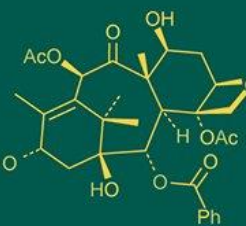
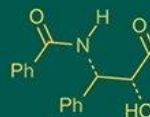
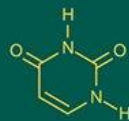


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Factors affecting the decision to exit dairy farming: A case study in Punjab (India)

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Abstract

Punjab is one of the leading dairy state in India providing subsistence to landless, marginal and small farmers. Punjab is the land for 2.16 percent of the country's total bovine population, producing 14.07 MT (6.4 percent) of milk annually (BAHS, 2022). Feed prices have increased by 14.1 percent over the last three years, therefore, farmers' returns are not compensating as feed and fodder accounts for more than 70% of the cost at dairy farm. As a result, the dairy industry is having numerous difficulties due to farmers quitting the business. In order to identify reasons for closure of dairy farms in Punjab, survey was conducted at the Department of Dairy Economics and Business Management, GADVASU, Ludhiana. Simple random sampling technique was applied, and a sample size of 33 farmers, who exited from dairy farming in Punjab, was selected for the primary study. Chi square test, ANOVA and Factor analysis was used to identify the main reasons which lead to the exit of farmers from dairy enterprise. The study revealed that high concentrate feed prices and high dry fodder prices were among the main feeding related reasons for the closure of dairy farms in the state. Other reasons include, high cost of labour (management/production), high veterinary expenses, disease incidence (health), less price of milk, less sale price of animals and adulteration (marketing). Broader focus on dairy support programs would help reduce the number of farmers exiting dairy enterprise.

Keywords: Closure of farms, dairy farming, garret's ranking, loss incurred and milk price

Introduction

Dairying has been one of the major allied sectors of agriculture in Punjab since time immemorial. It plays an important role in agricultural sector as its evident from contribution to the total agricultural GDP in India and Punjab as 30.2 per cent and 38.2 per cent, respectively (BAHS, 2023 and Statistical Abstract of Punjab, 2022). The enterprise as a source of livelihood has been supplementing income to small, marginal and landless farmers. Punjab is the home of 2.15% of the total bovine population of the country wherein buffaloes and cattle comprises of 3.7% and 1.3% respectively. The emergence of dairy farming as a profitable enterprise has been attributed to the increase in the population of high yielding exotic cattle in Punjab by 15.30% and also the decline in low-yielding indigenous and non-descript cattle by 46.9% as recorded from census 1997 to 2019. At present, the total exotic and indigenous cattle population is 2.11 million and 0.43 million respectively whereas buffalo population is 4.02 million which altogether produces 14.3 million tonnes of milk in Punjab (i.e. 6.2% of the total milk production in the country). Buffaloes constitute the major share of total milk produced in the state with 8.5 MT (59.4%) followed by crossbred cattle 4.06 MT (32.2%) and goats with only 0.09 MT (0.6%). Punjab ranks 7th in milk production in the country after Uttar Pradesh (36.2 MT), Rajasthan (33.3 MT), Madhya Pradesh (20.1 MT), Gujarat (17.2 MT), Andhra Pradesh (15.4 MT) and Maharashtra (15 MT) (BAHS, 2023). Apart from high yielding genetic selection of bovine population, the profitability of the dairy enterprise is also due to the higher milk yield of species more than the national average. For instance, crossbred cattle milk yield in Punjab is 12.83 kg/day/animal followed by buffalo (9.92 kg/day/animal) and indigenous cattle (9.15 kg/day/animal) respectively whereas milk yield of crossbred cattle, buffalo and indigenous cattle in India is 8.41, 6.76 and 4.17 kg/day/animal respectively (BAHS, 2023) as shown in Figure 1.

There are four types of production systems in Punjab namely; domestic/landless farmers (0-2 animals), small & medium dairy farmers (3-15 animals), large/commercial dairy farms (15 to 500 animals) and peri-urban dairy farms (intensified production system, located at the

Outskirts of cities) respectively as shown in Figure 2. These production systems are categorized on the basis of size of the farm and it also influences the economics of a dairy farm. Further, importance of dairy farming in Punjab could be gauged from the output value of milk which is more than 80% out of the total value of output from livestock in Punjab. Despite of the production efficiencies and economics of the scale in the dairy enterprise, it has been observed that there has been exit of the enterprise among dairy farmers of Punjab. As Punjab is a traditional dairy state of the country with highest per capita availability of milk i.e. 1283 g/day which is around 3 times more than the national average of 459 g/day (BAHS, 2023), but the economic activity of dairy-farming dependent households has been adversely affected with their exit from the enterprise. This has further affected dairy industry throughout the whole value chain including middleman, retailers and consumers. Apart from this, other vertical and horizontal integrations concerned with the dairy enterprise such as feed companies, bovine/ large animal specialists or veterinarians, dairy processors are also liable to risk. However, technology advancements such as milking machines, precision dairy farming techniques including ID identification tools, tagging, etc. are uproaring on the one hand whereas on the other hand dairy farmers are finding it hard to continue with the enterprise due to various reasons. Economic factors such as fluctuating milk prices, rising production costs, and competition from larger dairy corporations are some of the factors that contribute to the closure of dairy farms. Moreover, changes in consumer preferences towards plant-based alternatives or organic dairy products could impact the demand for conventional dairy products, affecting the viability of dairy farms.

Therefore, the main purpose of this paper is to derive determinants which influence the decisions leading to closure of dairy farms in Punjab. This paper would help government organizations and dairy cooperatives to delve with the root cause of exiting the enterprise and draw policy implications for dairy farmers. This information would be an essential step to balance agricultural economy and to maintain its contribution in the state's Gross Domestic Product. Main objectives of the study are as follows:

1. To examine the socio-economic status of dairy farmers
2. To examine the marketing channels followed by dairy farmers
3. To identify the main reasons which lead to the exit of dairy farm

Review of literature

Under certain assumptions, particularly, perfect knowledge and the absence of exit barriers, the perfectly competitive market model specifies the exit or shut-down decision rule as being based upon the comparison of a product's market price to an individual producer's short-run average variable costs. Despite of this, dairy producers may not adhere to the strictly defined economic shut-down rule due to the nature of capital used, biological lags between breeding and milking, and incomplete information, among other things, regarding future milk prices (Bragg & Dalton, 2004) [2]. Although total bovine population in Punjab state has increased over the years, but the year 2021-22 saw many milk producers in Punjab quitting from the milk supply chain. The causes of these recent shifts have not been thoroughly investigated for the Punjab region in India. However, some review of literature has been useful to cite major reasons for these economic and social changes.

(Boehlje, 1992) [1] contends that the following five categories of factors technology, human capital, finances, institutions, and sociology have an impact on shifts in the organization of agriculture. Using Boehlke's life-cycle model, Gale (1994) [7] discovered evidence that the likelihood of an exit decision resembles the business cycle of a company i.e., exit is more likely during the consolidation phase rather than during startup or maturity. Goetz and Dibertin (2001) [10] studied reasons to cease farming by the U.S. farmers, with a particular emphasis on understanding the roles of off-farm employment and federal farm program payments and found that the net number of farmers quitting between 1987 and 1997 is not statistically affected by off-farm employment, *ceteris paribus*. However, when the transaction costs connected with transitioning to full-time off-farm employment decrease, farmers leave the workforce at quicker rates. In addition, farmers leave the industry more quickly in cases where their land and structures are worth more, they irrigate less of their property, they get larger government program payouts, provided, they live in counties with high population densities or close to a city. In contrast to this, if a farmer owns their own farm, their rate of resignation is lower. (Gloy *et al.*, 2002) [9] examined the links between technology, finances, human resource issues, and profitability at New York dairy farms. The variables that determined the production factor were the number of cows, production per cow, and milking system; the profitability variable was determined by return on assets and each of the production element was found to have a substantial impact on the return on assets ratio using regression analysis. (Fotiz, 2004) estimated the factors behind farm exits and variations in herd-size among dairy farms under the New England Dairy Compact and found that the pricing strategy of the Dairy Compact decreased farm exits while substantially increasing the number of cows whereas farm exits surged due to development pressures and historically low unemployment rates. Furthermore, some of the literature emphasizes the close relation between social issues and their decision to exit dairy farming as cited by (CBS, 2017; Zeugenhouderij, 2016; Silvasti *et al.*, 2014; Geerling-Eiff & Van der Meulen, 2008; Schnabel, 2001) [8]. (CBS, 2017) [19, 20, 21] studied the relation between succession rate of farmers and their decision to exit dairy farming and found that 60% of farmers aged 55 and older had a successor, small dairy farms with less than 50 cows, had only a 28% level of succession whereas in larger dairy farms, with 100 cows or more, 85% of the older farmers has a successor (CBS, 2017). (Booijink, 2018) [18] also identified social and economic dimensions by studying the reasons for closing dairy farms in the Netherlands. Major reasons are the physical issues including the influence of laws and regulations, financial reasons, or the lack of a successor.

Materials and methods

Selection of study area and sample households:

According to the 20th livestock census, 2019, crossbred cattle density in Punjab is highest in Amritsar (67 per sq. km) followed by Gurdaspur (64 per sq. km), Pathankot (60 per sq. km), Jalandhar (55 per sq. km) and Ludhiana (54 per sq. km) whereas indigenous cattle is more densely populated in Fazilka (22 per sq. km), Pathankot (21 per sq. km), Mansa (15 per sq. km), Sangrur (15 per sq. km), Barnala (11 per sq. km) and Bathinda (10 per sq. km) respectively. Major districts where buffaloes are densely populated are Sangrur (111 per sq. km), SAS Nagar (106 per sq. km), Mansa (103

per sq. km), Barnala (103 per sq. km) and Amritsar (101 per sq. km). Therefore, five districts (as shown in Table 1) were selected by simple random sampling technique *viz.* Ludhiana, Patiala, Amritsar, Bathinda and Malerkotla respectively having higher concentration of bovine population in the state. In the second stage, on the basis of probability proportion to size of population, villages were selected by multi-stage random sampling. A total of 33 farmers were identified who have exited dairy enterprise in last 20 years.

The dairy farms are categorized according to the production systems in Punjab i.e. small & medium category and large & commercial category as shown in Figure 1. Domestic and per-urban categories were not included in the survey.

Collection of data

The questionnaire was designed to collect the data from respondent sample households. The data comprised of total capital investments, farm size, net Profit earned during operation period of dairy farm, income generated after closure of dairy farm, total loss incurred by the farmer after closure of dairy farm, price of milk, marketing channel followed, etc. was collected from the respondent dairy farmers by personal interview method using a specially designed and pre-tested questionnaire. The required information regarding various reasons which led to closure of the farms were categorized in four domains *viz.*, feeding, management/production, health and marketing.

Statistical tools of analysis:

Chi square test was used to test the association between size categories and various socio-economic and other general profile parameters using the following formula:

$$\chi^2 = \sum [(O-E)^2/E]$$

Wherein, the summation is taken over all the k classes. O represents observed data and E represents expected data respectively.

The simultaneous influence of several factors on the farm size categories was determined using two-way Analysis of Variance. This implies the testing of relationships between size-categories and their economic variables namely; average herd size, land ownership, initial capital investment, capital generated on closure of dairy farms, by 2-way ANOVA. Further, Factor analysis (Principal Component Analysis) was also performed using SPSS 16.0 computer standard statistical software package to explain the pattern of correlations within various categories of reasons (namely; feeding, production, health and marketing) that influenced the decision to exit dairy farming in Punjab.

Results and discussion

In Punjab state, various social, economic and marketing parameters has been identified which affected the farmer's decision to quit dairy farming. Various socio-economic factors includes age, literacy rate, caste, Experience in dairy farming, family type and family size. Other social factors includes primary occupation, land ownership status, herd size, training, loan and subsidy availed by the dairy farmers. Economic parameters includes average capital invested for starting dairy farm, capital generated after closure of dairy farms, status of shed whereas marketing parameters includes marketing channel followed and average price at which milk is sold via particular channel. Moreover, these parameters aided in identifying the main reasons leading to closure of

dairy farms that have been further bifurcated into four categories namely; feeding, management/production, health and marketing.

Social parameters

Various socio-economic factors includes age, literacy rate, caste, experience in dairy farming, family type and family size. Other social factors includes primary occupation, land ownership status, herd size, training, loan and subsidy availed by the dairy farmers.

Socio-economic profile of sampled dairy farmers

The main objective of this section was to examine the basic characteristics of the sample dairy farmers that might have influence on the decision making process regarding exiting dairy enterprise and their loss and profitability ratio. There exists heterogeneity in socio economic characteristics among various farmers belonging to different regions/ districts of Punjab. An attempt has been made to document the important socio-economic characteristics of the respondent households which include age, education, main occupation, social status, experience in dairying, land ownership status, family type, total family size, total herd size, training in dairy farming, etc. The information pertaining to the socio-economic details of the sampled dairy farmers across Punjab are presented in Table 2. The table 2 depicts that majority (around 48%) of the respondents belonged to the old age group (above 50 years) whereas others belonging to the middle age group i.e., 30.3% in the age group 40-50 years and 21.2% in the age group 30-40 year. Education status of farmers is considered to have strong bearing on the decision to close dairy farming as around 40% of the sampled farmers studied up to matriculation whereas 15% of them studied up to middle and higher secondary each. Moreover, around 30% were found to be graduated and post-graduated. A perusal of the Table 2 also summarized the social status of the sample dairy farmers of Punjab. Maximum proportion of farmers (93.9 per cent) belongs to the general category and remaining 3.03 per cent of the farmers belong to SC and OBC category each. Apart from the experience of famers in dairy farming, it is depicted that majority of the farmers (around 48%) had experience of more than 20 years followed by 33.3% with 10 to 20 years of experience, 12.1% with 5 to 10 years of experience and only 6.1% were found to have experience of less than 5 years. Further, most of the families of dairy farmers (63.6%) were found to be nuclear with 18.2% families having less than 4 family members whereas 36.4% were living in joint families. Leonard *et al.*, 2016 found that the average age of farmers is rising in the majority of EU nations, while the proportion of farmers under the age of 40 is falling. The fact that younger farmers rather than older ones are linked to more productive and efficient farming methods, has raised concerns that this demographic trend could have detrimental effects on the agriculture and more specifically on the livestock sector. Furthermore, chi-square test findings implies that caste, experience in dairy farming, family type and family size of the farmers were found to be significantly and positively associated with the dairy farm category and variables such as age & literacy level were found to be non-significant with the dairy farm category.

Dairying as primary occupation

The information regarding the main occupation of the households is useful to analyze the adoption status of dairy

farming as main or subsidiary occupation. As agriculture is the main occupation in Punjab, therefore, overall 72.7% of the farmers were found to have crop farming as their primary occupation. Around 9% of the farmers were found to have been reliant dairying as their main occupation and ultimate source of their income. Around 6% were found have adopted integrated farming whereas 3% had poultry as their primary occupation and 6.1% of the farmers were found to be practicing various occupations other than agriculture as the primary source of income.

In United States, around 53% of the total income of the farm operating households is contributed by wages & salaries from off-farm employment, 16% by other off-farm income, 13% by off-farm business income and 8% by interest and dividend income while only 11% is contributed by farm income on an average (USDA, 1997; Goetz & Debertin, 2001) [10]. In category-wise analysis, it has been observed that all the Small & Medium category farmers were found to have crop farming as their primary occupation whereas the proportion dropped to 64% in case of large & commercial dairy farmers as shown in Table 3. Moreover, 16.1%, 6.4%, 3.2% and 9.7% of the farmers were found to have integrated, dairying, poultry and other occupations as their main source of income. Chi-square test findings implies that the primary occupation was found to be significantly and positively associated with the dairy production system categories.

Herd ownership status of selected dairy farmers

Overall, there are 9.29 lakh households that own cattle in Punjab (around 20% of the total cattle farmers in Punjab) in comparison to the 14.9 lakh buffalo households which are 32.3% of the total buffalo owners in India. Around 68% of the total bovine population in Punjab is concentrated in the small & medium category followed by 23% in large & commercial, 5% in domestic/ landless and 4% in the peri-urban category. With the given bovine structure, 62% of the total milk production is contributed by small & medium category due to higher bovine population in the category whereas large & commercial, domestic/ landless, peri-urban farm categories contribute 33%, 1% and 4% respectively to the total milk production in the state.

However, out of the total dairy farms that have been closed, there were found to be around 72% of the mixed farms and 27% of the crossbred farms. No, buffalo farmer was found to have exited their dairy farming enterprise. Apart from the size of the dairy farm, it was concluded that 93.9% of the farms were large and commercial (15 to 500 animals) whereas remaining belonged to the small and medium (3 to 15 animals) category. In addition to that, no domestic/landless (1-2 animals) and peri-urban dairy farms was included in the survey. Moreover, average herd size of the study was found to be 61 as shown in Table 4. On an average, small & marginal dairy farmers own 8 buffaloes (66.7%) and 4 cattle (33.3%) whereas large & commercial dairy farmers own 29.7 buffaloes (46.3%) and 34.4 cattle (53.7%). Furthermore, around 42% and 58% of the farmers were found to be rearing Murrah and mixed (including Nili Ravi and Murrah) breeds respectively. Majority of the farmers (85%) were found rearing Holstein Friesian (popularly called HF) followed by Jersey (6%) and mixed breeds including both HF and Jersey (9%) respectively. The application of one-way ANOVA on the average herd size category found that there is no significant difference (p value= 0.6775 at 5% level of

freedom) between the average herd size category of dairy farmers.

Land ownership status of selected dairy farmers

As majority (73%) of the farmers had agriculture as their primary occupation, so it is important to study the land ownership status of dairy farmers in Punjab. Moreover, crop and dairy integrated farming is common practice prevalent in Punjab. Majority of the farmers (33.3%) had 5 to 10 acres of owned land followed by 27.3% with less than 5 acres, 18.2% with more than 20 acres and 15.1% with 10-20 acres. However, 6.1% of the dairy farmers were found to be landless. Further, it has been found that small & medium dairy farmers owned 8.3 acres of the total operational land on an average whereas it is 13.9 acres by large & commercial dairy farmers. Out of the total operational land, small & medium dairy farmers were found to have 1.8 acres of owned land and 6.5 acres of land which was leased in whereas large & commercial dairy farmers were found to have 11.1 acres of owned land, 13.4 acres of leased in and 14.8 acres of leased out land on an average. There was little or no significant difference between category-wise sale value of land and rented value of land as shown in Table 5. A 2-way ANOVA was carried out to detect differences between land ownership status in different dairy production systems or farm sizes. The null hypothesis for this analysis was “the mean of land owned by dairy farmers in each farm size category are the same.” It was found that there is significant difference (p value= 0.011 at 5% level of freedom) between the variables of land inventory of dairy farmers of different farm size categories.

Status of training, loan and subsidy availed by dairy farmers in Punjab

The data regarding training of dairy farmers is important as it signifies that the farmers are well informed about the basic techniques of dairy farming at an organized and commercial scale. Various parameters regarding, whether the farmers have taken training or not, organization concerned and the number of days of training programmes, have been analyzed. It is evident that neighbours/ relatives/ friends were the source of motivation to start dairy farming for around 55% of the farmers. Around 18.2% of the farmers were being motivated by “Department of Animal Husbandry, Punjab” through their various extension programme & schemes whereas 3.03% by ‘Pashu-Palan and Kisan Melas’ held in various zones and regions in Punjab state. Advertisement in newspaper/ TV/ radio influenced around 3% of the farmers to start dairy farming. Various other sources (mainly inherited dairy farming) motivated 21.2% of the sampled farmers. Around 40% of the farmers had taken training from various sources viz., Dairy Training Centre, Bija (77%), PAU, Ludhiana (15.4%) and KVK, Rauni (7.7%) respectively. Majority of the farmers (around 77%) attended training of up to 15 days.

Further, loan and subsidy are one of the crucial parts of starting any enterprise as initial capital investment is required in order to start the dairy farm. For dairy farmers who are having money constraints, subsidy and loan from institutional sources could be a helping hand to start the enterprise with recommended shed parameters, ample number of equipments and animals to set up at least minimum herd size of 3 to 7 bovines at the farm. For this, subsidy on animals should be easily available to the farmers. From the survey, it was evident that 48.5% of the respondents applied for the loan and

only 21% applied for the subsidy. Average loan taken per animal and average subsidy per animal was found to be Rs.26692.1 and Rs.4579.9 respectively. Moreover, 68.75% of the farmers took loan for 5 to 10 years whereas 18.75% and 12.5% availed loan for less than 5 years and more than 10 years respectively. Average amount of interest rate was 7% and no amount/ installment were due for the farmer to pay the bank. Indian overseas bank, IDBI bank, State Bank of India, Allahabad bank, Union Bank of India, Punjab National Bank were the sources reported by farmers for availing loans.

Economic parameters

Economic parameters includes average capital invested for starting dairy farm, capital generated after closure of dairy farms, status of shed.

Average capital invested and capital generated by dairy farmers in punjab

The average initial capital investment incurred for starting a dairy farm and the net earnings and cash flow after closure of dairy farm by small & medium and large & commercial dairy farmers in Punjab have been presented in the Table 6.

The average investment per animal in small & medium category was found to be Rs.43, 083.3 whereas it was higher in the large & commercial dairy farm category with Rs.51,950.1 respectively due to higher average herd size in the latter category. The total investment made on a dairy farm can be bifurcated into three main categories namely, shed, equipments and animals. Total investment made by small & medium farmers was found to be Rs.5.17 lakhs and by large & commercial farmers Rs.33.3 lakhs. Small & medium category incurred Rs.1.75 lakhs (33.8%), Rs.0.52 lakhs (10.1%) and Rs.2.9 lakhs (56.1%) on shed, equipment and animals respectively whereas large & commercial dairy farmers incurred Rs.11.5 lakhs (34.5%), Rs.2.30 lakhs (6.9%) and Rs.19.5 lakhs (58.6%) on shed, equipment and animals respectively. Further, net profit earned during operation of dairy farm per month was higher in large & commercial category with Rs.34,483.9 and it was Rs.9,000 in small & medium category.

Total capital generated on closure of dairy farm was found to be Rs.3.37 lakhs and Rs.16.2 lakhs by small & medium and large & commercial category respectively. It has been observed that small & medium farmers incurred more loss after closure of the farm i.e., a total of Rs.3.25 lakhs and Rs.27,083.3 per animal as compared to the large & commercial farmers who incurred a total loss of Rs.7.24 lakhs and Rs.11,297.9 per animal. A total capital of Rs.90,000 was generated after sale of equipments and Rs. 15.3 lakhs from sale of animals in large & commercial category. Small & medium farmers generated total capital of Rs.3.37 lakhs only from the sale of animals.

Status of shed after closure of dairy farm

The status of the shed of dairy farm has been analyzed before closure and after closure of the dairy farms as shown in Table 7. It has been found that only large & commercial dairy farm category rented their shed after closure of the farm (15%) at the rate of Rs.57,400 per month and 3% was found to have been using shed on rent before closure of the farm at the rate of Rs.10,000 per month respectively. Around 91% of the farmers owned the shed before closure of the farm. All the small & medium farmers had their own shed at the farm. 83.9% of the farm shed remained unutilized in large &

commercial dairy farms and all of the sheds were unutilized in the small & medium category. Moreover, none of the selected farmers sold their shed after closure of dairy farm.

Marketing parameters

Marketing parameters includes marketing channel followed and average price at which milk is sold via particular channel.

Marketing channels followed

The various marketing channels followed by dairy farmers who closed their dairy farm has been presented in the Table 8.

It has been observed that 51.6% of the farmers preferred organized marketing channels whereas others preferred unorganized channels. Around 45% of the farmers preferred to sale their milk produced in Verka whereas 21% to local vendors and 18.2% to the both households & local vendors respectively.

The lower price of milk is one of the prominent reasons leading to the closure of dairy farms. As feed prices has been rising over the time at the rate of 14% in last three years (i.e. from Rs.2209.8/Qtl in April, 2020 to Rs.2520.4/Qtl in February, 2023), milk procurement price paid to farmers by cooperatives has only increased by 8.1% on average in last 5 years. Therefore, the rise in feed and fodder costs is not justifying the milk procurement price paid to the farmers in Punjab. In order to lower the gap between total cost and returns, it is important to make the dairy farming viable by lowering the variable cost per month.

Major reasons identified for exiting dairy farming in punjab

In decision to quit or to keep dairy farming, farmers usually compare the utility they expect to derive from continuing to farm with the utility derived from exiting the dairy farming and becoming either fully employed by off-farm activities, relocate or retire. Consumption levels determine utility, which is based on the revenue or returns on labor (and capital) invested per unit of time in off-farm employment or agriculture (Goetz & Debertin, 2001) ^[10]. However, there are four main reasons that have been reported in the state viz., feeding, management/production, health and marketing. Results of Principal component analysis carried out on the various factor scores are reported in Table 9.

It has been observed that apart from feeding related reasons, Eigen value>1 for two factors explaining 55.19% of the variation in the data set, therefore it is a two component solution wherein costly green fodder is negatively impacting the decision to exit dairy farming whereas less availability of dry fodder and costly concentrate feed is positively impacting the exiting decision in the first component. However, in the second component, costly dry fodder is highly negatively impacting the decision and poor quality of concentrate feed is positively impacting the decision of exiting dairy farms. Nisha and Devaki, 2023 also studied the reasons for closure of livestock farms in Tamil Nadu and found that the feed cost was the major reason for the farm closure or reduction of the farm size followed by marketing, disease management and low production and income from livestock farming. Further, the results from managerial or production related reasons signifies that Eigen value>1 for four factors explaining 92.93% of the variation in the dataset, therefore it is a four component solution wherein lack of technical knowledge is positively impacting and poor milk yield is negatively

impacting the decision to exit dairy farming in the first component. However, in the second component, costly labour is positively impacting and lack of pure breed is negatively impacting the decision. High purchase price of animals and shortage of labour are also negatively impacting in the third and the 4th component respectively. Gloy *et al.*, 2002 ^[9], identified that there has been a decline in the number of dairy farms but rise in the milk production & productivity, and farm size in the United States resulting in exit of dairy farming by less profitable farms, but the most profitable farms have stayed in production and have profitably increased production as a normal course of business. Apart from reasons pertaining to health of bovines, Eigen value >1 for two factors explaining 67.80% of the variation in the dataset, therefore it is a two component solution wherein it has been observed that disease incidence is negatively impacting while high veterinary expenses and reproductive problems are positively impacting the farmer's decision to exit dairy farming in the first component whereas lack of veterinary services is negatively impacting the decision in the second component. Apart from the disease incidence and pandemics, Wang *et al.*, 2020 found that Covid-19 affected dairy industry in countries like China and USA which resulted in closure of dairy farms and also dairy processing units due to decreased farm-gate milk prices, disruption of supply chains, labour shortages, increased production costs, and lack of operating capital.

In case of marketing related reasons, Eigen value >1 for three factors explaining 66.62% of the variation in the dataset, therefore it is a three component solution wherein it has been further observed that in the first component, lack of market information, less milk price received by the farmer are

positively impacting whereas less sale price of animals is negatively impacting the decision to exit farming. In the second component, distant market and higher marketing cost are positively impacting whereas malpractices by the middlemen and delay in payment are negatively impacting the decision to exit farming. The third component explains that fluctuating prices of milk are highly positively impacting the farmer's decision to quit dairy enterprise. Tauer, 2006 ^[14] applied the Dixit entry/exit real option model to the entry/exit decisions of New York dairy farmers. Given the cost structure of a 500-cattle farm, the entry milk price is \$17.52 per hundredweight (cwt) and the exit milk price is \$10.84 per hundredweight (cwt). However, for the 50-cow farm cost structure, the entry and exit prices are higher at \$23.71 per cwt, and \$13.48 per cwt respectively. Accordingly, if infinite numbers of dairy farms enter and exit at these prices, the price of milk ranges between \$13.48 and \$17.52 per cwt. Further, (Bragg & Dalton, 2004; Davidson, 2001) ^[2, 4] also found that decision to quit dairy farming was more likely to be correlated with less milk price whereas other factors include age of the producer, more income from sources outside the farm, less returns over variable costs, and a more diverse mix of farm income. Similarly, Goetz & Debertin, 2001 ^[10] also observed that farmers exit dairy farming more quickly in the following scenarios: their land and buildings value is higher; less land irrigation; they earn more government program payments; they choose to reside in counties with high population densities or within close proximity to a city. The likelihood and rate at which net farm exits from a county happen are inversely correlated with off-farm employment. Further, if a farmer owns their own farm, their rate of resignation is lower.

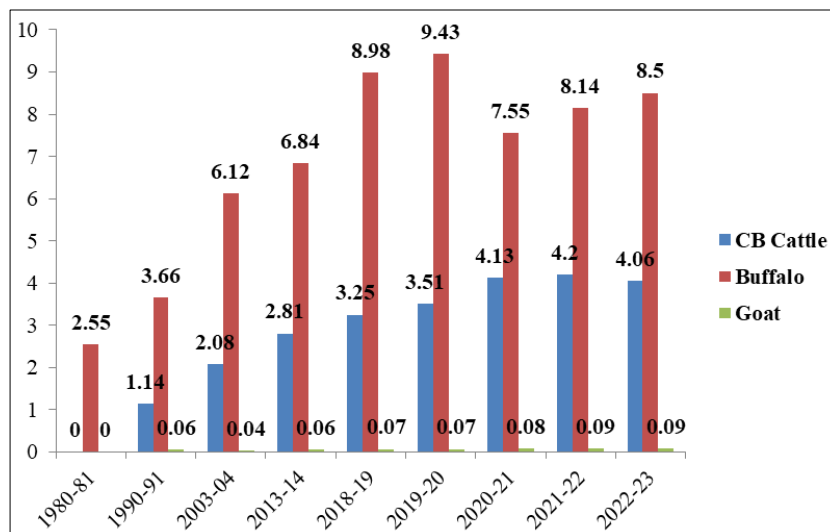


Fig 1: Historical trend in species-wise milk production in Punjab

Table 1: Districts, Blocks & Villages selected under the study of dairy farming in Punjab

District	Block	Village
Ludhiana	Ludhiana-1	Pamal, Threke, Dolo Kalan, Phullanwal, Lalton Kalan, Baddowal
Patiala	Patran, Samana	Tambu Wala, Mavi Kalan, Chonagra, Ghagga, Duttal, Khang, Shutrana
Amritsar	Ajnala	Machinangal, Sangatpura
Bathinda	Goniana, Talwandi Sabo	Bagha, Blahar Mehma
Malerkotla	Malerkotla	Lasoi, Bhurthala Mander, Uchi Rurki, Saraud

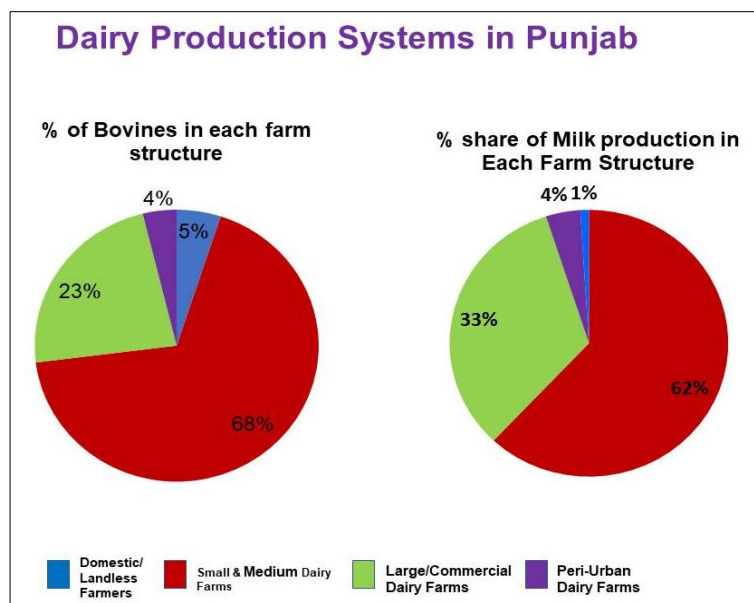


Fig 2: Dairy production systems in Punjab

Table 2: Socio-economic characteristics of selected dairy farmers in Punjab

Socio-Economic Characteristics/Farm		Overall (33)	χ^2
Age (years)	30-40	7 (21.21)	0.00258
	40-50	10 (30.30)	
	>50	16 (48.48)	
	Average age	51.8	
	Total	33 (100.0)	
Literacy Level	Up to Middle	5 (15.15)	0.00765
	Matric	13 (39.39)	
	10+2	5 (15.15)	
	Graduate & above	10 (30.30)	
Caste	General	31 (93.94)	0.934*
	OBC	1 (3.03)	
	SC	1 (3.03)	
	Total	33 (100.0)	
Experience in Dairy Farming (Years)	0-5	2 (6.06)	0.749*
	5-10	4 (12.12)	
	10-20	11 (33.33)	
	>20	16 (48.48)	
	Total	33 (100.0)	
Family type	Joint	12 (36.36)	0.270*
	Nuclear	21 (63.64)	
	Total	33 (100.0)	
Family size (No. of members)	<4	6 (18.18)	0.5006*
	5-8	22 (66.67)	
	>8	5 (15.15)	
	Total	33 (100.0)	

*Significant at 5 per cent level of freedom

Table 3: Primary occupation of dairy farmers in Punjab

Dairy Production System	Primary Occupation					Total	χ^2
	Crop	Cropping & Others	Dairy	Poultry	Others		
Small & Medium (3 to 15 animals)	2 (100.0)	-	-	-	-	2 (100.0)	0.8998*
Large & Commercial (15 to 500 animals)	20 (64.5)	5 (16.1)	2 (6.4)	1 (3.2)	3 (9.7)	31 (100.0)	

*Significant at 5 per cent level of freedom

Table 4: Average herd size of selected dairy farmers in Punjab

Dairy Production System	Average Herd Size			F
	Buffalo	Cattle	Total	
Small & Medium (3 to 15 animals)	8	4	12	0.1746 (F-crit= 3.996)
Large & Commercial (15 to 500 animals)	29.7	34.4	64.1	
Average	28.4	32.6	61	

Table 5: Average land owned by selected dairy farmers in Punjab

Dairy Production System	Total Operational land (acres)	Owned land (acres)	Leased in (acres)	Leased out (acres)	Sale value of land (Rs. lakhs)	Rented value of land (Rs.)	F-value
Small & Medium (3 to 15 animals)	8.3	1.8	6.5	-	37.5	53,500	4.85509 (F crit= 3.1404)
Large & Commercial (15 to 500 animals)	13.9	11.1	13.4	14.8	38	54,766.7	
Average	13.5	10.5	12.4	14.8	38	54,687.5	

Table 6: Capital investment for starting dairy farm and capital generated on closure of dairy farms in Punjab

Average Investment	Initial Capital Investment (Start)			Capital generated (Closure)		
	Small & Medium (3 to 15 animals) (Rs. lakhs)	Large & Commercial (15 to 500 animals) (Rs. Lakhs)	Overall (Rs. lakhs)	Small & Medium (3 to 15 animals) (Rs. lakhs)	Large & Commercial (15 to 500 animals) (Rs. Lakhs)	Overall (Rs. lakhs)
Shed	1.75 (33.8)	11.5 (34.5)	10.9 (34.4%)	-	-	-
Equipment	0.52 (10.1)	2.30 (6.9)	2.19 (6.9%)	-	0.9 (5.5)	0.9 (5.8)
Animal	2.9 (56.1)	19.5 (58.6)	18.5 (58.6%)	3.37 (100.0)	15.3 (94.4)	14.5 (94.2)
Total	5.17 (100.0)	33.3 (100.0)	31.6 (100.0%)	3.37 (100.0)	16.2 (100.0)	15.4 (100.0)
Average herd size	12	64.1	61	12	64.1	61
Investment/ animal (Rs.)	43,083.3	51,950.1	51,360.2	-	-	-
Net Profit earned during operation of dairy farm/ month (Rs.)	9,000	34,483.9	32,939.4	-	-	-
Total loss incurred on closure of dairy farm	-	-	-	3.25	7.24	7.0
Loss/ animal	-	-	-	27,083.3	11,297.9	11,475.4

Table 7: Status of Shed after Closure of Dairy Farm

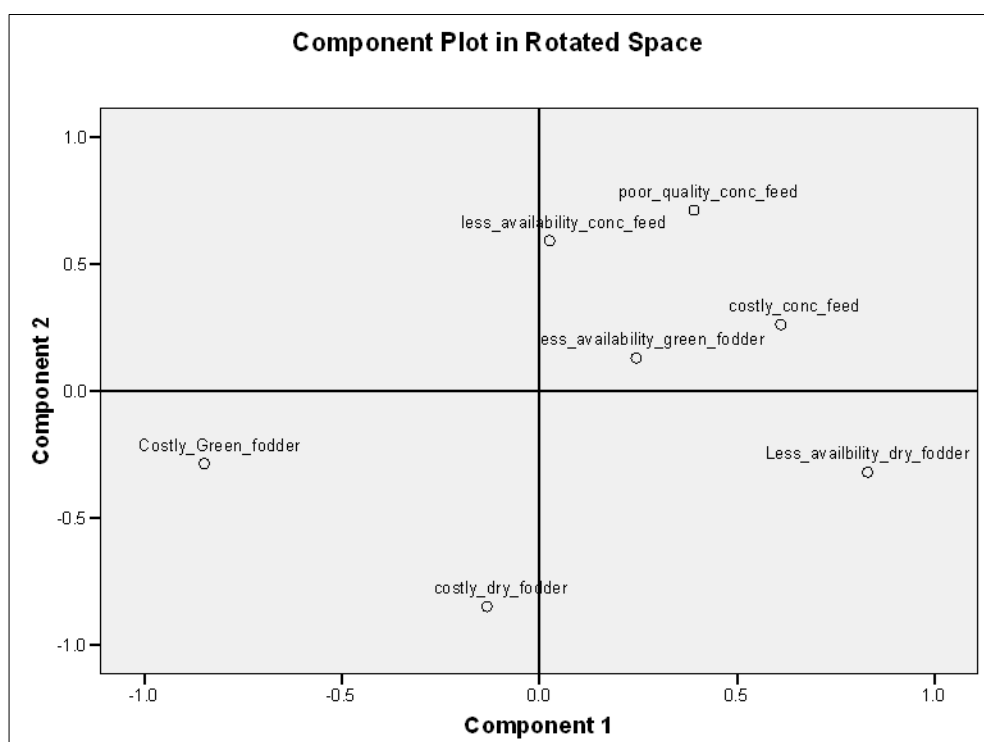
Dairy Production System	Before Closure		After Closure		Total
	Owned	Rented	Unutilized	Rented	
Small & Marginal (3 to 15 animals)	2 (6.1)	-	2 (6.1)	-	2 (100.0)
Large & Commercial (15 to 500 animals)	30 (90.9)	1 (3.0)	26 (83.9)	5 (15.1)	31 (100.0)
If rented, rent paid (Rs./ month)		10,000		57,400	

Table 8: Marketing channels followed by selected dairy farmers

Marketing Channel	Preferred by farmers (%)	Average price of milk sold (Rs.)
Unorganized		
a) Local vendors	21.1	41.5
b) Households	9.1	41.7
c) Households & Local vendors	18.2	39.3
Organized		
d) Verka	45.4	30.1
e) Nestle	3.1	38
f) Verka & households	3.1	30
	(100.00)	35.2

Table 9: Rotated component matrix for data set of selected reasons for dairy farm exit in Punjab

Variables	Component			
	1	2	3	4
Feeding related reasons				
Costly Green fodder	-.849	-.286		
Less availability of dry fodder	.831	-.319		
Costly concentrate feed	.611	.262		
Less availability of green fodder	.245	.131		
Costly dry fodder	-.133	-.848		
Poor quality of concentrate feed	.391	.712		
Less availability of concentrate feed		.592		
Management/ production related reasons				
Lack of technical knowledge	.866	.185	.124	.240
Poor milk yield	-.851		.255	.370
Lack of pure quality breed		-.877	.285	.291
Costly labor	.225	.835	.327	
High purchase price of animals			-.979	.181
Shortage of labor		.173	.201	-.959
Health related reasons				
High vet expenses	.817	-.120		
Disease incidence	-.811	.209		
Reproductive problems	.640	.411		
Lack of vet services	-.104	-.942		
High calf mortality	-.339	.644		
Marketing related reasons				
Less sale price of animals	-.793		.211	
Lack of market information	.790	.127		
Less milk price	.770		.221	
Distant market		.756	-.218	
Middleman malpractice	-.201	-.733	-.279	
Higher marketing cost		.665		
Fluctuating milk price		-.205	.904	
Payment delay	-.267	-.533	-.647	

**Fig 3:** Feeding related reasons faced by dairy farmers in Punjab

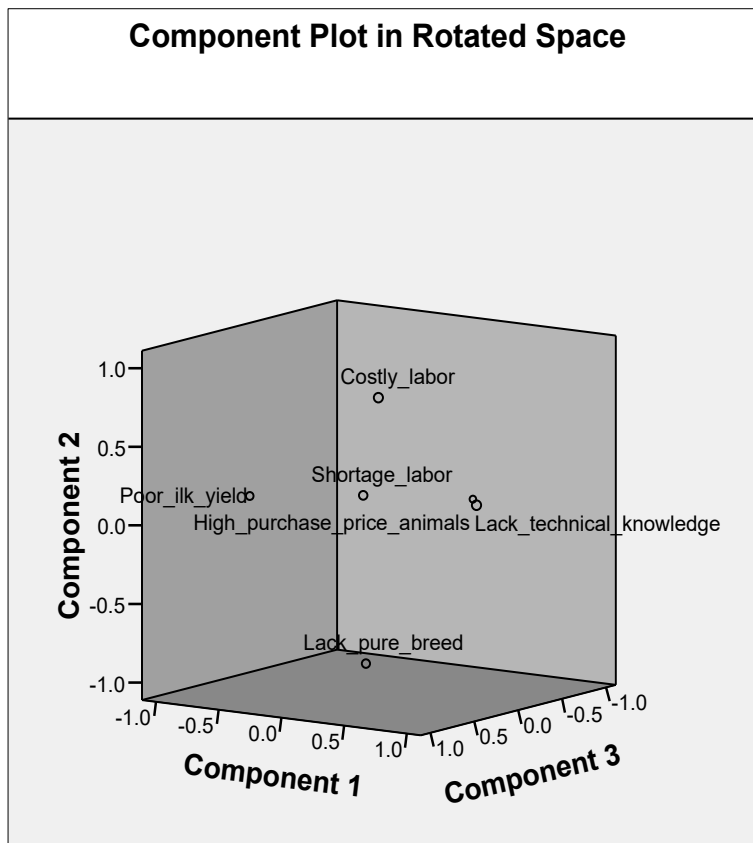


Fig 4: Production related reasons faced by dairy farmers in Punjab

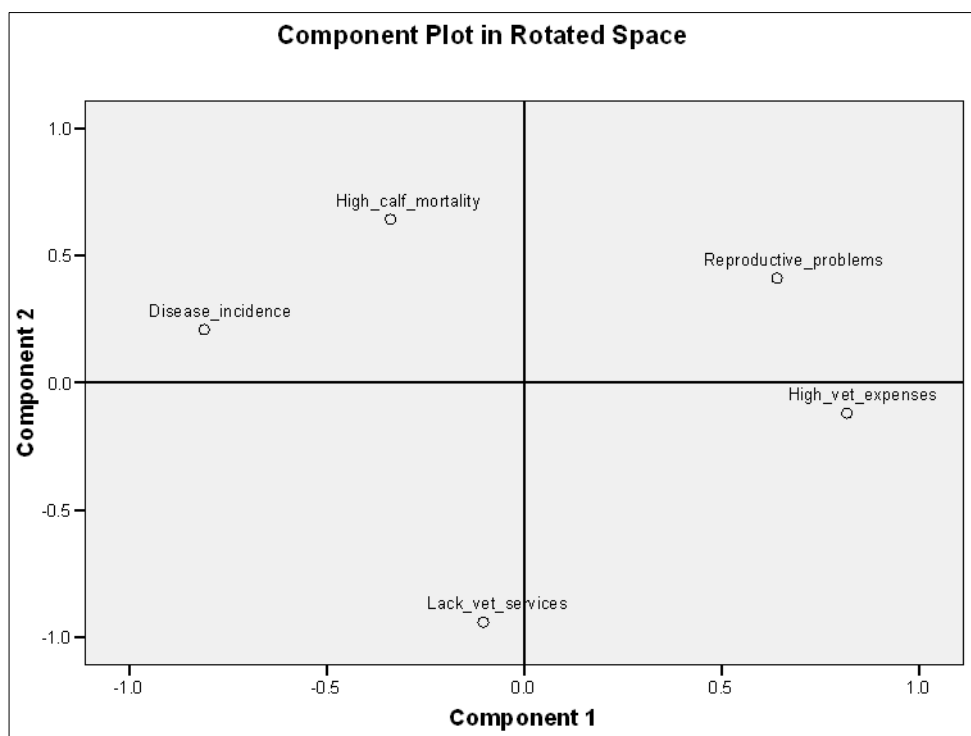


Fig 5: Health related reasons faced by dairy farmers in Punjab

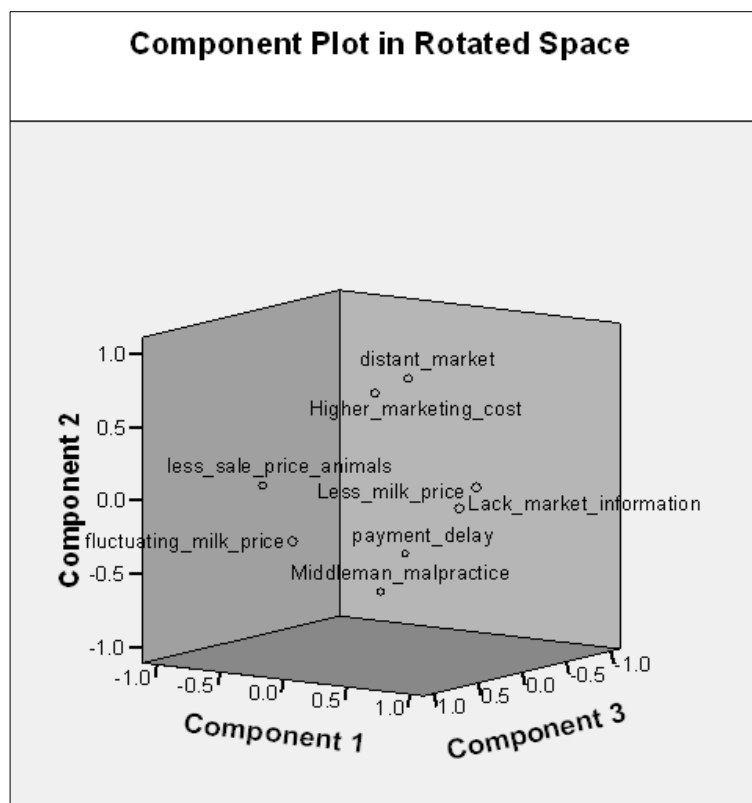


Fig 6: Marketing related reasons faced by dairy farmers in Punjab

Conclusion

The closure of dairy farms in the Punjab state marks a significant shift in the agricultural landscape of the region. While this decision is influenced by various factors such as economic viability, marketing patterns, feeding and production related concerns, its consequences ripple across multiple dimensions. Firstly, the closure of dairy farms impacted the livelihoods of countless individuals who depend on them for employment and income generation as dairying was found to be the primary occupation of around 9% of the selected dairy farmers. Farmers, laborers, and associated industries face uncertainty and potential economic hardship. Secondly, there are potential repercussions for the dairy industry itself, including disruptions to the local supply chain, reduced availability of dairy products, and increased milk adulteration, difficulty in maintaining self-sufficiency to meet demand of milk and milk products. Moreover, it's crucial to consider the social and cultural implications of such closures. The closure of dairy farms in Punjab reflects the complex interplay of economic, environmental, and societal factors; it also underscores the need for comprehensive strategies that balance economic development with environmental sustainability and social equity. Any transition must prioritize the well-being of affected individuals and communities while striving for a more resilient and sustainable agricultural sector.

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