainability) :

Degree of Sustainability : Highly Agree-4, Agree-3, Some What Agree-2, Least Agree-1 and Not at all Agree-0

Technological Dimensions	Technologies					
	AI	HS	FMD	RP	Cultivation and use of green fodder	Use of parasitic deworming

1. TECHNICAL APPROPRIABILITY

- Technology is simple to use.
- Technology is relevant and essential intervention.
- Technology is effective in solving the problems.
- Technology is need based.
- Technology is physically compatible to the farmers.
- Technology is culturally compatible to the farmers.

2. ECONOMIC FEASIBILITY

- Technology is workable at different farms.
- Technology is to provide higher production per unit cost.
- Technology will help to generate employment opportunities.
- Technology is value added.
- Technology will open more market avenues.

3. ECONOMIC VIABILITY

- Technology is economically viable and cost effective.
- Resource-poor can afford the technology.

Technological Dimensions	Technologies					
	AI	Vaccination		Cultivation and use of green fodder	Use of parasitic deworming	Anti drugs tick control
		HS	FMD RP			

c. Technology will help to enhance present production and productivity.

d. Technology will help to generate more income.

4. ENVIRONMENTAL SOUNDNESS

a. Technology is eco-friendly

b. Technology may disturb (Plant-animal-man relationship) eco-system.

c. Technology may have hazardous effect on environment.

d. It may have residual effect and in long terms may create problems for animal and human life.

e. Consequences may lead to destroy existing resources.

5. TEMPORAL STABILITY

a. Technology consistently performing well on the farm.

b. Technology does not get affected by any extragenous factors.

c. There is no effect on its result over the long run.

d. Continue to be a source of additional income and livelihood without being affected by any other factor.

6. LOCAL ADAPTABILITY

a. The technology is adaptable to the farmers socio-economic conditions.

b. The technology is adaptable to the resource base of the farmers.

Technological Dimensions	Technologies						
	AI	HS	FMD	RP	Cultivation and use of green fodder	Use of parasitic deworming	Anti drugs tick control

- c. Locally available resources could be utilized in a better way through this technology.
 - d. The technology is well fit to farmers environment/situations.
 - e. The technology is adaptable to physical and climatic factors at the farm such as soil, water, air, temperature and other physical factors.
- 7. RESOURCES USE EFFICIENCY**
- a. With this technology the available inputs/resources are effectively utilized.
 - b. The resources use efficiency on my farm is better with this technology.
 - c. Resource mobilization is not a constraint with this technology.
 - d. All the inputs/resources are better way utilized and not to incur much expenditure on inputs.
- 8. SOCIAL ACCEPTABILITY AND SOCIAL SUSTAINABILITY**
- a. Technology is acceptable to different sections of the society.
 - b. Technology is well acceptable even amongst socially and economically weaker sections of the society.
 - c. Technology is resisted by some sections of the society.
 - d. Technology has viewed local problems needs and aspirations of members of society.

Technological Dimensions	Technologies					
	AI	Vaccination		Cultivation and use of green fodder	Use of parasitic deworming	Anti drugs tick control
		HS	FMD RP			

9. POLITICAL TACITNESS

- a. The technology is used unhampered in existing political set up.
- b. There is no interference by politicians in the use of technology.
- c. The technology is not affecting regional, state or national policies set forth.
- d. Technology gives support to push forward in the existing political set up.
- e. Local or opinion leaders have legitimized technology by their approval.
- f. Technology can not work in the existing intricacies and implications of the political set up.

10. ADMINISTRATIVE MANAGEABILITY

- a. Practically it is possible to implement the technology
- b. There is no hinderence to implement technology under the existing bureucratic structure.
- c. The technology implimentation is administratively manageable.
- d. The technology implementation is achievable.

11. CULTURAL DESIRABILITY

- a. Technology fits with the cultural patterns and values of the society.

Technological Dimensions	Technologies						
	Vaccination				Cultivation and use of green fodder	Use of parasitic deworming	Anti drugs tick control
	AI	HS	FMD	RP			

- b. Technology is not consistent with the tradition and cultural pattern of some sections of the society.
- c. It is no way deviation from the existing cultural pattern and values of the society.

12. RENEWABILITY

- a. Technology can be used for longer duration without much additional effort and input.
- b. Technology can be reused for time and again.
- c. Even after a long time, the technology is found to perform well on the farm.
- d. Technology is found to perform equally well at any given time and place.
- e. Even constant use of technology has not effort on its impact.

13. EQUITY

- a. The products of technology can evenly be distributed among the local producers and consumers.
- b. The products available at farm are better way utilized in practising crop/livestock enterprises.
- c. The products of one enterprise are used in another enterprise practised on the same farm.
- d. Technology is useful in evenly distributing the products among the users.

Technological Dimensions	Technologies					
	AI	HS	FMD	RP	Cultivation and use of green fodder	Use of parasitic deworming

14. PRODUCTIVITY

- a. The technology is yielding as per the expectation and its potentials on farm.
- b. The technology is superior over existing (traditional) one in respect of per unit production.
- c. Technology has more relative advantages over existing one in respect of quantity and quality of products.
- d. Technology has helped in saving time and money.

24. In your opinion what is needed for a technology to be sustainable in livestock production.

- 1.
- 2.
- 3.
- 4.
- 5.

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VITAE

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