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PROSPECTS AND LIMITATIONS OF DAIRYING IN GUJRANWALA DISTRICT (PUNJAB-PAKISTAN)

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ABSTRACT

A study involving survey of 120 respondents of different categories from district Gujranwala (Punjab-Pakistan) was conducted to investigate the trends in dairying Average milk production of cows and buffaloes was found to be 4.50 and 6.53 lit./day respectively. Milk is mostly (98.3 %) consumed as fresh processed and marketed to milk collectors in raw form. Combined animal feeding was the common practice with no special dietary allowance for high yielders. Average green fodder offered to lactating cows and buffaloes was found to be 43.49 ±2.67 and 59.03 ±1.39 kg/head/day, whereas corresponding values for dry cows and buffaloes were 26.46 ±2.13 and 39.48 ±1.58 kg/day, respectively. Lactating animals were preferred for concentrate feeding. Animals were vaccinated mainly against foot and mouth disease (FMD) and haemorrhagic septicaemia (HS). Adoption level of disinfection of the navel cord, dehorning (in cows), natural breeding, teat dipping, washing of udder and culling was 8.3, 25.8, 51.7, 20.8, 74 and 61.70 % respectively. Special feeding of dairy animals before calving was also reported by 41.7 % respondents. Record keeping was utterly lacking (91.7 %). Age at first breeding, age at first calving, lactation length, dry period, intercalving interval and productive life in case of buffaloes was 40.87±0.43, 52.48±0.48, 10.66±0.085, 4.35±0.051, 15.13±0.18 months and 9.22 ± 0.18 years respectively while in case of cattle the corresponding values were 29.11±1.280, 43.20±6.33, 9.12±0.37, 2.56±0.11, 12.50±0.50 months and 8.36 ±0.42 years, respectively. It may be inferred from these results that adoption of modern husbandry practices is still grossly lacking with a variable degree leading to low productivity and low profitability of the producer.

Key words: Dairying, Punjab, Pakistan.

INTRODUCTION

Livestock play a key role in the agricultural economy of Pakistan and dairy animals are considered an important component of livestock wealth. At global level, Pakistan is among the five largest countries contributing about Rs.570 billion per annum to the national economy (Kakakhel, 2010).Out of the total milk produced in the country, buffalo and cattle contributes about 68 and 27 %, respectively, while the rest is shared by small ruminants and camels (Raza and Rabbani, 2012).More than 70 % dairy animals are owned by farmers having herd size of 1-10 animals. These farmers are back bone of our dairy industry that supplies more than 80 % of market milk. A significant percentage of cattle (76.4) and buffaloes (81.4) are kept by these small/landless farmers (Pakistan Economic Survey, 2010-11).

Pakistan is blessed with promising dairy breeds of various farm animals viz. buffaloes (Nili-Ravi, Kundhi) and cattle (Sahiwal, Red Sindhi, Cholistani), goats (Beetal, Dera Din Panah, Kamori), camel (Brella).These animals are well reputed not only for their high productive potential and are reported to be well acclimatized in their respective home tract. Rural subsistence smallholdings, rural, market-oriented smallholdings, rural commercial farms, peri-urban commercial dairy farms are the main dairy farming systems of Pakistan.

Majority of the farmers retain a portion of the milk produced for domestic needs and the rest is marketed. Mixed farming (crop and livestock) is in vogue in the Punjab. The landless farmers mainly keep dairy animals to meet their daily home requirements through the sale of milk and sometimes by selling of animals as a ready bank to meet the financial needs. These farmers mostly depend on grazing for their animals along the canal banks and water channels and feed some fodder obtained in return of their services rendered for land owners .However, mostly the animals remain underfed. Only the lactating animals get the owners attention for proper feeding, whilst dry animals often remain neglected. Inadequate feeding thus does not allow exploitation of their genetic potential (Raza *et al*., 2006).

Production of quality food in terms of meat and milk is the most important function being performed by large and small ruminants. Currently Pakistan posses 35.6

million cattle and 32 million buffaloes as the dairy animals (Pakistan Economic Survey, 2010-11)

Although national production of milk and meat show a consistent increasing trend over the last four decades but it is due to horizontal increase in the number of livestock in the country. The demand for livestock products of course has to further increase due to rapid population growth, urbanization and increase in the per capita income in country. The productivity of our animals is far below than their actual genetic potential. Major constraints in this respect include inadequate feed resources, limited health coverage, highly inadequate A.I services, almost non availability of superior bulls for natural services and limited access to credit facilities for dairying. In this regard, rural communities in general and small farmers in particular suffer the most, getting low return from their farms produce, which makes extremely difficult for small and landless farmers to purchase various inputs like feed, medicine and other miscellaneous items. Realizing the significance of dairy sector and the accompanying problems, the present study was planned to know the existing dairying trends in an irrigated area i.e district Gujranwala.

MATERIALS AND METHODS

The study was carried out by interviewing 120 respondents using a pre-tested questionnaire in an irrigated area as mentioned in introduction section-Gujranwala district. The respondents were comprised of four categories viz. landless producers (1-2 animals); small farmers (3-5 animals), medium farmers (6-10 animals) and large farmers (> 10 animals).The respondents from four tehsils (Gujranwala, Kamonke, Nowshera Virkan and Wazirabad) were interviewed on various aspects of dairying. From each tehsil, 30 respondents were selected randomly. The questionnaire was based on various aspects of dairying such as animal inventory, herd size, milk production and its disposal, farm income, feed, labor, breeding, health management, various husbandry practices etc. The data was collected and analyzed by using descriptive statistics (Steel *et al*., 1997).

RESULTS AND DISCUSSION

Feeding: Most of the farmers (87.5 %) were dependent on farm produced feed for their animals, while only 2.5 % farmers purchased feed for their animals. Practice of combined feeding was the commonest among the farmers (95.8 %) than individual feeding of animals (4.2 %). Feeding frequency twice and thrice a day was 66.7 % and 29.2 % cases, respectively. *Ad-libitum* feeding was seen in very rare cases (4.2 %). Know-how about in fodder preservation techniques was very limited e.g. silage making (5.8 %). As a whole farmers (94.2 %) were unaware about these concepts.

Consumption of green fodder: Quantitative and qualitative insufficiency of feed and fodder in general is one of contributory factors towards low milk yield. Average consumption of green fodder by lactating cows and buffaloes was found to be 43.49 ±2.670 and 59.03 ±1.390, respectively.

Consumption of concentrates, wheat straw and other feeding material: Due to high milk production and better market price of milk, almost all the respondents offered homemade concentrates to their high yielders. Better milk prices provides a spur to farmers to feed their animals quality ration. The existing price of the available concentrate ranged from Rs. 18-22 / kg depending upon the area, locality and season of the year. Practice of concentrate feeding was mostly found for lactating cows and buffaloes e.g 1.84 ±0.221, 2.13 ± 0.216 kg/d, respectively. These findings are in line with the study of Pundir *et al.* (2000) on Mehsana buffaloes in India where 45.5 % farmers offered 0.5 to 2 kg concentrates daily to only milking animals at the time of milking. Singh (2003) in his study also reported concentrate feeding only to lactating cows and working bullocks.

Grazing of livestock: Most preferred sites for grazing were banks of canals, road sides and their own land. Of the total, 43.3 % respondents were found grazing their animals in summer and reported no grazing in winter. Most of the farmers (18.3 %) grazed their animals for six hours. During winter season 82.5 % farmers did not graze their animals.

Housing: Mostly conventional housing (75 %) was practiced. Only 21.7 % respondents adopted loose housing system. A very small percentage (3.3) of farmers used a combination of these two systems was also noticed (3.3 %). Pundir *et al.* (2000) in a study on buffalo reported that majority of farmers (87 %) follow the conventional housing system which is in agreement with the present study. Cows in tie-stalls have been reported to have a higher clinical mastitis rate, a higher disease rate and a lower fertility status (Valde *et al*., 1997).Another disadvantage of tie-stalls compared to loose-housing systems is a higher incidence of podal and body lesions, especially when cows do not have access to regular outdoor exercise (Regula *et al.,* 2004).

Various husbandry practices

Dehorning: Dehorning of calves was practiced by 25.8 % farmers. Fulwider *et al*. (2007) reported that calves were dehorned at different ages, 34.5 % at 8 weeks and 78.8 % at 12 weeks of age which is contrary to the present findings.

Drenching and dipping: Drenching and dipping was practiced by 67.5 % and 20.8 % respondents respectively. The majority of the farmers drenched their animals on quarterly basis (31.7 %), 15 % thrice a year while 14.2 % respondents performed twice a year. Only about 5% respondents performed drenching once a year with an average drenching cost of Rs. 33.04/ per head. Dipping was practiced biannually (18.3 % out of 20.8 %) while only 0.8 % on quarterly basis (out of 20.8 %).Bilal *et al*. (2008) reported 33 and 31 % adaptation trend in respect of deworming and dipping respectively for calves and these findings are in partial agreement with the present study.

Dry animal therapy and hoof trimming: Trend of dry animal therapy and hoof trimming was entirely lacking among the farmers. These findings are in line with study of Ahmad *et al*., (2009) and Tiwari *et al*. (2006) who reported the same. Dry animal therapy increases the protective properties of colostrums and reduces the calf infection (Smith, 1977).

Navel cord disinfection: Majority of the farmers (91.7 %) have no awareness about this practice. The results of the presents study are in line with those of Ahmad *et al*.,(2009) and Tiwari *et al*.,(2006) who reported that all the commercial dairy owners did not cut or disinfect the navel cord due to which navel cord infection in buffaloes calves was mostly at farms.

Breeding: More than 50 % cows and buffaloes were bred naturally, while 48.8 % follow both artificial insemination and natural mating. Half of the respondents use their farm produced breeding bull for the natural breeding while rest of the farmers (49.2 %) hire the services of village bull. On an average, cost of natural service and artificial insemination was Rs. 60 and 200 / animal respectively.

Culling: On overall basis, 61.7 % respondents regularly cull their animals on different basis whereas it was absent in others. General bases of culling were repeat breeding, low milk production, reproductive disorders, mastitis, old age and disability. The main reason of culling was found to be repeat breeding and low production (36.6 %). No specific time was followed for culling dairy animals.

Milking practices: Simply, washing of udder before milking was found to be the commonest practice (74 %). Practice of teat dipping along with washing of udder is followed by 20.8 % respondents. Almost half (47.5 %) of the farmers use oxytocin injection for milk let down. A dose of 1 ml of oxytocin/ animal/milking administrated as reported by 28.3 % farmers while 19.2 % inject double than this. In the present study, all dairy animals were found to be hand milked. The present study is in line with study of Pundir *et al.* (2000) who reported 80 % of farmers practiced cleaning of udder and teats of the buffalo before milking. Practice of teat dipping reduces the chances of teats from attack of pathogens thereby improves the udder health by controlling the mastitis as reported by Goodger *et al*., (1988).

Maintenance of farm records: The trend of maintenance of farm records is lacking in majority cases (91.7 %).Tomaszewski (1993) is of the opinion that record keeping systems had provided an essential link that significantly increased milk production besides strengthening the linkages among producers and consumers.

Calf management

Postnatal feeding: Almost all respondents (99.2 %) showed positive response regarding the colostrum feeding to calves. However, a lot of variation exist in the first time colostrum feeding to the calves e.g. :19.2 % respondents offer within one hour after birth , 14.2 % after 2 hours, 17.5 % after 3 hours, 31.7 % after 4 hours and 17.5 % respondents reported colostrum feeding to calves after 5 hours of their birth. Mostly respondents (59.2 %) continued colostrum feeding up to four days. On an average 3.77 liter colostrum was offered daily to each calf which is in accordance with the study of Fulwider *et al* (2007) who reported that many farmers offering 3.8 liters /day milk as first feed to calves. As a whole 80.8 % did not feed the colostrum till the expulsion of the placenta, and majority animals did not shed placenta for more than 7-8 hours post-calving, leading to reduced immunity level in calves.

Feeding system: Natural suckling was found to be the most preferred calf feeding system. The farmers were using calves only for milk let down. The calves were suckling milk both before and after milking. It has been emphasized that a calf must receive sufficient milk during first three months or a minimum 110 liters of whole milk should be fed over a period of 4-5 weeks (Sharma and Mishra, 1987). Feeding milk replacer was practiced by only 8.3 % farmers.

Health management

Vaccination: The animals were reported to be vaccinated against FMD and HS by 87.5 % farmers. This is mainly performed by the state officials (66.7 %). Self-vaccination for diseases was practiced only by 16.7 % respondents. A small number of respondents (2.5 %) seek vaccination services from different NGO's like Pakistan Dairy Development Company or Livestock and Dairy Development Board. On overall basis average cost of vaccination was found to be Rs. 15.46 /animal /year. The findings of present study are in line with those of Karim and Najeeb (2001).

Milk production related aspects

Milk production and its disposal: Average milk production of cows and buffaloes was 4.50 and 6.53 kg/day. Total milk production of each farm averaged 85.79 kg/day, of which 65.95 kg was marketed every day and 17.08 kg was used for domestic consumption. On average marketed milk price / litre worked out to be Rs. 28.25/ liter. Jahangir *et al*. (1990) conducted a survey of livestock production in the Shahkot area, district Sheikhupura and reported average milk production in cows and buffaloes as 5.19 and 6.49 liters per day, respectively. These results are in line with the present study. Majority of the farmers (72.5 %) were marketing their milk. Because of better milk marketing conditions, the farmers were very more inclined toward milk marketing instead of its use at home. Thorpel *et al.* (2000) studied the dairy development in Kenya and reported that marketed milk (85-90 %) of the milk produced/ marketed was consumed in raw form. The factors influencing informal market were traditional preferences for fresh raw milk (which is boiled before consumption) and consumers' unwillingness to pay the costs of processing and packaging. Raw milk markets offered higher prices to producers and lower prices to consumers. These markets also provided valuable opportunities for employment of rural and urban workers.

It was noticed that only 72.5 % respondents were involved in the milk disposal. Main source of milk disposal was the milk collector and most of the farmers (53.30 %) belonged to this category. The present findings of the study indicated that 53.3 % the respondents sell raw milk directly to the milk collector/dohdies.These findings are contrary with the findings of the Tariq *et a.*(2008) who reported 97 % milk distribution through traditional gawala system in Pakistan. It was due to the lack of proper planning, collection, distribution facilities etc.

On an average, price of the marketed mixed (cow and buffalo) milk was Rs. 28.25 / litres. Majority of the (85.8 %) of the farmers sold milk without any quality evaluation. Of 14.2 % respondents, 10.8 % respondents marketed their milk on the basis of fat content and a very limited number (3.3 %) on the basis of fat and total solids. These farmers in fact marketed their milk to established enterprises on the basis of payment based on fat and total solids. Around 34.2 % farmers received payment on monthly basis for their marketed milk. In majority of cases (79.10 %), milk was transported through motorbike while other transportation modes contributed little in this regard. Milk was collected mainly (95.8 %) directly from farmers. Maximum distance of 20 km was covered by only three respondents to reach the sale point which was covered within 22 minutes time. Maximum distance covered by respondents to reach a milk collection point was 20 km. Khan (2008) reported that milk is hauled to cities using bikes, vans and cycles. In additions, there are public and private large dairy farms supplying milk to urban areas using their own vans. The second most important source of the farmer's income was sale of young calves. Buffalo calves aged 1.5 year were sold each at the rate of Rs.13208. Age wise one year cattle calf was sold for Rs.6750. In case of buffalo calves, majority of the farmers (27.5 %) marketed calves when 2 years old, whereas 25 % farmers marketed just at 1 year age and 15 % farmers marketed their stock at 3 years of age. Almost similar trend was observed with cow calves. However, females calves of both species were raised as future replacements, but exceptionally a few may be sold to meet unavoidable financial requirements.

Cost of milk production: Average cost of milk production per liter was higher with farmers having large herds (Rs. 20.15) and the lowest (Rs.16.77) with landless farmers. The lowest cost of landless farmers verses large farmers was observed in terms of labor, farm mechanization and other husbandry practices. Average cost of milk production/ litter on overall basis was Rs.19.21 / litre. Khan *et al.,* (2008) reported the economic analysis of milk production in different cattle colonies in Karachi. Purchased price of a dairy animal has increased tremendously and became double i.e. Rs. 100000/- as compared to the price i.e. Rs 50000 in years 2003 and 2004. Calf rearing, commercial tariff on electricity, disposal of animal dung, occurrence of various diseases and costly labour hiring were identified as the major constraints affecting the cost of milk production in urban areas.

Production traits

Age at first breeding: Farmers do not maintain the production traits record. Respondents provided information based on their memories. Age at first breeding in buffalo and cows on overall basis averaged 40.87±0.425 and 29.11±1.280 months, respectively. In buffaloes, age at first breeding in various categories did not vary too much, however it varied a lot in respect of cows. This indicated that farmers irrespective of herd size provided almost uniform management to buffaloes, whereas, there seemed some inconsistency in case of cows. High level of cross breeding in cows and environmental effects may be partly responsible for this variation.

Average age at first calving: Average age at first calving in buffaloes and cows was observed as 52.48±0.478 and 43.20±6.330 months, respectively. The age at first calving in buffalo was not much different among different farmers categories, but a lot of variation (± 6.33) existed in cows. Great variation in age at first calving could be attributed to great variation in the management of cows in different categories. Late age at first calving is attributed to poor management and under

feeding and large number of crossbred cows with different blood levels.

Average lactation and dry period: Buffaloes are in milk on an average for 10.66 ± 0.085 months and there was no noticeable difference in lactation period among different categories of farmers. Average dry period of 4.35±0.051 months was observed in buffaloes and there was hardly any appreciable difference in the dry period of buffaloes among the small or large farmers. The average lactation length and dry period in cows was found to be 9.12±0.368 and 2.56±0.112 months respectively. Ahmad (2004) reported average lactation length in Sahiwal cows as 8.5 months, which is close to the finding of the present study.

Average inter-calving interval: Inter-calving interval in buffaloes and cows averaged 15.13±0.178 and 12.50±0.504 months, respectively. The inter calving interval in buffaloes did not vary much, while the same showed high variation in case of cows which may be due to great extent of cross breeding in cows besides environmental and management factors. Average productive life of buffaloes and cows was reported as 9.22±0.177 and 8.36±0.416 years, respectively. This can be improved significantly by improving their nutrition, genetic makeup and management.

Table 1. Milk collection and its disposal

a) Mode of milk disposal	Frequency	Percentage
Family use	33	27.50
Market and family use	87	72.50
Total	120	100
b) Sources of milk disposal		
No disposal	33	27.50
Milk collector	64	53.30
Milk collector and established enterprise	8	6.70
Milk collector and nearby town	2	1.60
Established enterprise	8	6.70
Local sale point	1	0.80
Nearby town	1	0.80
Any other	3	2.50
Total	120	100

Table 2. Milk price/ liter, basis for payment and time of payment

Payment	Frequency	Percentage
Domestic consumption	33	27.5
Weekly	10	8.3
Fortnightly	16	13.3
Monthly	41	34.2
Weekly and monthly	16	13.3
Fortnightly and monthly	2	1.6
Bimonthly	2	1.6
Total	120	100

Table 3: Production traits of dairy animals

Production trait	Buffalo	Cow
	Mean ± SE	Mean ± SE
Age at first breeding (months)	40.87±0.425	29.11±1.280
Age at first calving (months)	52.48±0.478	43.20±6.330
Lactation length (months)	10.66±0.085	9.12±0.368
Dry period (months)	4.35±0.051	2.56±0.112
Inter-calving interval (months)	15.13±0.178	12.50±0.504
Productive life (years)	9.22 ± 0.177	8.36 ±0.416

Conclusion: The present study inferred that as a whole livestock husbandry is based on traditional lines resulting in to low productivity of dairy animals owing to several factors. Among these, key factors include malnutrition, poor genetic makeup, faulty housing ,inadequate health and extension services etc.Addressing these factors on scientific lines will not only boost dairy animals productivity but will serve as a viable tool to improve the economic viability of the dairy farming community.

REFERENCES

Ahmad, S., M. Yaqoob, N. Hashmi, M. A. Zaman and M. S. Amjad (2009). Farmers' attitude towards interventions regarding buffalo calf health care and management practices under field conditions. Pak Vet J, 29: 1-4.

Ahmad, M. (2004). Estimation of economic values for milk production in Sahiwal cows. 25th Annual Report, Livestock Production Research Institute Bahadurnagar ,Okara: 42-46.

Bilal, M. Q., A. Hameed and B. B. Khan (2008). Evaluation of calf management related technologies at farmer's level under technology transfer project. Pak J AgriSci, 45:177-180.

Fulwider, W. K., T. Grandin, B. E. Rollin, T. E. Engle, N. L. Dalsted and W. D. Lamm (2007). Survey of dairy management practices on one hundred thirteen North Central and Northeastern United States Dairies. J Dairy Sci, 91:1686–1692.

Goodger, W. J., J. C. Galland and V. E. Christiansen (1988). Survey of milking management practices on large dairies and their relationship to udder health and production variables. J Dairy Sci, 71: 2535-2542.

Jahangir, M., M. A. Qazi, S. H. Hanjra, A. S. Hashmi, A. Iqbal, G. R. Ahmad and Z. Khan (1990). Existing livestock production practices on small farms. Bangladesh. J Anim Sci, 19: 131-138.

Kakakhel, I. 920100. Daily Times. Dated February, 27.

Khan, B. B. (Ed.), (2008). Health and Husbandry of Dairy Animals.1st edition Pak. T.M. Printers, Faisalabad.

Khan, U. N., J. A. Lund, S. Javaid and Z. Hassan (2008). Economic analysis of milk production in cattle colonies of Karachi. Pak J Agri Sci, 45: 403-409.

Karim, M. and S. Najeeb (2001). An evaluation of extension activities of LPRI, Bahadurnagar during the year 1999-2000 in Okara District.22nd Annual Report, Livestock Production Research Institute Bahadurnagar, Okara: 115-122.

Pakistan Economic Survey, (2010-11). Ministry of Finance, Economic Advisors Wing, Islamabad.

Pundir, R. K., G. Sahana, N. K. Navani, P. K. Jain, D. V. Singh, S. Kumarand, A. S. Dave (2000). Characterization of Mehsana buffaloes in IndianAnim Gen Res Info, 28: 53-62.

Raza, S. H., M. Riaz, Virk and A. Iqbal, (2006). Milk productivity: A changing scenario for future investment. In: Proceed. Int. Conf. Productivity and Growth in Agriculture: Strategies and Interventions.6-7 December, Univ. of Agri. Faisalabad.

Raza, S. and M. Rabbani. (2012). Buffalo farming in Pakistan.Pakistan Today,Dated 23 June.

Regula, G., J. Danuser, B. Spycher and B. Wechsler, (2004). Health and welfare of dairy cows in different husbandry systems in Switzerland. Prev Vet Med, 66: 247- 264.

Singh, R. (2003). Survey of socio-economic profile of farmers and animal feed resources in the mountains of Himachal Pradesh. ENVIS Bull, 13*:* Himalayan Ecology.

Sharma, M. C. and R. R. Mishra (1987). Livestock health and management. Khanna Publishers, New Delhi, India.

Smith P, 1977. Proposed calfhood immunization program for the commercial dairy herd. J Dairy Sci, 60: 294-299.

Steel, R. G. D., J. H. Torrie and D. A. Dickey (1997). Principles and Procedures of Statistics. A Biometrical Approach (3rd Ed.). McGraw Hill Book Comp. Inc. New York, USA.

Tariq, M., M. I. Mustafa, A. Iqbal and H. Nawaz (2008). Milk marketing and value chain constraints. Pak J Agri Sci, 45:195-200.

Tiwari, R., M. C. Sharma and B. P. Singh (2006). Studies on buffalo health and production practices in small farms. Indian J Vet Med, 26: 62-64.

Thorpel, W., H. G. Muriuki, A. Omore, M. O. Owango and S. Staal1 (2000). Dairy development in Kenya: The past, the present and the future. Symp: "Challenges to Animal Production in the New Millennium". March 22-23, Kenya Agricultural Research Institute (KARI) Headquarters, Nairobi.

Tomaszewski, M. A., (1993). Record-keeping systems and control of data flow and information retrieval to manage large high producing herds. J Dairy Sci, 76: 3188-3194.

Valde, J. P., D. W. Hird, M. C. Thurmond and O. Osteras (1997). Comparison of ketosis clinical mastitis, somatic cell count, and reproductive performance between free-stall and tiestall barns in Norwegian dairy herds with automatic feeding. Acta Vet Scand, 38: 181- 192.