

REPORT ON DAIRY MISSION TO PAKISTAN
8 to 20th May 2006

**Mission carried out under the auspices of the Australia-
Pakistan Agriculture Sector Linkages Program**

By

**Peter Wynn, David Harris, Richard Moss, Bob Clem,
Robert Sutton and Peter Doyle**

Contents

1.	Background	3
2.	Mission objectives and outputs.....	3
2.1.	Mission objectives	3
2.2.	Outputs sought.....	4
2.3.	Achievement of outputs.....	4
3.	Mission team	4
4.	Dairy sector trends.....	5
4.1.	Dairy Production Systems	5
4.1.1.	<i>A national perspective</i>	5
4.1.2.	<i>Punjab province</i>	8
4.1.3.	<i>Sindh province</i>	11
4.2.	Economic and policy constraints on the Pakistan dairy industry.....	13
4.2.1.	<i>Farm production</i>	13
4.2.2.	<i>Milk marketing</i>	14
4.2.3.	<i>Trade policy</i>	15
4.2.4.	<i>Domestic policy</i>	16
4.2.5.	<i>Policy changes and industry development issues</i>	17
5.	Research and development opportunities	18
5.1.	Current status of research in the dairy sector: Punjab.....	18
5.2.	Current status of research in the dairy sector: Sindh	21
5.3.	Existing and proposed research and development programs	21
6.	Capacity development	22
6.1.	Capacity development: Punjab	22
6.2.	Capacity development: Sindh.....	23
6.3.	Capacity development: Industry policy advice.....	24
7.	Opportunities for trade related industry-industry relationships for the mutual benefit of Pakistan and Australia.....	25
8.	Recommendations	26
8.1.	ACIAR research project	26
8.1.1.	<i>Systems research</i>	26
8.1.2.	<i>Trade and policy</i>	26
8.2.	Capacity development	27
8.3.	Trade.....	27
9.	ASLP Pakistan Dairy Support Project: LPS/2005/132.....	27
9.1.	Structure as developed in debriefing meeting: 23 June 2006	27
9.1.1.	Theme 1: Support for a model system of smallholder dairy production.....	28
9.1.2.	Theme 2: Capture and enhancement of knowledge relevant to smallholder dairy systems. 29	
9.2.	Project management	29
9.2.1.	Advisory Council.....	29
9.2.2.	Agencies responsible for development and implementation	30
10.	Acknowledgments	30
10.	Attachments.....	31
10.1.	Itinerary for Australian Dairy Mission 8 -20 May 2006.....	31
10.2.	Material cited or used	37

1. Background

The Agriculture Sector Linkages Program (ASLP) has been established to build linkages between the agriculture sectors of Australia and Pakistan. The background to this mission and report has been taken from material provided to the mission team by the Australian Centre for International Agricultural Research (ACIAR). The ASLP has four components:

1. *Market Linkages*
2. *Academic Linkages*
3. *Agriculture Linkages*
4. *Linkages Program Review*

ACIAR manages and is implementing components 3 and 4. The main goals of the agriculture linkages component are to:

- Transfer Australian knowledge and expertise to key sectors of Pakistan agribusiness to increase profitability and enhance export potential.
- Contribute to poverty alleviation of small-holder farmers through collaborative research and development.
- Enhance the capacity of the Pakistan research, development and extension system to deliver targeted and practical research outputs to agribusiness and farmers.

ACIAR, in close consultation with senior officials of the Ministry for Food, Agriculture and Livestock (MINFAL) and the Pakistan Council for Agricultural Research (PARC) has scoped and identified possible ASLP priorities. Ministerial input, from the Minister of Industries, Production and Special Initiatives and the State Minister of Economic Affairs & Statistics, provided clear directives on focus and priorities during this process. Input was also sought from a broad cross-section of national and provincial research and extension institutions, the National Rural Support Program (NRSP) and industry bodies, such as Dairy Pakistan. Hence, the Pakistan partners largely formulated the priorities, and subsequent activities have been designed to progress planning and implementation.

Horticulture and livestock were identified as the primary focal sectors. At the same time, the need was recognised to also target a number of crosscutting areas that underpin the long term viability of these agro-enterprises, being the issue of water management and institutional and technical capacity building.

Within the two priority sectors of horticulture and livestock, mango, citrus and dairy production are being addressed initially. The mango and citrus industries are the most important horticultural tree crops, with Pakistan an important global producer and increasingly, an exporter. The dairy sector is one of the world's largest, with Pakistan ranking as 5th largest milk producer. There is large potential to increase productivity in all three sectors, with dairy offering significant poverty alleviation potential. The focus of this mission was on the dairy sector.

It had been previously agreed to target the following priority in dairy:

- Technical support for the dairy sector to increase individual animal milk production.

It had also been agreed to integrate capacity building for the R&D sector into this priority to deliver impacts and sustain progress beyond the life of the ASLP and to address the issue of efficient use of water as an enabling technology.

2. Mission objectives and outputs

2.1. Mission objectives

The aim of the mission was to identify opportunities where partnerships between Australia and Pakistan can contribute to the continued development of the Pakistan dairy production and marketing sectors. Specifically, the objectives were to:

1. Define areas where Australian technical expertise can contribute to profitable and sustainable improvements in milk production in smallholder crop-livestock systems.
2. Identify areas for scientific training in dairy technologies for Pakistani scientists where Australia has relevant expertise.

3. Review the policy environment influencing milk production, distribution and marketing and assess whether this is optimal for future development of the industry and for the participants in that industry.
4. Identify opportunities for trade related industry-industry relationships for the mutual benefit of Pakistan and Australia.

2.2. Outputs sought

The major outputs sought from this mission were:

1. The publication of a formal report broadly covering:
 - a) Dairy production and marketing systems in the major production areas, including the current systems and trends, and the drivers of change.
 - b) The adequacy and coordination of support being provided by National and State Government agencies, cooperatives, NGOs and the private sector to dairy farmers. Significant National, State or internationally funded programs should be identified and commented upon.
 - c) Current (and muted future) policy settings at National and State levels that affect the profitability and future direction of the dairy sector. A recommendation on whether the ASLP supports a partnership proposal in the policy arena, and what specific issues warrant attention, is required.
 - d) Gaps in scientific knowledge and/or in the application of knowledge, particularly in areas where Australian expertise could help to rectify current limitations.
 - e) Potential opportunities for private sector linkages between Pakistan and Australia.
 - f) Recommendations on the focus of a potential ACIAR project to improve dairy production in Pakistan, including the leading and collaborating Pakistan and Australian partners. The expectation is that such a project will focus on smallholder systems and will include the development of local capacity to support the dairy sector.
2. The submission of a Full proposal, LPS/2005/132: Improving dairy production in Pakistan, to ACIAR. The detail of this proposal will be recommended by the mission team, but is likely to consider the development of options to profitably increase milk production per lactation within a whole-of-system context for small holder farmers; capacity building of leading institutions to undertake research to support the long-term development of the dairy sector; and options to develop improved milk collection systems, processing and marketing, with a particular emphasis on product quality and value adding.

2.3. Achievement of outputs

Output 1 was achieved during and subsequent to the mission. Output 2 has been achieved in part with the broad detail of a proposal prepared in ACIAR's proforma. However, the itinerary arranged by ACIAR did not allow sufficient time to discuss the feasibility of the program with those who might be project partners, to identify the staff who would actively carry out activities or to discuss budgetary considerations. This occurred as most meetings with Government Departments, Universities and the National Rural Support Program were with senior staff and focused at a high level.

A draft proposal will be submitted to ACIAR separate to this report and it will be necessary for the Australian project leader, when identified, to visit Pakistan to identify participants, develop work breakdown structures with participants and their managers and develop a detailed budget. Ideally, an ACIAR representative and a member of the current mission would participate in this process.

3. Mission team

Dr Peter Doyle, Principal Scientist – Dairy, Primary Industries Research Victoria, Department of Primary Industries, Victoria (Mission Leader)

Associate Professor Peter Wynn, Faculty of Veterinary Science, The University of Sydney.

Mr Bob Clem, Principal Scientist – Pastures, Department of Primary Industries and Fisheries, Qld.

Mr Richard Moss, Principal Scientist - Dairy, Department of Primary Industries and Fisheries, Qld.

Mr Robert Sutton, National Manager, Agribusiness & Consumer, Austrade

4. Dairy sector trends

4.1. Dairy Production Systems

4.1.1. A national perspective

The Pakistan population has increased from 65 to 161 million over the past 3 decades and is forecast to increase to 234 million by 2025. Within the Pakistan economy, agriculture, including livestock, is the largest sector. With the increasing population pressures, rural development, based around productivity gains in food and livestock production, is important to food security and crucial to poverty alleviation. However, traditional family succession practices are leading to fragmentation of land holdings, with land shared among off-spring, leading to economically un-viable farm units.

Estimated land availability has declined to about 0.15 ha per capita and is forecast to shrink to 0.06 ha over time (Sheikh *et al.* 2005). Similarly, per capita water availability has declined from 5,600 cu meters to 1,200 cu meters over recent decades, and may fall to what is considered a water-deficit level (<1,000 cu meters per year) by 2010. Access to irrigation water from rivers or ground water is a major constraint to crop and livestock production in many rural communities.

The bulk of agricultural and livestock production comes from small household farms that are owned or tenanted, with landless families also rearing livestock. The rate of increase in the Pakistan population and the need to dramatically increase food production means that competition for land and water resources will become more intense and the ecological sustainability of already fragile systems will be further challenged. Significant areas of range land, that comprise about 60% of the area of Pakistan, have already been exploited beyond repair.

The rapidity of these changes and the lack of further arable land mean that increases in food crop and livestock production must come from productivity improvements: increased yields per unit of inputs. Notably, the highest densities of livestock in rural areas correspond with areas where the intensity of cropping and density of humans is greatest. Thus, any interventions to increase farm milk output need to occur in a systems context.

Nationally, supply of milk and meat does not match domestic demand. It is estimated that milk and/or dairy products currently provide more than half of the animal protein available for each person daily. Further, nearly 30% of household expenditure on food items is on milk and dairy products. With the projected population growth, the deficit between domestic supply and demand for milk is expected to grow from 3.5 to 55.5 million tonnes by 2020.

The rural population engaged in livestock production has been estimated at 30 to 35 million, and these farmers/households derive 30 to 40% of their income from livestock (Economic Survey of Pakistan 2004-05). Statistics indicate that national milk production exceeds 28 million tonne, having increased from around 12 million tonnes in 1990. Given the nature and geographic spread of the production systems, the collection and marketing systems, the accuracy of this data would not be expected to be high. One estimate indicates that a further 6 million tonnes of milk may be lost due to poor handling and management. None-the-less milk production has been estimated to be increasing at >5% per annum. This sustained rate of increase is substantial, and has been achieved despite perceptions that farmer's knowledge and skills are generally low and that adoption of technology has been poor.

Pakistan ranks as the 5th largest producer of milk in the world and dairy is by far the largest livestock sector, valued in 2002 at Rs 300 billion pa (AU\$6.6 billion).

There are over 26 million buffalo and 24 million cattle in Pakistan. Buffalo are the major milk-producing animal, accounting for about 75% of all milk produced (Sarwan *et al.* 2002) and numbers are increasing. They are concentrated in irrigation areas and along rivers, as are the human population. Nili Ravi and Kundi are the principal breeds and there is strong cultural attachment to these breeds in Punjab and Sindh, respectively. While there are significant numbers of high producing animals in research institutes and commercial herds, the genetic potential of buffalo in rural areas is seen as a constraint to milk production. Buffalo have a seasonal breeding cycle, with calving concentrated in autumn and early winter. This together with the seasonal variation in fodder supply means that peak milk production from buffaloes occurs from November to February, with abundant berseem fodder available in January/February. However, their milk production drops rapidly during summer (June/July), due to limitations in feed availability, high temperatures and the on-set of late lactation. As

milk from buffaloes is a much larger proportion of total production, compared with cow's milk, milk supply is high in winter with significant deficits in relation to demand in summer. Milking herds often comprise both buffalo and cattle, with cattle used to maintain continuity of production.

Cattle numbers are relatively static, possibly reflecting the increased mechanisation of cropping systems. The major milk-producing breeds are Sahiwal (Punjab), Red Sindhi (Sindh) and Tharparker (a dual purpose breed). Lactation lengths in Sahiwal and Red Sindhi are 270 to over 400 days, and generally longer than in buffalo. Dairy cows are more productive than buffalo through the summer and are used by farmers to even out milk supply and maintain cash flow.

Milk production systems in irrigation areas in Pakistan have been classified as:

- Rural subsistence farmers – milk produced to meet household needs for milk or products made from milk.
- Rural market-oriented farmers – milk produced for home use with small, but regular, surpluses for marketing.
- Rural commercial farms – larger herds (>40 animals) well organised, with direct links to milk processing plants.
- Peri-urban commercial farms – gowalas (animal husbandrists) settled in the outskirts of cities with herd size about 20 animals marketing into urban areas.

However, there are some variations in how systems are described between provinces. In the Punjab, the three major livestock production systems are: irrigated systems, Barani systems and desert systems, with buffalo and cattle production systems classified into rural-irrigated, rural Barani, progressive (commercial) and peri-urban. In Sindh, the systems are classified as settled (mixed or dairy farming) and migratory farming. It will be important in any ACIAR project to clearly define the milk production systems being examined, as although general descriptions of feeding systems and average levels of milk production are a useful starting point, there will always be significant variations in feeding management and production levels within system categories. This is to be expected given different access to cropping and grazing land, irrigation water, and feed resources for housed animals, as well as different numbers and types of animals and differences in access to capital/finance.

The majority of buffalo and cattle are in rural subsistence farms, with most of the rest in rural market-oriented farms. Over 70% of buffalo and cattle are in herds of less than 10 animals. Also, about 70% of households with large ruminants have herds of less than 5 animals, while a further 20 to 25% of households have 5 to 10 animals.

Many farmers rear not only large ruminants, but also sheep and goats of which there are over 24 and 56 million, respectively, in Pakistan. The interdependencies and reasons for keeping a number of livestock species need to be understood at the household level when considering interventions to increase milk production. For example, why do the poorest, landless farmers keep large ruminants, when intuitively the risks and costs incurred in rearing small ruminants are much lower? Is it because they provide a daily source of food and income? Such questions need to be posed across wealth classes, as it is unlikely farmers will adopt existing technologies if they are not presented in a systems context, which acknowledges the social and economic aspects of a farming system, as well as the resource and technical aspects.

During the mission, Government agencies, research scientists, university staff, rural development personnel, commercial dairy farmers and rural community groups listed a raft of constraints to increasing milk production. They included:

- Farmer knowledge and attitude: gender is important in who rears livestock, poor knowledge of forage production, animal nutrition, health and management, limited acceptance of better management practices.
- Farm resources and access to credit: access to land and water, as well as cost of pumping water, limited access to credit.
- Quality of buffalo and cattle: low genetic potential, poor selection and use of high potential animals, reproductive failure / long inter-calving intervals, culling and slaughtering of valuable animals, high mortality rates, susceptibility to heat stress.
- Animal health: vaccination including access to viable vaccines, poor access to veterinary services.

- Feed resources: insufficient feed to meet requirements, seasonality of supply, poor feeding strategies, competition for feed resources, seed availability and quality, poor agronomic practices, with limitations imposed by poor input (water, fertiliser) use, poor conservation practices, cost and quality of supplementary feeds.
- Lack of effective veterinary and extension services: skills and motivation of Government staff, extremely high ratio of households to service providers.
- Food safety: sanitary and hygienic conditions of production, harvesting and transport.
- Marketing: the traditional supply chain and those developed by milk processors were said to disadvantage farmers.
- Infrastructure: inadequate infrastructure for handling, processing, storage and transportation of livestock products, particularly in remote areas.
- Government policy: at national, provincial and district level were unstable.

The extent to which such an all encompassing set of constraints apply to individual businesses will vary because of their uniqueness. Farmers will have different goals, motivations, knowledge and skills, different access to resources (land, water, labour), different assets and access to credit. This was apparent in our discussions with rural communities where access to water was a critical constraint in one village, while 8 km away it was not an issue and nutritional management and animal health were major impediments to profitable milk production.

Various estimates of the fodder/feed deficit at a national level exist, for example a 15 to 30% deficit in total digestible nutrient requirements for livestock. On average, livestock obtain about 50% of their nutrients from green fodder, 38% from crop residues and the remainder from grazing vacant lands and cropping land post harvest, and cereal by-products and oil cake/meals. Such estimates highlight the limitations in digestible energy and protein supply at a national level, but ultimately understanding deficits in different agro-climatic zones and the resources available to individual households will be needed to sustainably increase milk production.

Between 1990 and 2005, there has been a trend towards reduced areas of fodder crops, while production per ha has remained static. At the same time, the livestock population has increased, circumstances that suggest nutrient requirements for maintenance have increased, reducing availability for production. This critical constraint of insufficient feed consumed by dairy animals is recognised by scientists, as is the fact that this is aggravated by continuous increases in the milking animal population. Why are these trends occurring? Do farmers not understand basic principles of requirements for maintenance and production? Are there other factors at play, such as risk management because of high mortality or opportunities in meat and livestock trading to commercial milk producers?

Clearly, large ruminants have traditionally provided milk for household consumption in Pakistan, and will continue to do so. However, they also fulfil other roles, such as:

- providing supplementary income from milk,
- being an easily liquidated asset, thus providing security against crop failure,
- providing manure important to maintaining soil fertility,
- meat production,
- sale of milking or breeding cows to commercial milk producers,
- an avenue to convert crop by-products into saleable foods,
- gainful employment of available family labour, and
- in some systems, providing draft power.

To sustainably increase milk production, with impacts in poverty alleviation, will require improved integration of disciplines within research organisations, of research and extension and involving these service providers in participatory research and extension with communities. Human resource development in the rural population through education of farmers in basic principles of nutrition (maintenance versus production requirements), in reproduction management, mastitis, vaccination and metabolic problems would yield returns in the short term in rural systems.

While fresh milk production in Pakistan has been estimated to have increased at >5%/annum, some of this growth may be attributed to increases in milking animal numbers. Given the limitations in feed availability, increasing milk production through further increases in the buffalo and/or cattle populations would seem to be unsustainable. Constraints on the land and feed resources available for milk production dictate that the most sensible and sustainable approach is to increase per cow production, given the inefficiencies in providing maintenance feed requirements for additional animals.

Bridging the gap between current levels of per buffalo or cow milk production in rural areas and potential production from the current genetics or improved genetics will require a systems approach involving multi-disciplinary teams. Without this, the technologies and knowledge already available are likely to have little impact and the time frames to adoption of new technology would be extremely long. As over 90% of the buffalo and over 70% of the cattle population are in the Punjab and Sindh provinces, our observations of milk production systems in these provinces are considered further below.

Drivers for increased milk production at a national level:

Projected population growth.

Increasing domestic demand: while supply has increased by >5% pa over the past 15 years, demand is anticipated to more than treble by 2020, requiring an even faster boost in production.

Reduce reliance on imported milk powders.

Milk is by far the most valuable livestock product in Pakistan.

Income generation for the rural poor.

Improving human nutrition and health.

National government increasing investment in dairy development.

4.1.2. Punjab province

In Punjab, the mission visited two provincial livestock research centres, a fodder research institute, the National Agricultural Research Centre Islamabad, the University of Agriculture Faisalabad and several locations where National Rural Support Program is active. In addition, the team visited peri-urban farms around Lahore, commercial mixed farms with 50 to 80 buffalo and cattle near Okara, small rural producers along road sides and community groups in Bhakkar. These visits and the discussions that took place gave a reasonable understanding of the challenges to increasing milk production in Punjab.

There are four agro-ecological zones in Punjab, namely:

- Arid (Barani) - rain fed pastures
- Thall – availability of canal water
- Cholistan – desert systems
- State land and river belts

Punjab contains 58% of Pakistan's buffalo and 42% of the cattle population. Milk is produced primarily in the irrigation areas and along rivers. Milk production varies widely within and between systems with indicative data for average production given in Table 1. In larger commercial production systems average production would probably be higher than in peri-urban farms. The potential production of Nili Ravi buffalo and Sahiwal cows when well fed on locally available feeds in research centres is about 3,500 kg/lactation, respectively. Crossbreeding of Sahiwal with Holstein Friesian has produced adapted animals producing 5,000 kg milk/lactation.

Low milk production per animal is due to a number of interacting factors. Increasing livestock numbers, significant numbers of dry adult and younger replacements in herds, and poor reproductive performance with long inter-calving intervals all limit the amount of feed available for productive purposes. Cattle in small holder systems are predominantly indigenous breeds and frequently produce less than 1,000 kg/lactation, with lactation lengths between 200 and 260 days. Inter-calving intervals for cattle may exceed 450 days, and, because of seasonal breeding behaviour, buffalo often fail to breed until they cease to lactate, resulting in extended dry periods.

Table 1. Indicative levels of milk production (kg/lactation) of buffalo and cattle in different production systems.

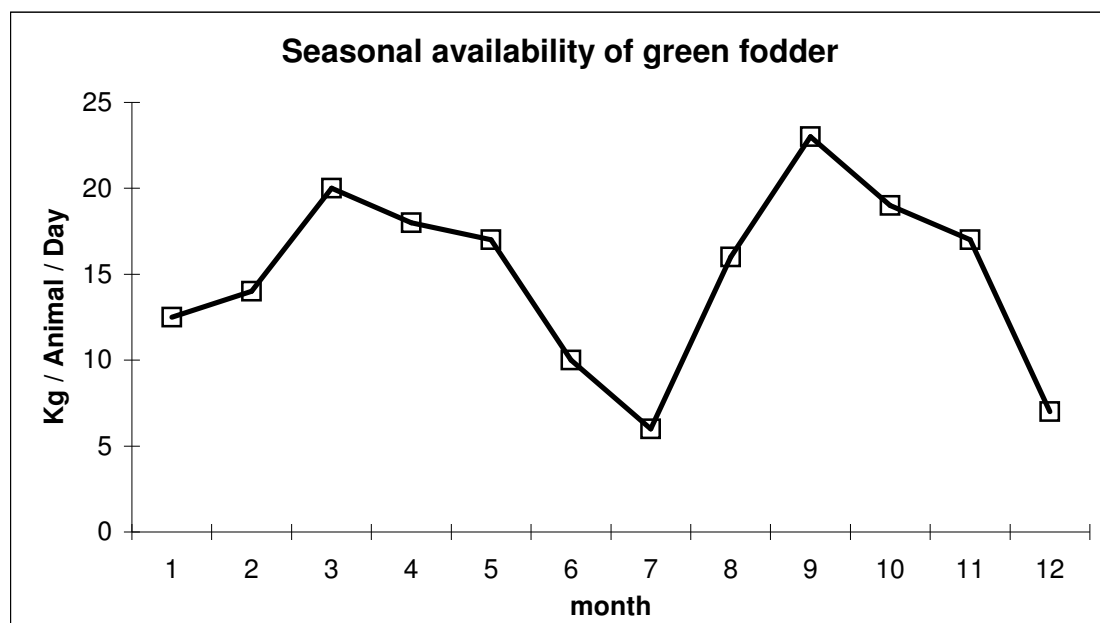
Production system	Buffalo	Cow
Commercial	2500	2500
Peri urban	2500	1800
Irrigated	2000	900
Arid (barani)	1200	450

In rural areas, feeding systems that recognise requirements for maintenance and production leading to strategic use of feeds to achieve higher per cow production compared with current haphazard/one size fits all feeding of the herd could significantly increase current milk output. Application of the principles of year round feed planning, including conservation to fill feed gaps, and feed budgeting as a rationale for allocating feed resources to maintenance and production could offer significant potential in the short term. However, differences in nutrient requirements of livestock in the tropics, as compared with temperate livestock systems, need to be acknowledged.

There are significant differences between the feeding systems and needs of small holder and peri-urban farmers. Grazing may provide 50-60% of the feed consumed by animals in small holder systems, whereas in peri-urban systems fodder crops may provide 50% and straw 35% of feed, respectively, with some concentrates fed. It is clearly easier to manage nutrition where animals are stall fed compared to systems involving grazing.

In general, critical feed shortages occur in May-July and November-January with declining quality, as annual crops mature, and lack of green forage at the conclusion of the major cropping seasons (see Fig 1). The major fodder crops in winter (rabi) are berseem clover, lucerne and oats, with some barley, rye and triticale. Main summer (karif) fodders are sorghums and sorghum hybrids, maize, millets, cowpea, guar and napier grass. It is the feed resources available at household level and their allocation that is critical to productivity gains (more milk per unit of feed).

Figure 1. Seasonal availability of green fodder (Source NRC, Islamabad).



Government and University Research Institutes have developed effective forage systems to improve nutrition and minimise seasonal feed gaps for milk production. Forage crop yields achieved by research institutes are frequently 50-100% higher than achieved by farmers, but adoption of improved practices has been poor. Production differences partly relate to improved varieties, but probably also indicate lower inputs of resources, such as water, fertiliser and management by farmers.

Technologies have been demonstrated to improve the nutritive value of cereal straws with urea or acid/molasses treatment and for provision of quality conserved forage by harvesting crops for silage or hay, but again these have not been widely adopted.

Government attempts to provide concentrate mixes of consistent quality at near cost have had some impact near research or feed preparation centres, but penetration into the bulk of rural milk producers has been minuscule. The cost and quality of by-products available for production of formulated concentrate vary within and between years.

Nutritional analyses of local feeds are available and have been used in ration formulation at a research level, but this information is not readily available to farmers. In addition, many farmers have limited knowledge of animal requirements or ration formulation for milk production.

A second major constraint relates to animal health, with mortality rates as high as 20% in rural systems. Endemic diseases FMD, haemorrhagic septicaemia, brucellosis, as well as leptospirosis, clostridial diseases, mastitis, metabolic diseases and internal and external parasites all present challenges. While there are Government supported vaccination programs, limited animal health coverage occurs with the average area covered by each veterinary officer being 248 sq. km (>55,000 animals) and the average area covered by each veterinary assistant 85 sq. km. (>19,000 animals),

A further constraint is the low genetic potential of animals and poor management in rural systems. Cattle in small holder systems are predominantly indigenous breeds, while animals in peri-urban systems are of higher genetic merit (see Table 1). Peak yields of 16 - 18 kg/day are achievable for buffalo and cross-bred cattle (indigenous x Holstein Friesian) in commercial/market oriented production systems, with average production of 7 - 9 kg/day. However, the price for high genetic merit buffalo (Rs 70,000 to 150,000) and cattle is beyond the means of most rural households. Availability and take-up or transfer of research information on genetics and reproduction has been limited beyond the larger producers. Supply of semen and/or superior blood lines from animal breeding programs reach very few farmers. However, it would seem illogical to approach these constraints in rural small holder systems through improved animal genetics before the constraints in nutrition and health are addressed, given that nutrient requirements will increase with genetic improvements.

Why is a systems approach essential? Production and demand for milk cannot be considered in isolation to cropping or demand for meat. The dairy industry is a major supplier of animals for meat through cull buffaloes and cows plus male calves. Demand for meat has increased returns for cull animals and low conception rates are resulting in a loss of breeding stock, with a consequent increase in price for replacement animals. At the same time, dairy farmers in colonies, as far away as Karachi, source multi-parous buffaloes for their systems (see below). While beneficial to breeders, who often are small holders, this impacts on milk production costs and is having adverse effects on the national herd, breeding and improvement programs. National and herd disease management is not assisted by continual transport of animals, often over large distances, from breeder to milk feedlots.

For small rural producers the sale of replacement breeding animals to milk feedlots could be as profitable as milk production and keeping animals for meat may also be attractive. This may partly explain the disproportionate number of non-lactating animals on rural farms. An example of the value of milk compared with selling animals to a peri-urban milk producer or for meat is given in Table 2.

Table 2. Value of milk versus selling cows to commercial producers or for meat.

Activity	Value (Rupees)
Rural producer (2,500 kg/cow.lactation @ Rs 9-10/kg)	25,000
Commercial peri-urban producer (2,500 kg/cow.lactation @ Rs 16-20/kg)	50,000
Sale value of 3+ year old cow, buffalo at point of calving	70,000-100,000
Slaughter value of cull cow, buffalo	25,000-30,000

Perhaps the major challenge to increasing per cow production in the Punjab, or elsewhere in Pakistan, is the sheer logistics of taking technology to masses of farmers, including the complexities of ensuring information is available to women. In some rural areas the poor understanding and adoption of technologies for livestock production is exacerbated by the fact that agricultural farmers are keeping more livestock. This shift is being caused by lower profits from crops and in particular wheat and cotton and increasing demand for milk and meat. The ratio of extension officers to community groups could be as wide as 35:1. In addition, many scientists are discipline specialists, who find it difficult to translate their research into applications within systems. This suggests success may only be achieved through participatory planning and participatory R&D involving community groups. The National

Rural Support Program and other provincial driven rural support programs offer an opportunity to explore this approach.

In the past there has been little intervention by government or research institutes to disseminate and drive adoption of improved technologies resulting from livestock research. The influence of research institutes appears to have been restricted to farms within close proximity to their boundaries or to larger commercial farmers who seek out information. The livestock extension officers trained or employed by Government or Universities and co-ordination or co-operation among and within Research Institutes appears to be limited. At the same time, research disciplines appeared to operate in isolation, so understanding and interpretation of livestock production in a holistic systems context appears to be lacking.

The National and Provincial governments have recognised these problems and proposed development strategies will assist in progressing uptake of technologies for increased milk production. The major logistic problem remains the very large number and wide spread of small holder farmers and the limited number and capacity of extension services to service them. This is a logical area where international programs can offer support.

Constraints on the land and feed resources available for milk production by rural market-oriented and subsistence farms in Punjab dictate that the most sensible and sustainable approach is to increase per cow production, given the inefficiencies in providing maintenance feed requirements for additional animals.

Drivers for increased milk production - Punjab:

These are aligned with national policy and drivers.

- Fulfillment of increasing demand for livestock products.
- Phasing out of import of livestock and livestock products.
- Promotion of exports of livestock and livestock products.
- Rural poverty alleviation through exploitation of livestock resources/potential.
- Development strategy: improving availability of feed and fodder; improving livestock health coverage; improving breeding practices; improved husbandry practices; and improving marketing of livestock and livestock products.

4.1.3. Sindh province

Sindh contains 35% of Pakistan's buffalo and 30% of the cattle population. The preferred dairy breeds are Kundi buffalo and Red Sindhi-based cows. The mission visited the provincial livestock centre in Hyderabad and Sindh Agricultural University. In Sindh, agriculture is concentrated in irrigated farms close to river systems. Small holder rural milk production is also concentrated in these areas. The remainder of the province is arid and has limited capability for dairy production. Milk production levels in small holder systems are similar to the Punjab. While in Punjab, lower profits from crops and the increasing demand for milk and meat were leading to farmers keeping more stock in agricultural areas, in Sindh it was indicated that increasing intensity of cereal cropping in irrigated agricultural areas was displacing livestock into more marginal lands.

The mission was unable to visit small-holder systems in the time available. However, two buffalo colonies were visited. There are a number of large buffalo colonies based on peri-urban feedlot systems on the fringes of Karachi and other major cities. These peri-urban dairy colonies were established from 1980 under Government policy to depopulate livestock from metropolitan cities to avoid pollution, while meeting the growing milk demands of the urban population. They provide farmers with a competitive edge in price, given the milk deficit of cities leads to significantly higher prices than in rural areas, and proximity to market. They also provide employment, with about one milker employed for every 10 milking animals. Discussions indicated there were about 1 million buffalo in dairy colonies around Karachi, where the domestic demand for milk is about 8 million litres per day. While average daily production was said to be about 8 kg milk per buffalo, a short fall as high as 4 million litres per day in supply occurs. This is presumably due to seasonality of breeding, short lactation lengths and that not all animals are in milk.

The Landhi Cattle Colony, which has over 340,000 buffaloes in feedlots in an area with a 5 km radius was visited. Individual feedlots in the colony may contain over 300 lactating animals, with animals

owned by small holders and/or leased from larger owners and run co-operatively. The larger herd owners may have 50-100 animals, which may in turn be leased to small holders. Features of the colony were:

- Milk production averaged 2,400 L/lactation, compared with 1,200 L/lactation in rural small holder systems.
- All feed is purchased from irrigated cropping regions and must be transported considerable distances daily, adding to feed costs. Escalating fuel prices will further erode profit margins for feedlots sourcing forage from distant crop growing areas.
- While straw was stored dry, there were significant issues with mycotoxins, exacerbated by poor storage, with concentrate feeds.
- Feedlot rations consist of harvested forages – chopped maize stover, forage sorghum and/or millet with chaffed cereal straw plus concentrates fed at up to 1 kg/3 kg milk or up to 8 kg/head.day.
- Feedlots do not keep dry animals or rear herd replacements. Animals are purchased at point of calving from breeders in Sindh and Punjab provinces.
- Many farmers use growth hormone to increase milk production, with feed offered not always increased to meet the increased nutrient demand.
- Calves are sold and without their suckling stimulus, hormones injections (oxytocin) are used for milk let-down. Low pregnancy and high abortion rates are associated with use of oxytocin.
- These injections of oxytocin and growth hormone interact negatively with animal condition, feed nutrient supply and reproduction and very few animals conceive during lactation.
- Productivity of feedlots is restricted because of very low reproductive rates and animals are sold at end of lactation with >90% going to slaughter for meat consumption. A few animals are purchased by breeders from rural areas for mating and sale back to feedlots.
- This one-way traffic through feedlots is counter-productive to breeding programs to improve genetic potential of the Pakistan buffalo herd, and causes upward pressure on price of replacement animals, with average prices now Rs 70,000 – 100,000 (~\$A 2 000) for buffalo at point of calving. Dry animals attract a slaughter value of ~Rs 25,000, a substantial loss against returns from milk for a single lactation, but a high price for potential breeders.
- Transport of feed from rural crop farms to feedlots represents a net loss in soil fertility on farm which has to be replaced with purchased fertilizers, but creates an environmental problem at feedlot with a concentration of nutrient rich manure, which is of high bulk for storage or transport but could be returned to farms, possibly as back loads.
- Health and disease problems are exacerbated by massive transport of animals from many regions, adding to potential to spread of diseases, such as foot and mouth disease, haemorrhagic septicaemia, brucellosis, TB, leptospirosis and others, together with higher incidence of management diseases, such as mastitis and metabolic disorders.
- Veterinary cover was much better than rural areas, but costs and effectiveness of vaccines were said to be a problem.
- Hygiene during milk harvesting, storage and transport was an issue that would be best addressed by regulation.

While farmers at the colony raised many issues, farmer exit rates were very low at less than 2% /year. This indicates the systems are profitable for the producers due to the high milk price. However, in the long term a rethink is needed so that these systems meet food safety requirements, impact less on the environment and are acceptable in animal welfare terms. The production systems are currently complicated by poor hygiene, and serious environmental and welfare problems. It is unlikely milk processors with international reputations to protect could link to such production systems, and regulation will be required to address some issues.

It is likely that the demand for fodder by these dairy colonies has implications for agricultural systems in rural areas. For example, continual export of organic matter and nutrients in fodder would place more pressure on agricultural land and might be the catalyst for changes in the farming systems. Understanding these interactions between the colonies and agricultural systems will be important if

rural farmers can profit more from supply of fodder to the colonies than from crop and livestock production.

Drivers for increased milk production - Sindh:

These are aligned with national policy and drivers. However, there seemed to be a much greater emphasis on increasing milk production from commercial and peri-urban systems than on rural subsistence systems. It was indicated that of the eight milk processing plants in Sindh, only one was operating. This may be indicative of limitations in supply leading to non profitable operations.

4.2. Economic and policy constraints on the Pakistan dairy industry

4.2.1. Farm production

The Pakistan dairy industry produces around 28 million tonnes of milk and the Punjab province accounts for 49% of total output, with Sindh province accounting for 38% of output. The industry is based on buffalo and cattle. Buffaloes are the traditional source of milk production. The cattle herd includes a variety of animals, with cross bred animals based on traditional milking breeds and the local draft cattle. Milk production can be categorised as from two main farming systems:

- semi-subsistence whole farm systems; and
- specialised dairy farms.

The semi-subsistence farming systems involve small scale farmers with 2-10 milking animals. Some farmers have no land and run a small milking herd. Farmers with land have milking cattle as a component of a whole farm system. There are a variety of farming systems within this category, with many of these farmers retaining their milking animals to generate some regular cash income and for home consumption purposes:

- typically the morning milking is sold for cash income and the evening milking is retained for household consumption;
- this sector accounts for approximately 80% of industry output.

The specialised dairy farms mostly involve peri-urban feedlot systems that supply fresh milk to the major city markets. These operations have substantially larger herds and are located on the fringe of cities to minimise distribution costs. There are some larger specialised milk production enterprises located in rural areas close to the major transport routes.

The industry is based on hand milking because of the small scale of the herds and the cost of investing in milking machines. There are also technical constraints for adapting this technology to milking buffalo. Average milking yields are low in comparison to other countries. There is a wide variation in milk yields between buffalo and cattle and between the different production systems:

- there has been a long running debate about the merits of buffalo and cattle which remains unresolved from a farm extension perspective;
- average milk yield across the industry is 1,500 litres/year (4 litres/day);
- anecdotal evidence suggest yields vary between 2 and 20 litres/day;
- potential cow milk yields are higher than buffalo yields.

A major cause of the low yield performance is inadequate feeding. There are too many cattle for the available feed supply. Yield performance is likely to improve if farmers reduced their herd size and improved the feeding regime for the remaining animals. The alternative is to increase feed production through forage yield improvements, changes in cropping areas or increased imports:

- this would have implications for the production of other crops and/or the policy settings for the cereals sector – trade and domestic policy.

As cattle require feed for maintenance, a further constraint on yield performance is the total herd size. Many farmers in the semi-subsistence systems are carrying large numbers of non-milk production animals. This may be for risk management purposes because of the high livestock mortality rates. It may also be due to home consumption requirements (ie large families) and a desire to diversify into meat production with non-milking stock:

- this further reduces feed availability for milk production.

The issue of poverty alleviation for livestock producers primarily involves the financial performance of the semi-subsistence milk producers. Major constraints on improving farm income for these producers include:

- the inferior milk yield performance;
- the low price received for milk caused by infrastructure constraints and possibly domestic policy arrangements affecting the retail price of milk;
- the need or desire to retain milk for household consumption; and
- ineffective and inadequate farm support services provided by provincial governments – notably farm extension advice, animal health support and farm financial advice.

These constraints are linked to the government policy environment at the federal and provincial government level. They relate to the provision of public infrastructure, the allocation of funding for services to assist farm development and possibly market interventions that distort price signals. However, these issues can only be considered in the context of a whole farm system and the social conditions affecting the farm family:

- farmers in this sector are not necessarily responsive to higher milk prices because of these constraints;
- some of the future growth in milk output will be retained for home consumption.

4.2.2. Milk marketing

The milk marketing system is under-developed by the standards of developed countries. It reflects the way the industry has developed under the policy constraints. A developed marketing system based on milk collection and processing is emerging. However, it only accounts for around 2-3% of total milk utilisation.

Milk sales from the peri-urban sector are mostly sold direct to households – it is un-pasteurised and it is not chilled. The distribution system is based around milk collectors operating as individuals or contracted groups distributing milk from a major producer. There are fundamental issues of food safety that must be addressed in this component of the marketing system:

- food safety regulations and hygiene standards are major areas of government policy intervention because of public health considerations; and
- reforms to existing regulations and effective compliance are neglected areas of government intervention.

Milk sales by the commercial sector are small and mostly involve UHT milk. There is some emergence of a market for fresh milk. The development of a commercial milk marketing system has been constrained by limited milk supplies available for collection. The integrity of the milk collection system in terms of hygiene and chilling a highly perishable commodity has also limited the development of this sector.

In Punjab, the commercial sector is investing in the development of a farm to factory cold chain distribution system. Milk is sourced from larger producers in rural areas that are located close to the major transport routes. There is some competition for milk supplies and these producers have alternative market outlets, which can generate higher farm returns:

- as many of these producers appear to be more specialised milk producers they are responsive to higher milk prices;
- however, they will still face the constraints of inadequate feed supplies and milk yield performance.

In Sindh, it was noted that seven of the eight processing plants were not operating, presumably due to supply limitations and supply chain issues. In addition, while consumers of fresh milk prefer high fat buffalo milk to cow's milk, the high proportion of buffalo milk presents some challenges for processors. They would prefer cow's milk, or at least a different ratio of buffalo to cow milk, to alleviate problems in handling excess fat.

Milk sales by the rural market-oriented sector are often limited to the informal milk collection system that supplies a local town. These milk collectors are often the only sales channel available for these producers. It is based around a milk pick-up limited by the capacity of motor-bikes to carry milk cans. This appears to be the most efficient way of collecting milk from rural areas that are not located close to a major transport route:

- the poor distribution infrastructure is a major constraint for developing alternative market outlets for producers in these areas;
- the lack of a commercial market outlet through milk companies limits the price received by farmers;
- a perishable commodity like milk requires a good road system and a cold chain system that allows timely delivery to processing plants.

At times it was indicated that producers did not receive a premium for summer milk (low supply months) or for milk with higher fat content except for that paid by milk collection centres that are operated by processors. At other times it was indicated price did vary with season in the traditional marketing systems as Dodhis competed for milk to meet their supply commitments.

Subsistence producers are often reliant on sales to the local town. There are conflicting reports of pricing policy interventions at the retail level. This is an important issue to investigate. It is the major factor that determines the price received by farmers for the one marketing outlet they have for their milk. It is a critical issue for the success of poverty alleviation strategies based on improvements in livestock production.

4.2.3. Trade policy

Trade policy arrangements for dairy product imports will determine the overall market conditions for developing an internationally competitive dairy industry. Competition is the critical ingredient for creating the incentive to improve the physical and financial performance of all sectors of the industry. High levels of protection or long term price support arrangements will limit the longer term development of the industry.

Imports of dairy products mostly consist of milk powders. There is a small trade in cheese and other dairy products for specialised end-uses. Milk powder imports include small quantities of skim milk powder and whole milk powder but most of the trade is in milk powder enriched with vegetable fat.

A precise picture of the utilisation of the powder imports could not be established. Most of the imports are used by manufactures of ice cream, confectionary, infant formulas and retail packs of powdered milk. In some cases the imports are used to blend with domestic milk supplies to standardise the fat and protein inputs for specific products (eg ice cream).

Current trade policy arrangements rely on tariffs – there are no tariff rate quotas (TRQs). It appears import licences are freely available, but this issue requires further investigation. Current tariff rates are:

- 25% for bulk imports of all milk powders (packs > 20 kg);
- 35% for non-bulk imports of all milk powders (eg retail packs);
- the same tariff rates apply to bulk and non-bulk imports of other dairy products (eg cheese, UHT milk, butter, whey, etc).

The differential in tariff rates provides trade protection for the domestic manufacturers of UHT milk and milk powders for retail sales. The milk processing sector is small and dominated by two players – Nestle and Haleeb. Imports compete with domestic supplies of milk powder, which are in limited supply due to the lack of milk drying facilities.

Competition in the small but growing market segment for retail packs of milk powder is limited. Most of the sales occur in the major population centres where wealthy consumers have a choice between milk powder and UHT milk. The major milk processors would like to retain and extend import protection to limit competition in this market segment:

- import protection is a sensitive issue and there are commercial concerns about the potential competition from India.

Some government policy makers believe there is the potential for Pakistan to develop an export capability. Milk hygiene issues will need to be addressed before this can occur. However, there is a conflict between this objective and the reliance on significant import protection that supports returns for the major producers of UHT milk and milk powder. An internationally competitive industry can only develop under minimal trade protection.

4.2.4. Domestic policy

Within the industry there are differing views on the way government policy should be used to assist the industry. There is a conflict between the need to generate higher returns for milk producers and a desire to maintain low retail prices for milk that relate to poverty alleviation for the urban poor. These pressures are evident in other industries (eg sugar, wheat) and have led to the implementation of support policies.

There are no domestic support policies that raise returns for domestic milk producers. However, in time political pressures may emerge to introduce price regulations in order to stimulate increased milk production. This could require increased trade protection. Policy makers do not appear to be aware of the implications of these sorts of policy developments for future industry development:

- there would be some value in making key policy makers aware of the mistakes with previous Australian dairy policies.

Future policy development in the industry will be shaped by social and political considerations. The economic implications for industry development also need to be considered. Currently the prevailing view for industry policy is to rely on market forces to shape the industry's development. However, there are indications that some policy makers think a more interventionist approach may be needed:

- for example, some policy makers believe the milk collectors in the informal sector should be eliminated in order to raise returns for milk producers;
- an alternative is to regulate the margins for milk collectors and distributors – this type of policy intervention was used in Australia for many years in the fluid milk sector;
- there would be value in making key policy makers aware of the implications of attempts to direct market outcomes in milk distribution.

The lack of marketing cooperatives for milk producers is surprising. It was suggested this is related to corporate governance issues that affected the development of cooperatives in other sectors of the economy. Producers of perishable products have limited market power in the price determination process. Marketing cooperatives can strengthen the bargaining position of producers.

Milk processing cooperatives would introduce more competition and provide alternative sales outlets for raw milk. It is the best way to maximise returns for producers and a viable alternative to domestic price support. However, successful cooperatives require expertise in marketing and distribution. They will also require an investment in milk dryers to manage the seasonal peak in milk supplies:

- an understanding of the development of dairy cooperatives in Australia would be highly beneficial for industry policy makers.

Retail pricing controls is potentially a more important policy intervention affecting current industry developments. District level governments have the power to fix retail milk prices based on the recommendations of a price committee. It is not clear if these powers are exercised in all districts or if they are effective:

- it appears there are no price controls on retail sales of UHT milk and milk powder in the major city markets – this issue needs to be further investigated.

In some cases it appears these price controls are affecting the price determination process for milk sold through the informal sector. If retail price controls are applied it effectively sets the maximum price received by farmers for raw milk. Price rises due to increased demand or seasonal changes in supply are constrained. This distorts the price signals that flow back to producers and removes the incentive for changes in production:

- the retail price control is equivalent to imposing a tax on farmers in order to subsidise the cost of milk consumption in urban areas;

- it leads to supply deficiencies in the retail market and limits the opportunity for farmers to increase their income;
- an understanding of how retail pricing regulations affects poverty alleviation in rural areas would be highly beneficial for industry policy makers.

4.2.5. Policy changes and industry development issues

The issue of future trade policy, industry support measures, regulatory arrangements and alternative marketing structures must be examined in the context of long term industry development. The overall objective should be to increase the amount of milk directed into the processing sector (ie reduce milk sales through the informal sector). However, this needs to occur in conjunction with increased competition for raw milk purchases:

- producers need alternative marketing channels to maximise farm returns;
- farm returns should be determined under market conditions closely aligned with world prices (ie limited trade protection);
- there is insufficient competition in the processing sector and the development of marketing cooperatives would inject greater competition in the market;
- imports or the threat of imports would place competitive pressures on milk processors to minimise their costs and the size of the marketing margin.

The government has recently established an organisation – *Dairy Pakistan* – to lead the development of the industry. Initiatives have been introduced to encourage improvements in milk collection. Interest subsidies are being used to support the introduction of village based milk collection chillers. The implications of these policy initiatives in the context of the existing market structure and future industry development is unclear:

- an investigation of the industry development policies used by the Federal and Provincial Governments would be highly beneficial for industry policy makers.

A related issue is how the Provincial Governments are directing the expenditures of their agriculture and livestock departments in support of industry development. It appears there have been sizeable expenditures directed into primary research activities for some time. However, the application and adoption of the research by farmers is limited.

The overall impression is that farm extension activities are ineffective and have not addressed the clear market failure in farm level R&D. Milk producers have not received adequate training and advice on how to improve farm performance. There also appears to be serious deficiencies in the provision of animal health services to livestock producers:

- there is a lack of extension advice on the financial benefits of on-farm changes, the adoption of R&D results and the utilisation of animal health services;
- this has stifled the transition from a semi-subsistence whole farm approach to more specialised farming operations;
- provincial government policies on industry development assistance measures appear to be unbalanced – these are WTO ‘green box’ measures;
- an understanding of provincial Government expenditures and regulations in this area would be highly beneficial for industry policy makers.

Some milk processors are investing in the development of milk collection systems that suit their individual requirements. In some cases this includes the provision of extension and animal health services. Rural based producers who sell milk to a processor may gain higher returns. It depends on their location and the amount of competition for their milk.

However, processed milk is currently a very small component of the industry – less than 5% of total output. This means only a small number of dairy farmers will benefit from developments initiated by milk processors. For example, Nestle has a milk collection system for 135,000 farmers and only 3,000 are considered to be progressive adopters of advice on farm performance improvements:

- there are 13.8 million farms in Pakistan producing milk;
- processors will prefer to deal with farms close to major transport routes;
- a more important issue is how the large number of producers in more isolated areas are affected by the policy initiatives of provincial governments.

The current market structure and policy arrangements may have short term implications for successful R&D and farm extension activities. An ACIAR project that shows how to achieve significant improvements in farm performance could be rapidly adopted across the industry. However, there are constraints that could affect the realisation of these benefits in the form of higher farm incomes:

- poverty alleviation benefits in regions that rely on informal milk sales will depend on capacity constraints in the milk collection system; and
- the lack of chilling facilities will mean the evening milking will continued to be consumed on farm.

An effective price determination process requires competition between milk collectors for the available milk supplies. Competition ensures farm returns are maximised. If village level production expands a larger number of milk collectors may be needed due to the limited carrying capacity of motor-bikes. An alternative approach is to encourage competition from a milk processor or establish a marketing cooperative:

- increased output and a limited milk collection capacity would put downward pressure on milk returns and affect R&D adoption rates;
- regulations that limit the activities of milk collectors or constrain marketing margins will be counter-productive for the goal of poverty alleviation.

A further consideration is the capacity of the local retail market to absorb the additional milk supplies if there is only one marketing channel. There may be unsatisfied demand in the local retail markets due to the constraints in farm/retail distribution system. This is an important question for the realisation of farm level benefits from higher milk production. It is an issue that should be considered as part of the proposed ACIAR project.

Higher milk supplies with an unchanged retail demand will place downward pressure of farm returns. Capacity constraints in the milk collection system, the number of retail outlets and the extent of home delivery sales are issues that would contribute to the pressure on farm returns. It is in this sort of market environment that retail price controls can be detrimental for longer term industry development.

5. Research and development opportunities

5.1. Current status of research in the dairy sector: Punjab

There is an impressive and diverse range of research activities in the major facilities visited (see Attachment 9.1). Research institutes have focused largely on defining the most suitable animals for commercial milk and meat production. The importance of developing dual purpose genotypes has also been recognised, which will be highly relevant to providing on-farm flexibility in production and, therefore, spreading financial risk over more than one product. This has been integrated to some degree with research on diversifying the feed base for use on-farm in different geographic regions. There has been a focus on increasing fodder crop production, while work on the optimisation of rations to provide the correct balance of nutrients to match genetic potential for production is being investigated less extensively. However, some work on this latter aspect was in progress at the Livestock Research Production Institute at Bhadar Nagar, Okara.

The University of Agriculture (Faisalabad) focused more on the evaluation of local forages, crop residues and industrial by-products in the formulation of nutritional strategies to feed dairy cattle. Their programs extended to the evaluation and management of plant toxins and anti-nutritional factors in rations. The recycling of animal excreta as a source of rate limiting nutrients was also being investigated.

In contrast, the Fodder Research Institute at Sargodha had a strong emphasis on plant improvement of all major fodder species with some 50% of staff devoted to this program. Improvements in forage yields of up to 75% have been demonstrated. Technologies for fodder and seed production of a large

range of fodder crops were also being developed with forage yield improvements of 50 to 150% over current farmer practice. Another important function of this Institute was seed production of forage crops. The role was to provide basic seed and oversee seed production on other government farms and farms of seed companies and private farmers. Linkages to other forage programs being undertaken in crop institutes that were not visited and to the dairy sector were less clear. There were some linkages to animal production using a herd of 80 buffalo to evaluate fodder species in terms of animal outputs.

The extensive resources residing within the National Agriculture Research Centre was impressive in terms of the quality of both facilities and personnel involved in research. The range of research covered the important areas of plant and animal sciences relating to dairy and meat production. While this was impressive the paucity of funding to achieve research goals was quite evident.

Key deficiencies

1. The most striking deficiency in research was the discipline as opposed to systems orientation and the ineffective interface between research and extension or farmers,
2. One of the major limitations to dairy production relates to reproductive inefficiency in dairy herds irrespective of size. While work was in progress relating to improving the feed base across all institutes, the relationship of this to reproductive efficiency was lacking. The need to shorten inter-calving intervals to improve on-farm production efficiency, particularly in buffaloes, is not being addressed. Research at this nutrition/reproduction interface is of central importance.
3. An extension of point 1 is the need to understand more about the nutritional management of the cow between the end of one lactation and subsequent calving (the transition period). This will be important in the management of key metabolic diseases, such as milk fever, the cause of major losses in some sectors of the industry. Research into understanding dietary calcium and phosphorus supply in relation to requirements with the local feed base will be important.
4. The relationship between the evaluation of the feed base for the provision of balanced dietary minerals, herd health and reproductive efficiency appears to be lacking across institutes. A multi-disciplinary approach should be taken to this problem.
5. The provision of facilities for the accurate evaluation of the quality of feed ingredients and forages appears to be deficient in many institutes. Retention of skilled laboratory staff was also an issue. We see this as being important in a research sense, but relatively unimportant for the individual producer, since the variation in management strategies is far more important than being provided with an accurate assessment of the quality of feed components on offer. However, we do see a place for a readily accessible reference source of the range of feeding values of each feed component likely to contribute to the feed-base of dairy cattle/buffaloes and small ruminants on farm. This could be used by research and extension staff alike. At the farm level and in any extension activities there needs to be more emphasis on efficient production of forages that are adapted to the growing conditions encountered in the various agro-ecological regions and that meet the nutritional needs of the animals. A system that depends on an adequate supply of moderate to good quality feed that is easily grown or provided over the full year is much more sustainable and can be manipulated more quickly and cheaply than one that relies on the erratic supply of high quality feeds or the need for expensive concentrates to keep animals producing.
6. The accurate assessment of the dietary (energy and protein) needs of both Sahiwal and Sahiwal cross cows and buffalo for maintenance and production in each environment should be determined. Work of this nature should include the impact of heat stress on productivity, much of which will be driven by limitations to feed intake. Application of feed profiling, feed budgeting and feed planning principles at farm level would be useful in education of extension staff and farmers of nutrient requirements for maintenance and production.
7. The management of the heat stress in both buffalo and cow herds on farm irrespective of herd size, requires further work. Although the principles are well established their application on farm in this environment appears to have been ignored. Any program developed should be applied in nature and evolve as a set of simple recommendations for adoption on farm.
8. Since the buffalo will remain an important part of the dairy industry, research on the development of more effective means of semen storage and use for artificial insemination will assist in the alleviation of the long inter-calving intervals in this species. Facilities and expertise for this work are in place at NARC in Islamabad, but funding is not. There is scope for collaboration with Australian expertise in this area. Associated with the process of AI is the importance of oestrus

detection, which is often difficult particularly in the buffalo. Again this may be associated with nutritional management.

9. In the area of forage supply the ineffective interface between research and extension and farm operations mentioned in 1 is even more complex because the forage production is generally a part of the cropping system at the individual farm level and often incorporated in the crop science area in the research institutes and government departments. There seemed recognition that greater integration was necessary but there was little evidence that this was happening. The reasons for the ineffectiveness are likely to be varied and were not always clear, but the strong discipline focus in the institutes, the technology led programs with farmers and the government supported poverty alleviation programs with the communities were not highly effective in achieving permanent and strongly beneficial change. Initiatives that recognise the needs of the farmers and communities are more likely to be successful and could draw on a plethora of sound scientific information that is already available in the research organisations.
10. At the farm level the main constraints seem to be the heavy reliance on the traditional fodders such as maize and sorghums in summer and berseem in winter and the inability of these to provide year-round feed programs in a cut and carry system. Improved varieties were not widely used and the use of perennial species was limited. Lucerne was being used in some areas and it was reported to be persisting for 5 to 6 years and dwarf napier grass (*Pennisetum purpureum* cv Mott) where it was used was highly regarded. There are potential benefits in using perennial fodders especially if legumes could be incorporated in arresting soil and land degradation.
11. Poor availability of good quality seed or seed of better varieties was also often mentioned as a strong constraint. This issue could not be pursued on this mission but the fact that farmers do not leave fodder crops for seed as there is a scarcity of fodder at the time seed could be produced does provide some explanation. It was stated (at the Fodder Research Institute) that there is currently no viable seed production system in Pakistan and the Punjab Seed Corporation has not included fodder seed in their mandate.
12. There was little evidence in the cash crop/fodder crop system that farmers were adopting or were aware of the need to adopt more sustainable farming methods, although land degradation and especially soil salinisation was recognised at institute and government level. The annual cropping programs used on farm did allow for some crop/fodder crop rotation and the popular use of berseem suggests that it is valued for the benefits that may be provided to the following crop. Some mixed summer fodder crops (sorghum or millet and cowpea) were being tested at the Fodder Research Institute. The use of perennial species and grass-legume mixtures, such as *Panicum* spp and lucerne, in longer term (up to 5 year) rotations will reduce the negative effects of regular cultivation on soil structure and help to increase soil organic matter and maintain soil fertility. Perennial species also have the added benefit of reducing the cost of seed for annual plantings. There was no evidence of the use of minimum or no-till techniques at the sites visited.
13. Although fertilizer was being applied to crops and some maize crops observed were very well grown there was little opportunity because of the mission itinerary to pursue the issue of nutrient cycling and especially removal from the farmed areas in the cut and carry system. Some manure was being recycled but large amounts were also being stored for fuel.
14. Having identified these key areas requiring attention perhaps the most important recommendation relates to the integration of research effort across sites. There is evidence of duplication and even triplication of research programs across institutes. Some rationalisation of programs funded by different agencies is warranted. It is not clear which organisation would assume this role. In relation to the research program this should be confined the major areas of interest.

Summary: The focus of an ACIAR research project should relate very much to improving the efficiency of management of the small holder production unit. To have impact a project would need to involve participatory research bringing together discipline skills from a range of institutions. Key elements of a project might be in-depth analysis of current systems; improved feed supply; nutritional management of the dairy buffalo/cow in a whole farm systems context; analysis of the current marketing system and opportunities to form community cooperatives. The management of herd health will be an important adjunct to the project. Thorough analysis of the socio-economic and biophysical features of a range of businesses in communities accompanied by participatory RD&E is more likely to lead to effective transfer of technologies than a broad brush extension program.

5.2. Current status of research in the dairy sector: Sindh

Discussions with the Dairy Association at Landhi Colony quickly identified the fact that substantially less research effort is being expended either by the Pakistani Ministry or by aid agencies in this province compared with Punjab. We only visited the offices of the Directorate of Animal Husbandry, Hyderabad and the Sindh Agricultural University.

The visit to Sindh Agricultural University identified a hub of research facilities and motivated staff capable of a variety of research activities: a number of these staff were relatively new appointments who may well have the capabilities to contribute to an ACIAR research program. Importantly the different departments or sections appeared to work closely together, quite unlike other institutes. Laboratory facilities were superior to most of the other laboratories that we visited and were comparable to anything available at NARC in Islamabad. This included the capability for full feed analysis, including minerals, energy and protein, as well as extensive analytical equipment for the detection of drug and antibiotic residues (HPLC, GC).

Equipment was also available for analyses of blood samples for a range of metabolites. It was difficult to ascertain if technical expertise was available to undertake these analyses as we visited on a Friday (half day holiday for religious observance).

The research initiatives required to address some of the formidable problems apparent within the buffalo colonies of Karachi will need long-term attention although there are areas that could be addressed immediately. The two most important are:

1. The re-organisation of the production system to facilitate a cost effective system for growth and development of replacement heifers for the herds. The fact that as many as 90% of cows being dried off are being sold for meat irrespective of parity provides an enormous inefficiency in the industry.
2. The inter-calving interval is over 500 days and also provides a major drain on resources.

These two problems are common to the production systems in both Punjab and Sindh provinces. Therefore it may be feasible to incorporate personnel from both regions in finding solutions.

It is important to note that the mission only visited dairy colonies in Sindh and there was insufficient time to visit small holders owning 3-10 cattle. An ACIAR project needs to focus on either rural market-oriented and subsistence farmers or peri-urban systems, but not both. The impression we have is that the provincial Government in Sindh has a priority to focus on research in the peri-urban systems. However, the University indicated it was in the process of becoming more involved in participatory research with surrounding communities.

Summary: As listed earlier, there are a large number of issues in the dairy colonies that would benefit from an integrated RD&E program. However, this was outside the brief for the mission, with ACIAR having agreed with stakeholders in Pakistan and Australia to focus on rural small holders aligned with poverty alleviation goals. Scientists within the Directorate of Animal Husbandry and/or Sindh Agricultural University could however make useful contributions to a research project focused on small-holder rural milk production systems.

5.3. Existing and proposed research and development programs

The following list of current and proposed livestock R&D programs aimed at increasing productivity per animal through research, extension and allied services was provided in Punjab:

- Improving availability and quality of feed and fodder
 - high yielding fodder crop varieties for irrigation and barani areas
 - molasses-urea blocks particularly in barani areas
 - use of meals and mixed concentrates
 - treatment of crop residues to increase feed quality
 - establishment of feed quality control services and laboratories
 - rehabilitation of range lands.
- Improving livestock health coverage
 - expansion and modernisation of diagnostic facilities

- control of animal diseases – vaccines
- control of internal and external parasites
- strengthened animal quarantine services and national disease control programs.
- Improved breeding practices
 - progeny testing, bull selection – Nili Ravi, Kundi buffaloes, Sahiwal, Red Sindi cattle
 - expanded semen production and artificial insemination services, training for technicians
 - “calf raising centres” at Govt farms to buy back/rear elite animals, distribution to breeders
 - upgrade non-descript cattle population by crossing with exotic (Friesian, Jersey) and selected local bulls (Sahiwal, Red Sindhi)
- Improved husbandry practices
 - establish aggressive livestock production extension services for technology transfer – trained staff, preparation of extension materials
 - strengthening of Livestock Production Research Institutes – outreach program for dissemination of technology to farmers
 - Govt farms to be used as demonstration “Model Farms” for training of progressive livestock farmers and breeders
 - improved marketing of livestock and livestock products
 - establish network of cold chain facilities for milk and meat collection, transportation and storage
 - establish vertical linkages of small-holder producers with processors through farmer associations
 - organise farmer associations to adopt best management practices for improved inputs, increased production and marketing.

It was difficult in the time available to gain a full understanding of the scope, scale and activities in existing and proposed projects. There are clearly opportunities to link any ACIAR project to these activities, but this should be done with a better understanding of the benefits. In summary, there are projects that support farmers and communities through training programs and financing that are provided by Government and Non Government Organisations (NGOs), including the National Rural Support Program (NRSP). There are also internationally assisted programs, such as Dairy Pakistan (USA aid project) focused on growing and commercialising the national dairy industry. There is a 6 year European Union and Government of Pakistan project, Strengthening of Livestock Services, with a focus on animal health, but also including animal nutrition and feed supply activities. A more locally oriented EU program is establishing milk processing plants for greater market access in two rural districts at Layyah and Sialkot (Punjab) and providing technical support to farmers to improve feeding and milk production. These programs are holistic and complementary, supporting development through improved market access, supply chains, technology transfer with training of farmers and service industries and increased access to finance with support to progress whole communities.

6. Capacity development

6.1. Capacity development: Punjab

The implementation of any research initiative and its transfer on farm depends on the adequate training of personnel.

1. Extension activities: It is clear that the most pressing need for small producers is the development of an effective process of transferring information in a format that can be readily adopted. This assumes that the education level of the producer will be at the most elementary level. Personnel trained in this area employed by government appear not to reach the small producer at all and provide at best the most rudimentary inputs for larger more urban oriented farmers. At this level the most effective form of training may be through the establishment of participatory RD&E models within communities and then monitoring and reporting progress in productivity over time.

The best people to undertake this role would be key motivated personnel within the NRSP network under the guidance of a project co-ordinator. These personnel may have to undertake a short course in

extension methodology preferably organised in Pakistan using the resources of local educational institutes with Australian expertise co-ordinating the training.

2. The use of young innovative people. In establishing key personnel to be actively involved within any community the emphasis should be on providing opportunities for a balance of influential middle aged producers together with those in the age group of 17-23. Care should be taken to avoid social conflict in not focusing on the senior leaders in each community. The issue of gender balance also requires careful consideration.
3. To maximise the educational experience and to involve tertiary education institutes within the region, it may be useful to engage one or two postgraduate students for the project. These students would be supervised by Pakistani academics, but under the understanding that their research would be driven primarily by the project co-ordinator. This provides an opportunity for both training young innovators, while at the same time engaging the inputs of academics who may not otherwise be involved in the research, development and extension program envisaged. It is important that the duration of their programs not exceed 2 years to ensure that all of their academic requirements are met well within the duration of the period of research funding. Having incomplete theses at the end of the project is not a viable option.

It is possible that an Australian postgraduate student may also join the project under the same conditions as outlined for the Pakistani counterparts. Again a 1 or 2 year program would be envisaged. Funding for this may be sourced independently of the project.

4. Training of scientists: One of the key areas in which technology will be advanced in this project will be the area of fodder production. It is important to facilitate the development of a 'fodder specialist' team as part of an ACIAR project to foster integration and exchange of information between institutions. Training in this area may be most effectively achieved through the conduct of a study tour for young scientists likely to make an impact in the long term in this area of research in Pakistan. Again there will be political sensitivities associated with the selection of personnel invited to participate. It may be useful for one or two personnel from NRSP also to be involved with this so that they can see how fodder species fit into production systems in Australia.
5. Similarly in the area of dairy nutrition, a lot could be gained from creating a 'nutrition specialists' network that examined current feed supply systems and developed extension material and decision support tools for education and practical application.
6. Related areas. The training of personnel in the area of AI technology is an important related area for any project. While this may not be the domain of the proposed ACIAR project, a related education program should be implemented through local educational institutes to engage as many people as possible. Training would most likely be at basic level to ensure the maintenance of semen quality at the time of insemination. Training in the elements of oestrus detection should also be included here.
7. The provision of training for para-veterinary personnel would be another aspect requiring attention in order to maximise the impact of any ACIAR project. This could be conducted outside the proposed project through appropriate linkages to other existing or planned programs. Alternatively, recommendations for the implementation of such a program may be developed in conjunction with an Australian cattle veterinary clinician as part of this program. This veterinarian could contribute to the educational material developed as part of the whole farm management educational program.

Summary: The personnel development program should be designed to maximise the interactions between discipline specialists and disciplines so that impact of the training program is long-term. Thus it is imperative to engage local training institutes to ensure that this program is sustained well beyond the life-time of the project. Arguably this aspect may be the most important part of the whole program given the emphasis on technology transfer envisaged for the program.

6.2. Capacity development: Sindh

Major capacity development in this region relate to both research and extension. As with the Punjab production extension and veterinary services are extremely limited. While there is a need for participatory RD&E to assist rural development, the mission team feel that financial constraints dictate the on-ground research in an ACIAR project would best be focused in one province, namely Punjab. However, such a project should invest in capacity development in Sindh. The Sindh Agricultural University is planning to become more involved in community level research. Involving key scientists from the University and Animal Husbandry Department in ACIAR project activities would foster

learning and could lead to spill over effects in Sindh. In developing capacity for this project local postgraduate students enrolled in Masters degrees (2 years) and supervised by local academics in conjunction with the Australian project leaders should be used where possible.

6.3. Capacity development: Industry policy advice

A contribution towards capacity development in the formulation of industry policy positions would be highly beneficial for longer term industry development. Based on discussions during the Mission policy development appears to be uncoordinated and under-resourced. There is no central body funding research and preparing policy advice on industry issues. The deficiency in this area extends from WTO trade policy positions through to domestic marketing arrangements.

The government has established an industry organisation – *Dairy Pakistan* – which appears to be focused on developing the production base of the industry. The long term role of this organisation is unclear. The newly appointed Chief Executive is formulating proposals to put to the Board of *Dairy Pakistan*. It was not possible to get a clear understanding of the resource capability of the organisation.

The Mission team met with a number of Government bodies in order to assess the potential for research partnerships on a policy component of the ACIAR project. *Dairy Pakistan* has the best potential to be the primary research partner. However, there are number of uncertainties about the merits of a research relationship with this organisation:

- it is not clear if the organisation will have a policy development role for the industry;
- the size of the organisation in terms of human resources is uncertain; and
- it is not clear if the organisation plans to develop a capacity to undertake or initiate economic research for policy development.

Despite these uncertainties *Dairy Pakistan* is in a position to make a useful contribution to industry development. It is essential to have an organisation that coordinates industry views on what governments should and should not do in terms of market interventions and industry development initiatives. There appears to be no representation of farmer interests. This is a source of concern when considering the need for changes in the way provincial governments are allocating funds for research and extension activities:

- government policy development works best when there is the discipline of well researched positions prepared by industry interests that cover all sections of the marketing chain.

The ACIAR project could make a valuable contribution to capacity development in the area of industry policy formulation. But it would only be successful if *Dairy Pakistan* had a commitment to develop a policy analysis capability. There are three components of an ACIAR policy project that could have substantial longer terms benefits in capacity development:

- a mission by selected individuals to Australia to visit government institutions, industry bodies, research organisations, extension service providers and alternative farm operations for the purposes of understanding how policy developments have affected the Australian dairy industry;
- a research paper that examines the options for developing (1) a representational structure for coordinating industry policy development and (2) the resource and operational requirements of an economic policy unit within *Dairy Pakistan*;
- a research activity that leads to the preparation of an overarching industry policy report that covers the major issues that will affect long term industry development.

The first component would need to be an organised activity with a suitably qualified chaperone that travelled with the mission. This is to ensure it would be a robust learning exercise with an opportunity to clarify and extend the information gathered by the participants. The members of the mission should be limited to a small number of individuals with direct operational links to similar work activities in Pakistan.

The second component would provide a basis for improving the on-going capability of industry policy development. It would draw on the examples in other countries and have important short term benefits in developing greater cross industry co-operation.

The third component would provide an opportunity to formally introduce the lessons that have been learned from the development of the Australian dairy industry. It would cover trade policy issues, domestic market support mechanisms, industry development policies, farm extension activities and the contribution of marketing cooperatives. The research activity would have:

- a direct linkage to the primary ACIAR project on improvements in farm production by addressing the policy issues that will affect the success of that project (ie retail price controls, extension activities, capacity constraints on milk pick-up, food safety issues, etc); and
- linkages with government organisations, industry bodies and NGOs involved in dairy industry development by requesting contributions on selected items.

7. Opportunities for trade related industry-industry relationships for the mutual benefit of Pakistan and Australia.

The delegation was asked to assess how the Australian and Pakistan private sectors could be included to expand the reach of the Agriculture Sector Linkages Program with a specific focus on dairy development within Pakistan. During the country visit, meetings were held with the Pakistan Government - MINFAL, Dairy Pakistan, Provincial Governments, Universities, NGO's and industry and community farmer groups. The quality and potential of the sector was clearly defined for the delegation and all delegates were very impressed with the capacity and determination demonstrated by community leaders at all stages of the dairy supply chain.

The principal findings can briefly be summarised as investment promotion, production technologies and institutional systems development. In several instances the missing links for industry development remain critical to longer-term development. The scale of the issues are national in proportion requiring a whole of government approach to cement the structural adjustments required for a sustainable, profitable industry within Pakistan. These observations acquired in a brief time frame indicate that much of the trade development work required will need to be linked to demand chain development. In short, without clearly defined and enforced standards, the consumer can be marginalised and confidence in the available supply will therefore be eroded. Due to the niche dairy focus and accepting the financial restrictions of this project, the delegation recommends that the principal actions for trade development should be based upon training within Pakistan and industry advice within Australia.

The purpose and scope of trade development can sometimes be in conflict with the broader project goal of poverty alleviation for small farm rural dairy producers. In many instances a rise in production for small farmers could result in increased home consumption of fresh whole milk rather than an increase in the tradeable supply. Accepting these limitations, an increase in the productive capacity (breed), improvements in nutrition (feed) and increased competitive demand (processing) should result in an improvement in rural producer wellbeing. At a policy level, further improvements within Pakistan could be achieved by establishing effective local/district agronomy services, a clear program on regional road development, an enforced minimum cold chain food standard, the facilitation of downstream competitive product development and a minimum retail consumer packaging standard.

As a result of these core observations, the following next steps are recommended within the trade development project of ASLP. The following activities are projected to occur within the next 12 months:

During the period July – December 2006, a country visit to Australia should be arranged to introduce Pakistan industry to the current best practice within Australia for the dairy industry. The market visit will focus on large dairy producing regions within Australia and will be principally funded directly by participants with limited transport subsidies. The busy schedule will include farmers, producers, investors and government from Pakistan and Australia.

Australia will then seek to introduce Australian and regional industry to Pakistan within a period of 12 months. This two-stage process will include profile raising for the Pakistan dairy industry within Australia and a subsequent range of industry meetings within Pakistan. The goal will be to achieve greater industry linkages to benefit the development of Pakistan Agribusiness. This activity should be seen as an ongoing development of rural business between Pakistan and Australia.

The third and final stage will be to deliver a rural leaders international marketing course within Pakistan based on the highly successful Young Agricultural Leaders Program delivered by the Australian Government within Australia. This five day education course will be delivered within Pakistan at a leading university to be agreed. The course content and lecturer delivery will be provided

under the ASLP by a leading Australian Agricultural University. The course of 80-100 participants should include Pakistan nationals from industry, universities, NGO's, rural farmer leaders and government. The selection for this course should be competitive and determined in consultation with the university provider and the course delivery staff from Australia.

The expected outcomes from these combined activities are to establish a package of universal industry knowledge. This broad body of knowledge and skills should assist the community, industry and government to manage the change process required within the Pakistan dairy sector. The collaborative process between both countries should also spark new directions for investment, development and commercial activity. A basis to determine outcomes on review should include international direct investment, Pakistan private investment and the underlying business activity in the agriculture sector.

On review of the meetings held, there were immediate business opportunities for both countries identified including: advice on livestock identification, biosecurity and food safety, cold chain management, seeds and pasture improvement, alternative crop and production systems, value added processing of meat/dairy products, and retail/franchise development. There remains clear scope for private sector involvement in these development areas with appropriate funding being available from the Pakistan Government using the recently negotiated Asian Development Bank (ADB) program.

In conclusion, the trade delegation would like to thank the many people within Pakistan who contributed to this trade development work. This significant body of knowledge was assembled with our hosts guidance, insight and vision for the future of the dairy sector in Pakistan. Together the delegation will work in the coming 12 months to assist these advisers to progress the many potential projects identified during this visit. The trade delegation expects to engage industry leaders with a specific focus on the unified representation of Dairy Pakistan and the potential extension of services at academic and district levels.

8. Recommendations

8.1. ACIAR research project

8.1.1. Systems research

The focus of an ACIAR research project should relate very much to improving the efficiency of management of the small holder production unit. There have been sizeable expenditures directed into primary research activities in Pakistan for some time. However, the application and adoption of the research by farmers is limited. To have impact a project would need to involve participatory RD&E bringing together discipline skills from a range of institutions. Key elements of a project might be in-depth analysis of current systems; improved feed supply; nutritional management of the dairy buffalo/cow in a whole farm systems context; analysis of the current marketing system and opportunities to form community cooperatives. Skills in socio-economic research will be essential to the success of a project.

The preliminary ACIAR proposal developed by Bill Winter and a draft full proposal to be submitted by the mission should form the basis of a final proposal. A visit to Pakistan by the project leader, an ACIAR Program Manager and potentially a member of this mission should visit Pakistan to finalise the details of a project with Pakistani Stakeholders at the level of activities, staff involved and budget. This visit should explore linkages with existing or proposed projects.

8.1.2. Trade and policy

In any ACIAR project, it will be important to investigate price and marketing and to understand any pricing policy interventions at the retail level. The current market structure and policy arrangements may have short-term implications for successful R&D and farm extension activities. An ACIAR project that shows how to achieve significant improvements in farm performance could be rapidly adopted across the industry. However, there are constraints that could affect the realisation of these benefits in the form of higher farm incomes. For example, the capacity of the local retail market to absorb the additional milk supplies if there is only one marketing channel. There may be unsatisfied demand in the local retail markets due to the constraints in farm/retail distribution system. This is an important question for the realisation of farm level benefits from higher milk production. Understanding the market is a critical issue for the success of poverty alleviation strategies based on improvements in livestock production.

There is insufficient competition in the processing sector and the development of marketing cooperatives would inject greater competition in the market.

An investigation of the industry development policies used by the Federal and Provincial Governments would be highly beneficial for industry policy makers. There would be value in making key policy makers aware of the implications of attempts to direct market outcomes in milk distribution. This could involve making key policy makers aware of the mistakes with previous Australian dairy policies and of the role of dairy cooperatives in Australia.

8.2. Capacity development

An ACIAR project should foster the development of skills in participatory RD&E so that there are impacts at the scientist, extension operative and farmer levels.

There will be a specific need to recruit and train systems specialists in Pakistan within the proposed ACIAR project.

The formation of networks or teams of Pakistani feed production and nutrition specialists to foster integration within and across disciplines would deliver greater efficiency from research to the end user. This is seen as a key component of the proposed ACIAR project.

Targeted post graduate training in project activities has the potential to assist with succession planning in Pakistan research organisations, to involve Universities within the project, and to build linkages between Australian and Pakistan Universities.

The proposed ACIAR project could make a valuable contribution to capacity development in the area of industry policy formulation, if *Dairy Pakistan* is involved and has a commitment to develop a policy analysis capability. Three components of an ACIAR policy project that could have substantial longer terms benefits in capacity development are:

- a mission by selected individuals to Australia to visit government institutions, industry bodies, research organisations, extension service providers and alternative farm operations for the purposes of understanding how policy developments have affected the Australian dairy industry;
- a research paper that examines the options for developing (1) a representational structure for coordinating industry policy development and (2) the resource and operational requirements of an economic policy unit within *Dairy Pakistan*;
- a research activity that leads to the preparation of an overarching industry policy report that covers the major issues that will affect long term industry development.

8.3. Trade

The principal recommendations for trade development are based upon training within Pakistan and industry advice within Australia. They are:

- A visit by Pakistan dairy industry stakeholders to Australia to share information on policy, marketing, value chains, processing and production systems.
- Achieving greater industry linkages to benefit the development of Pakistan Agribusiness by raising the profile of the Pakistan dairy industry within Australia and subsequent industry meetings within Pakistan.
- Development and delivery of a rural leaders international marketing course within Pakistan based on the highly successful Young Agricultural Leaders Program delivered by the Australian Government within Australia.

9. ASLP Pakistan Dairy Support Project: LPS/2005/132

9.1. Structure as developed in debriefing meeting: 23 June 2006

The project will have two major linked themes:

Theme 1: Support for a model system of smallholder dairy production

Theme 2: Capture & enhancement of knowledge relevant to smallholder dairy systems

Refinement of policies at the National and Provincial levels, as they affect the development of the smallholder and commercial dairy sectors, and the trade linkages between Pakistan and Australia to support dairy development, were also considered areas of significant importance. However, it was agreed that they should be addressed separately given that they may require different disciplinary skills and agencies than those required to address Themes 1 & 2.

9.1.1. Theme 1: Support for a model system of smallholder dairy production

Smallholder dairy farmers are the intended beneficiaries of this activity. The immediate target however are the research scientists and extension officers providing information to those farmers. The focus of this effort will be through the NRSP Institute of Rural Management working in two contrasting environments; potentially the NRSP dairy development program at Bhakkar, and at a location such as Okara where the dairy sector is more established and there is both smallholder and commercial dairy farmers and systems.

These issues are fundamental to the scope and nature of the project and warrant brief elaboration:

- Project activities and outputs are intended to benefit smallholder dairy farmers. These farmers typically have 5-10 cows (buffalo and/or cattle) for the production of milk and/or sale of heifers to other farmers. Some project outputs will be relevant to other larger producers, but they are not the primary target.
- Limitations of the extension service and the research/extension interface are widely recognised in Pakistan and these limitations are considered to be bottlenecks in the development of this sector. The major problems have been identified as the style of communication between farmers and extension staff, information available to extension staff that can be used to address farmer problems, skills and numbers of extension staff and a failure to consider problems and solutions in a whole-of-farm systems context. Similar constraints apply to the research/extension or research/farmer interface. All of these limitations can and will be addressed by this project. The NRSP Institute of Rural Management has a national role in training extension workers and working with this agency will have benefits throughout Pakistan and will provide sustainability of project outputs. This agency also has support from the EU funded initiative to improve the capacity of extension workers to which this initiative can add value.
- There is a need to focus the effort: that is, endeavouring to achieve success in a limited situation rather than to spread the effort beyond the resources and realities of the project. If success is achieved it will be a model for similar approaches elsewhere over time and space. This concept goes beyond the 'demonstration farm' to 'demonstration system', with well informed and trained extension personnel engaging with farmers in an interactive, co-learning environment. The choice of two sites is to provide contrast and broader learning for the scientists and extension personnel involved and also as a risk management strategy.

The NRSP activity at Bhakkar satisfies all of the fundamental issues outlined above: it is engaged with smallholder farmers; it involves the training and support of extension personnel; and it provides a discrete focus. The identified limitations of the NRSP program at present are: the extent of information available about the farmers from a whole-of-systems context; lack of appreciation of proven extension methodologies in smallholder systems that involve a more participatory approach; access to scientific information that has been developed in Pakistan and may be relevant to smallholder needs. Dairying around Okara provides a contrasting situation where there is a mix of larger commercial scale (>10 up to 80 animal) and smallholder farms and established outlets to processors as well as local markets. The Department of Livestock Development Punjab has established activities in communities and these linkages could be exploited to first examine the farming systems and then to focus on opportunities to increase productivity and income. The joint involvement of NRSP and the DoLD in the project may provide spin-off opportunities based on their experiences and successes for both agencies. In both case studies the project will develop an understanding of the district policy and marketing settings as they affect opportunities for development of the dairy sector. The farming systems and extension methodologies issues will be addressed as elements of this Theme, while the consolidation of information will be addressed in Theme 2.

An early activity involving NRSP and DoLD staff and extension trainees will be to undertake surveys of smallholder farmers from a whole-of-system context, considering issues such as feed resources and product output, the economics of the crop and livestock and off-farm activities within some different

wealth classes. These surveys will be a learning experience in their own right, and will help to inform the project team about how to balance the motivations of farmers with the resources available and with the range of potential technical interventions. If appropriate, both dryland and irrigated farming systems will be addressed given the considerable differences in problems and opportunities.

Computer tools are available which can initially be used as training platforms and later for direct interactions with farmers, but first these tools need to be calibrated to local circumstances, which will be possible with survey data.

The second initiative will be to develop training modules in extension methodologies that involve a more participatory approach and to embed them into the NRSP Institute of Rural Management program. Obviously these initiatives are linked as the resolution of problems identified by farmer must be done from a farming systems perspective, rather than from a simple component basis.

9.1.2. Theme 2: Capture and enhancement of knowledge relevant to smallholder dairy systems.

This Theme will address important structural and technical issues for the immediate and longer-term development of the dairy sector:

- Assemblage of technical information already in existence in Pakistan;
- Promoting greater interaction between scientists and agencies for their personal benefit and that of the sector;
- Advanced scientific training and establishment of professional linkages between Pakistani and Australian scientists;
- Promoting dialogue between the research and extension communities and development of systems thinking among scientists.

A vast amount of technical information is available in Pakistan of relevance to the dairy sector, but much of it has yet to be interpreted and packaged in a manner suitable for use in training of extension personnel and/or from a farming systems perspective. This has occurred because of poor linkages between research and extension and the discipline focus of scientists. This project can stimulate this process by bringing the technical experts together with the extension trainers to package information in a fashion relevant to the needs of the service providers to smallholders. The NRSP Institute of Rural Management extension training group and activities of DoLD in Okara will provide the focus for this activity, but the outputs produced by the network of scientists from this initiative will be readily available to other groups and agencies.

The number and membership of the scientific networks/groups has not been defined at this stage, but is likely to include areas such as crop and forage production, dairy cow husbandry (nutrition, health, reproduction, environment) and genetics. The groups will include recognised discipline leaders as well as young/next generation leaders to sustain the new systems and collaborative approach.

As information comes together in the activity outlined above, gaps in knowledge and expertise will become evident. These areas will become the focus for technical training, particularly in those areas where Australian scientists are well positioned to add value to their Pakistani counterparts. It is likely that in some instances this training will be of an advanced nature, with information and knowledge more relevant to the future development of the smallholder dairy sector or maybe the larger commercial sector than to current smallholder circumstances. This deviation from a smallholder focus is acceptable given that scientists will have experienced interactions with the extension system and be more aware of farmer needs.

As a guide, the potential agencies involved in these activities will include NARC, Dept of Livestock Development, Punjab; Livestock Production Research Institute, Okara; University of Agriculture Faisalabad; Fodder Research Institute, Sargodha; Livestock and Fisheries Dept, Sindh; Sindh Agricultural University; and NRSP.

9.2. Project management

9.2.1. Advisory Council

An Advisory Council will oversee the project - members will be drawn from: Pakistan Agricultural Research Council (PARC)

National Rural Support Program (NRSP)
National Agricultural Research Centre (NARC)
Department of Livestock Development, Punjab
Fodder Research Institute, Sargodha
Livestock & Fisheries Department, Sindh (Directorate of Animal Husbandry)
University of Sydney
ACIAR (ASLP Coordinator)

The Terms of Reference for the Advisory Council will be developed by the commissioned and collaborating agencies and ACIAR. Significant functions will include encouragement of inter-agency collaboration, communication between agencies, monitoring of progress, identification of opportunities and threats to the project and the like. The Advisory Council will meet annually, will be kept informed of issues and progress on an ad hoc basis, and will be supported by a secretariat within PARC.

9.2.2. Agencies responsible for development and implementation

Australian Commissioned Agency: University of Sydney

Project Leader: Dr Peter Wynn

Pakistan Collaborating Agency: PARC

In-country Project Leader: To be confirmed

Pakistan Collaborating Agency: NRSP

In-country Project Coordinator: Dr Razaqat Raja

Pakistan Collaborating Agency: DoLD, Punjab

In-country Project Coordinator: Dr Rashid Ahmad, Director

Pakistan Collaborating Agency: Other if necessary

Numerous other Pakistan agencies will participate in the project, at least those listed above under Theme 2. Greater operational flexibility will be achieved if that involvement is on an informal basis, with costs associated with involvement met by the project.

The project will also draw upon Australian expertise from agencies other than the University of Sydney, such as CSIRO, Queensland and Victorian Departments of Primary Industries, and private consultants. Those skills will be accessed via contracts.

10. Acknowledgments

We are indebted to Sosheel Solomon, ASLP program officer in Pakistan, and Dr Razaqat Hussain Raja, NRSP, Pakistan, for their professional assistance in arranging meetings and travel and for their hospitality and friendship during this mission.

Many people within Pakistan contributed to our visit and the content of this report. We found discussions with all to be open, and although there were differences in priorities between individuals and groups, there was a genuine desire by all to work towards improving the lot of rural milk producers.

Finally, we thank Catherine Hanley, ACIAR for assistance with the planning and conduct of the mission, Bill Winter and Christian Roth, ACIAR and our various employers for the opportunity to undertake the mission.

10. Attachments

10.1. Itinerary for Australian Dairy Mission 8 -20 May 2006

<i>Date</i>	<i>Location</i>	<i>Dairy Production Team Dr Peter Doyle (Team leader), Dr Peter Wynn, Mr Richard Moss, Mr Bob Clem</i>	<i>Dairy Policy/Trade Team Mr David Harris, Mr Robert Sutton</i>
Mon 8 th	Lahore		Mr David Harris , Arrive Lahore SQ0460
Tues 9 th	Lahore		<p>0900-1000 Meeting with Mr. Muhammad Azhar Chaudhry Special Secretary Agriculture Marketing Department Government of Punjab</p> <p>1030-1230 Meeting with Mr. Muhammad Iqbal Chief Operating Officer Pakistan Horticulture Development and Export Board (PHDEB)</p> <p>1230-1330 Lunch</p> <p>1330-1430 Meeting with Mr. Mansoor Arifeen Chief Executive Punjab Agri Marketing Company (PAMCO)</p> <p>1500-1600 Manager Agri Support Fund (ASF), Agri Business Project</p>
Wed 10 th	Lahore	Arrive Lahore SQ0460	<p>0800-1030 Meeting & visit to the Dairy Farm of Mr. Inam Elahi owner of Pak Fruit Juice Co.</p> <p>1115-1245 Meeting with Idara-e-Kissan Syed Amirul Din Bukhari</p>

			<p>Chief Executive, Idara-e-Kissan, Lahore Milk Plant, Lahore</p> <p>1245-1400 Lunch</p> <p>1400-1500 Meeting with Mr. Ikram-ul-Haq Chairman, Pakistan Dairy Association</p>
Thurs 11 th	Lahore	<p>0730-0830 Breakfast meeting with Dr Rafaqat Hussain Raja, NRSP Mr Sosheel Godfrey, ACIAR & Michael Moignard, Austrade New Delhi &Imran Saeed Khan, Austrade Pakistan</p> <p>0900-1100 Meeting with Mr. Babar Yaqoob Fateh Muhammad Secretary, Livestock Department Government of Punjab & Dr Iftikhar Ali, Deputy Secretary' & Saeed Ahmad Nawaz, Additional Secretary & Dr Sajjad Zaheer Malik, DG Extension for Livestock & Dairy Development, & Dr Zafar Jameel Gill, DG Research for Livestock & Dairy Development.</p> <p>1100-1230 Meeting with Suleman Ghani, Chairman, Planning & Development Board, Government of Punjab, & Nasim Riaz, Chief of Section , & Secretary Livestock Department.</p> <p>1300-1430 Meeting with DG Research Punjab & Dr Muhammad Ashraf Iqbal Mughal at Rakh Dera Chall (Livestock Farms Punjab)</p> <p>1300-1400 Joint Lunch</p>	<p>0730-0830 Breakfast meeting with Dr Rafaqat Hussain Raja, NRSP Mr Aosheel Godfrey, ACIAR & Michael Moignard, Austrade New Delhi &Imran Saeed Khan, Austrade Pakistan</p> <p>0900-1100 Meeting with Mr. Babar Yaqoob Fateh Muhammad Secretary, Livestock Department Government of Punjab & Dr Iftikhar Ali, Deputy Secretary' & Saeed Ahmad Nawaz, Additional Secretary & Dr Sajjad Zaheer Malik, DG Extension for Livestock & Dairy Development, & Dr Zafar Jameel Gill, DG Research for Livestock & Dairy Development.</p> <p>1100-1230 Meeting with Suleman Ghani, Chairman, Planning & Development Board, Government of Punjab, & Nasim Riaz, Chief of Section , & Secretary Livestock Department.</p> <p>1300-1400 Joint Lunch</p> <p>1400-1500 Interaction with informal milk collection & distribution processors on the way</p> <p>1530-1630 Visit Bhains Colony in the suburbs of Lahore, Mr. Amjad Javeed, Rehman Dairies</p>

		<p>1400-1500 Interaction with informal milk collection & distribution processors on the way</p> <p>1530-1630 Visit Bhains Colony in the suburbs of Lahore, Mr. Amjad Javeed, Rehman Dairies & Farrukh Nazir, District Officer (L&DD), City District Government, Lahore.</p> <p>1630-1730 Visit second dairy colony.</p> <p>2000 Dinner hosted by Zubair Nawaz Chatta ,private dairy company, with farmers and Dairy Pakistan representatives.</p>	<p>& Farrukh Nazir, District Officer (L&DD), City District Government, Lahore.</p> <p>1630-1730 Visit second dairy colony.</p> <p>2000 Dinner hosted by Zubair Nawaz Chatta ,private dairy company, with farmers and Dairy Pakistan representatives.</p>
Fri 12 th	Lahore to Faisalabad	<p>0700-0930 Drive to Bahadurnagar Okara</p> <p>0930-1500 Dr Rashid Ahmad, Director, & staff of Livestock Production Research Institute, Bahadurnagar Okara + Lunch</p> <p>1600-1730 Visit two private farms</p> <p>1730-1830 Travel to Faisalabad</p>	<p>0900-1030 Meeting with Mr. Arshad Hussain Hashmi, Manager Business and Sector Development Services (Agriculture and Dairy Sector) Small and Medium Enterprise Development Authority (SMEDA)</p> <p>1100-1200 Meeting with Nestle</p> <p>1230-1400 Meeting with Pakistan Dairy Development Company + Lunch</p> <p>1430-1700 Travel to Faisalabad</p>
Sat 13 th	Faisalabad Bhakar	<p>0900-1400 Visit University of Agriculture Faisalabad: Vice Chancellor, & Faculty of Animal Husbandry & Faculty of Veterinary Sciences</p> <p>1530 Drive to Bhakkar</p> <p>1700 – 1745 Visit roadside farm</p> <p>1745 – 2130 Continue to Bhakkar.</p>	<p>0900-1200 Visit University of Agriculture Faisalabad: Dept. of Marketing & Agribusiness</p> <p>1230-1400 Lunch</p> <p>1400 Drive for Bhakkar</p>

Sun 14 th	Bhakkar	<p>0500-0730 Visit Punjab Govt. dairy farm Rakh Ghulaman</p> <p>0900 – 1000 Dr Mughal, Director Livestock Farms & Jamil Basra, Manager Livestock Farms & Dr Sajjad Zaheer Malik, DG Extension</p> <p>1000-1300 Visit Rakh Ghulaman Community - dairy smallholders</p> <p>1400-1500 Team Meeting</p> <p>1500-1630 Visit Chori Ghulaman Community dairy smallholders</p> <p>1730-1830 NRSP, Field Unit Kaloorkot, Ghulam Rasoor, Regional Program Manager, Mianwali, & Mr Bukhari, District Program Manager, Bhakkar</p>	<p>0800-1230 Visit Punjab Govt. dairy farm Rakh Ghulaman; meetings with dairy smallholders</p> <p>1230-1400 Lunch</p> <p>1400-1700 Continue field visit & meeting with local NRSP team</p>
Mon 15 th	Sargodha Islamabad	<p>0700 Drive for Sargodha</p> <p>0930-1000 Visit NRSP District Office</p> <p>1000-1100 Continue to Sargodha</p> <p>1100-1230 Meeting Dr Akhtar Ali, Director, Fodder Research Institute & Staff</p> <p>1300-1500 Visit to Noon Pakistan Ltd Dairy Factory, Bhalwal District Sargodha & milk collection centre</p> <p>1500-1900 Drive to Islamabad</p>	<p>0700-1200 Drive to Islamabad</p> <p>1230-1400 Meeting with Livestock & Dairy Development Board + Lunch</p> <p>1430-1530 Meeting with Dr. Syed Wajid Pirzada, Chief WTO Unit, MINFAL</p>

Tues 16 th	Islamabad	<p>0900-1230 MINFAL organised stakeholder meeting with Muhammad Ismail Qureshi Secretary, MINFAL & representatives of Provincial Depts. Livestock; PARC; NRSP, Dairy Association, & private dairy sector.</p> <p>1230-1330 Lunch with all the participants 1330- 1350 Meeting with Dr. Muhammad Afzal, NARC</p> <p>1400-1445 Meeting with Animal Sciences Institute, NARC</p> <p>1445-1515 Meeting with Fodder Research Group, NARC</p> <p>1515-1600 Meeting with Range Research Group, NARC</p> <p>1600-1700 Meeting with Dr. Muhammad Afzal Animal Husbandry Commissioner, MINFAL & Member In-charge Animal Science Division, PARC</p> <p>1800-2000 Discussions with the High Commissioner</p>	<p>0900-1230 MINFAL organised stakeholder meeting with Muhammad Ismail Qureshi Secretary, MINFAL & representatives of Provincial Depts. Livestock; PARC; NRSP, Dairy Association, & private dairy sector.</p> <p>1230-1400 Lunch for all the participants 1430-1600 Meeting with Agri-Business Project team & ALMA</p> <p>1800-2000 Discussions with the High Commissioner</p>
Wed 17 th	Islamabad Karachi	<p>0800-1230 Team meeting and report writing including discussion with Sosheel and Dr Raja</p> <p>1300-1430 Report writing</p> <p>1500-1530 Meeting with Jahangir Khan Tareen, Minister for Industries, Production & Special Initiatives, GoP & Secretary of Ministry.</p> <p>1600-2200 Travel to Karachi</p>	<p>0830-1000 Austrade; Australian High Commission</p> <p>pm: team meeting Mr Robert Sutton</p> <p>Mr David Harris to leave at 2000 by PK 0381 for Lahore & at 2245 by SQ0460 for Singapore</p>

Thurs 18 th	Karachi Hyderabad	<p>0900-1200 Meeting with Dr Baz Muhammad Junejoo, Secretary, Livestock & Fisheries Department, Government of Sindh, Dr Shazado Malkani, Director General, Livestock & Fisheries Department & Dr Sarwar Sheikh, Director, Directorate of Animal Husbandry.</p> <p>1200-1330 Visit to Landhi Cattle Colony</p> <p>1330-1530 Lunch & meeting with Dairy Association</p> <p>1530-2100 Travel to Hyderabad</p>	
Fri 19 th	Hyderabad Karachi	<p>0800-1015 Meeting with Dr Sarwar Sheikh, Director, Directorate of Animal Husbandry & senior staff.</p> <p>1100-1330 Meeting with Dr Bashir Ahmed Sheikh, Vice Chancellor, Sindh Agricultural University & Heads of Departments.</p> <p>1400-1530 Lunch & discussions with University staff.</p> <p>1530-1900 Drive to Karachi including visit to dairy colony.</p>	
Sat 20 th	Karachi	<p>0830-1300 Team wrap-up discussions</p> <p>1330-1600 Report writing</p> <p>1630 Depart for airport.</p>	

10.2. Material cited or used

Background material on the Agriculture Sector Linkages Program (ASLP) provided by ACIAR.

Material in presentations provided by:

- Mr. Babar Yaqoob Fateh Muhammad, Secretary, Livestock Department, Government of Punjab, Lahore.
- Dr Rashid Ahmad, Director, Livestock Production Research Institute, Bahadurnagar, Okara.
- Dr Akhtar Ali, Director, Fodder Research Institute, Sargodha.
- Dr Sartaj Khan, Coordinator Fodder Research, National Agricultural Research Centre, Islamabad.
- Dr Sarwar Sheikh, Director, Directorate of Animal Husbandry, Government of Sindh, Hyderabad.

References

Economic Survey of Pakistan (2001-02 or 2004-05) Government of Pakistan, Finance Division, Economic Advisor Wing, Islamabad.

Sarwar M, Khan MA, Mahr-un-Nisa, Iqbal Zafar (2002) Review. Dairy industry in Pakistan: a scenario. *International Journal of Agriculture and Biology* **4** (3) 420-428.

Sheikh BA, Sheikh SA, Soomro GH (2005) Pakistan agriculture in global perspective. *Pakistan Journal of Agriculture, Agricultural Engineering and Veterinary Science* **21** (2) 53-59.