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Exploring the Cost of Milk Production & Potential Economies of Scale in a Dairy Cooperative

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Abstract

Agricultural cooperatives have been a unique way of addressing the concerns of the producers and consumers regarding pricing, storage, marketing, and other such activities of bringing the commodity to the market. One of such sectors is the dairy, where there are cooperatives in both the developed and developing countries. Amul Dairy, a milk cooperative in India is, synonymous with quality of its milk and milk products as well as fair prices to both the consumer and producer. In this study, we will examine the effectiveness of Amul by comparing the procurement prices offered by the dairy cooperative to the cost of producing milk. In addition, we will measure whether there are economies of scale in milk production.

Keywords

dairy cooperative, milk, India

Disciplines

Business

Exploring the cost of milk production & potential economies of scale in a dairy cooperative

Parth Shah

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Abstract

Agricultural cooperatives have been a unique way of addressing the concerns of the producers and consumers regarding pricing, storage, marketing, and other such activities of bringing the commodity to the market. One of such sectors is the dairy, where there are cooperatives in both the developed and developing countries. *Amul Dairy*, a milk cooperative in India is, synonymous with quality of its milk and milk products as well as fair prices to both the consumer and producer. In this study, we will examine the effectiveness of *Amul* by comparing the procurement prices offered by the dairy cooperative to the cost of producing milk. In addition, we will measure whether there are economies of scale in milk production.

Objective and Methodology

The primary objectives of this study are twofold: to analyze the effectiveness of a dairy cooperative via comparison of procurement prices to milk production, and determine whether there are economies of scale in milk production. Both of these objectives hold tremendous policy implications not only for cooperative executives, but also for policymakers and rest of the dairy private sector. Over the past couple of decades, India's milk production has grown to make it one of the largest milk producers in the world. Unlike rest of the major milk producers (primarily in the developed world), India's milk producers tend to be on a much smaller scale. Each milk producers tends to only have one or two animals resulting in low economies of scale. This particular scenario makes it even more critical for cooperative executives and policymakers to know the cost of milk production faced by milk producers. Although there has been a prior formula which approximates the cost of milk production by tracking national statistical organizations, the particular formula does not take into account different types of fodder used by the milk producer and more importantly does not calculate labor cost.

In contrast, the survey used in this study includes varying cost components (such as fodder, shelter, cattle feed, labor cost) as well as varying amounts of milk produced during the summer and winter costs. The survey was developed in coordination with milk producers as well as researchers at Indian Institute of Rural Management. The results of this study are quite significant because it will provide policymakers and cooperative executives with the current state of the Indian dairy market. As the per capita income of India increases over the next couple of

decades, India's dairy production will need to increase to meet the increasing demand. In my recent meeting with the Agricultural Minister, he indicated that the government was considering implementing a National Dairy Plan. The National Dairy Plan is aimed at increasing dairy production by improving fodder access to farmers and improving the quality of cows and buffaloes via artificial insemination. The government intends to spend \$3B over the next ten years to achieve this objective. The study will provide policymakers with a picture of different cost pressures faced by farmers in the dairy sector. Furthermore, it will determine whether milk production contains substantial financial incentives for new entrants to enter this activity or to maintain the current ones. This is particularly important to the government as it strives to increase milk production to meet the growing demand. Before we proceed any further, it would be useful to the reader to learn about the structure of the cooperative, and nature of the membership of the milk producer. I have discussed them in detail in an earlier paper on this subject, and have included them here for the reader's reference.

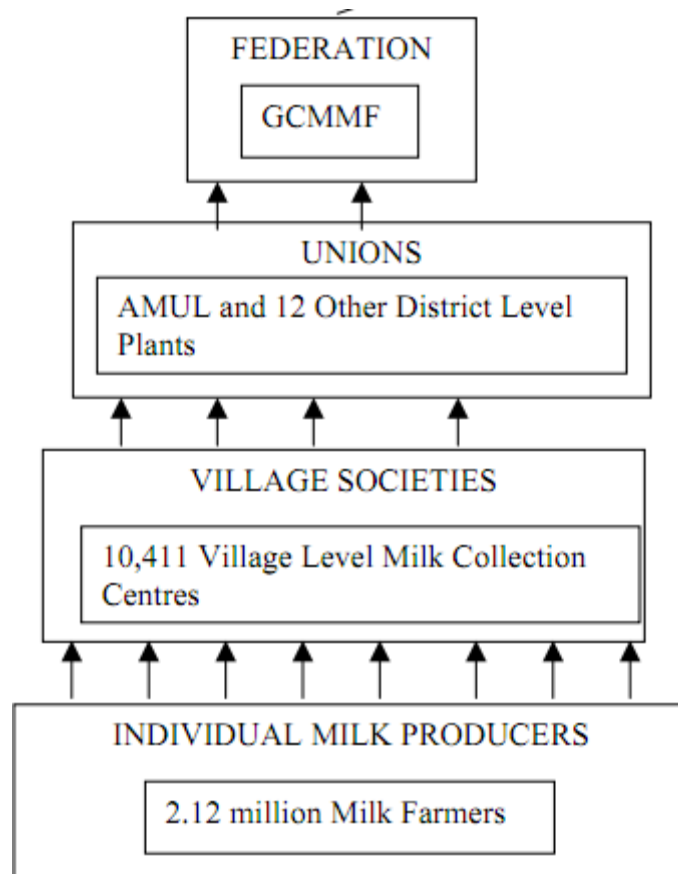
Structure

The Kaira District Union was later followed by milk collection centers and cooperatives set up in other villages and districts of Gujarat. In 1973, all the cooperatives were organized under an apex body the Gujarat Co-operative Milk Marketing Federation Ltd. (GCMMF). *Amul* is the brand name of the milk and milk products that come out of GCMMF. It is a three-tiered system consisting of milk collection centers at the village level, a collection of village collection centers into a cooperative at the district level and the GCMMF at the top. Each district union such as Kaira District Co-operative Milk Producers' Union Ltd sets its own milk prices in the district each year.

The cows and buffaloes give milk twice a day for about 8-9 months and 6-7 respectively. The period, in which they provide milk, is known as the lactation period. The milk producer makes his money from the animal during this period. He collects the milk from the cow or buffalo, and goes to his local collection center. These local collection centers are in each village (or in a couple of villages grouped together), where the dairy cooperatives' employees measure the amount of milk, % fat, and % SNF. There is a two-tier system in which the amount of money paid to each individual is determined by whether it's cow's or buffalo's milk, and the % fat in the milk. The % SNF does not tend to vary as much, making the % fat the primary factor in

determining the price. Although cows produce more milk daily and for a longer period of time, the milk has lower fat content. The cooperative does not prefer one animal over the other, and does has procurement prices accordingly.

Figure 1: Structure of the Kaira District Milk Producers' Union in State of Gujarat



Source: Indian Institute of Management - Ahmedabad

Nature of the Membership

Each member of the union is obligated to sell at least 1liter (L) of milk daily to the local collection centre to continue the district union's services. In addition, the membership of the union costs a one-time fee of Rs. 60. These services include access to the veterinary doctor, which charge a minimal amount of Rs. 60 per visit (compared to Rs. 300 per visit for a private doctor), and the treatment is of no extra cost. There is no contractual obligation, and each member can potentially sell milk over and above 1 liter to a private dairy. However, as there are

no private dairies in the nearby area, that privilege has remained a theoretical one. Most of the milk producers (that we surveyed in the village) keep a portion of the milk for daily consumption, since it is more expensive to buy the milk from Amul's local collection center than cost of producing it. In addition to the veterinary services, members also have access to Amul Dan (nutrition enriched fodder for cows and buffaloes), which allows cows and buffaloes to produce better quality of milk.

Purpose

As the above background suggests, the primary purpose of the Union was to provide fair prices to the milk producers without alienating the consumer. Over the course of several years, the Union has acted against price controls that kept the price of the milk low because that created a disincentive for production. The Union has been successful in increasing the milk production in the district primarily by bringing more milk producers into the union, rather than increasing each individual member's ability to produce more milk (for example, by getting a better breed of cows). In recent years, Amul has expanded beyond its initial mission and offers services such as fodder, education to members, extension of credit to members, etc.

Procedure

The survey was administered in seven villages: Navli, Napad, Chikodhra, Valasan, Sandesar, Vadod, and Bedva between December 30, 2011 and January 3, 2012. These villages were recommended by Amul to me based on my criteria of close proximity to Anand. The close proximity of these villages ensured that the milk producers either provided their milk to the local collection center or kept for domestic consumption. All of these villages are within a ten kilometer radius of Anand, and as such, fall under the Kaira District Co-operative Milk Producers' union collection facilities. All of the milk collected in these villages flows to Anand's Amul dairy, and as a result, all the milk producers are reimbursed based on the same pricing scale. I had conducted a similar survey in Navli back in May 2011. Based on my interaction with farmers in Navli and feedback from the professors at Institute of Rural Management at Anand, I constructed a more detailed questionnaire to be administered to the farmers. The questionnaire was in Gujarati. A copy of the survey is included in the appendix in both Gujarati and English. With the help of the four research assistants, I conducted this survey.

The survey was administered orally to the villagers and their responses were subsequently recorded. The assistants were paid for their effort, and before the study was conducted, I gave them detailed directions, and answered any questions they had. We conducted the survey after the milk producers had dropped off their milk at the collection center in the morning and evening. Furthermore, some of these responses were also recorded at the farmer's dairy farms or homes. In two of these villages (Chikodra and Napad), the data was only collected from farmers at their homes or milk farms rather than at the collection facility.

Results

Table 1: Revenue Part of the Survey conducted in villages around Anand, Gujarat

	Buffaloes	Cows
Number of Villagers	222.00	129
Number of Animals	2.10	5.32
Daily Total Amount of Milk in Summer	8.82	40.08
Daily Total Amount of Milk in Winter	10.02	46.19
Daily Total Amount of Milk poured in the dairy in Summer	6.92	38.27
Daily Total Amount of Milk poured in the dairy in Winter	7.85	44.00
Amount of Fat	7.4%	3.9%
Number of Months Buffalo continuously gives milk for	7.75	8.29
Number of Months between lactation periods	4.23	3.13
Number of Lactation periods during a buffalo's lifetime	9.55	9.89
How many buffaloes did you purchase?	1.03	4.21
Average Purchase Price of Buffalo	25,386.02	26,660.01
Do you keep the buffalo till it becomes old?	95%	90%
Do you sell the buffalo before it becomes old?	5%	10%
Selling Price of the buffalo?	22,378.79	24,722.00
Total Amount of Milk Produced in a year	2,192.61	12,170.34
Total Amount of Milk Sold to Dairy in a year	1,638.44	11,580.28
Total Amount of Annual Revenue from selling milk to dairy	52,933.05	229,035.77
Annual Deprecation cost of animal	5,864.72	18,579.85
Annual Salvage Costs of Animal	80,769.58	24,033.07
Average Amount of Annual Milk per animal	1,079.87	2,099.42
Total Raw Annual Revenue	61,202.72	229,035.77
Total Annual Bonus (20% of Raw Annual Revenue)	11,605.25	45,807.15
Total Trolley Revenue (1 Animal = Rs. 500/yr)	1,051.80	2,658.91
Total Cumulative Annual Revenue	73,807.50	277,501.84

*The unit of observation is a village household, that owns cows or buffaloes. If the household owns both types of animals, income & expenses are divided based on the amount of revenue contributed by each animal.

**All the amounts are in liters and Indian Rupees.

Table 2: Expenses Part of the Survey conducted in villages around Anand, Gujarat

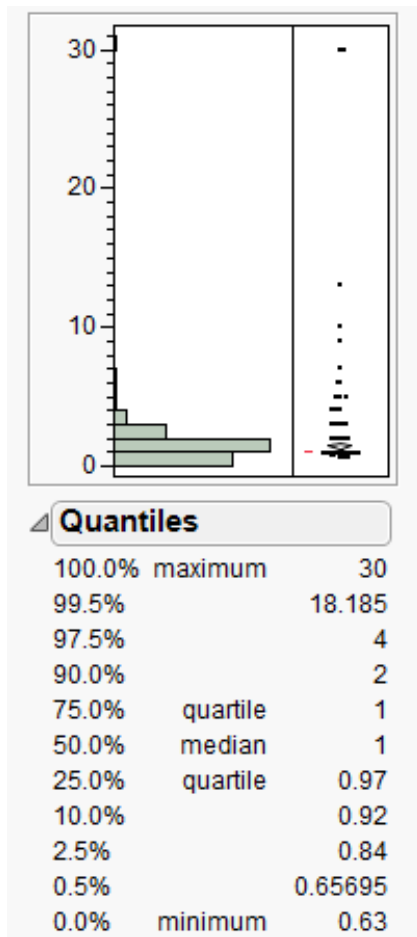
	Buffaloes	Cows
Expenses		
<u>Fixed Costs (Shetler, Electricity, and Water)</u>	1,299.76	7,398.59
Feeding Costs		
Total daily amount of Amuldaan fed to animals (kg)	5.67	22.22
Total daily amount of Dry Grass fed to animals (pura)	12.73	24.90
Total daily amount of Green Grass fed to animals (mandh)	1.94	4.37
Total daily amount of Makai Khor fed to animals (kg)	3.33	4.04
Total daily amount of Kapas Khor fed to animals (kg)	2.20	3.06
Total daily amount of Makai Phatri fed to animals (kg)	0.05	1.13
Total daily amount of Tuver Chuni fed to animals (kg)	0.01	2.09
Total daily additional feeding costs	-	141.88
<u>Total Annual Feed Costs</u>	95,038.94	221,626.05
Medical/Insurance Expenses		
<i>Do your animals have insurance?</i>	5%	9%
Average coverage per animal	25,583.33	3,527.13
Average annual premium per animal (in respect to coverage)	1,351.92	157.95
Number of Doctor visits in a year	2.30	1.79
<u>Total Annual Medical & Insurance Expenses</u>	428.23	5,981.03
Labor Costs		
Total number of unpaid daily hours	2.33	9.81
Annual cost of daily unpaid labor	13,638.00	14,716.67
Annual Salary paid to hired individuals	678.01	7,112.38
<u>Total Annual Labor Costs</u>	14,316.01	21,829.05
Total Annual Costs (excl. labor)	102,022.70	245,756.27
Total Annual Costs (incl. labor)	116,338.70	289,141.49
Total Amount of Milk Produced in a year	2,192.61	12,170.34
Milk Cost (Rs./L) excluding labor	52.20	28.82
Milk Cost (Rs./L) including labor	62.00	33.42

Table 3: Adjustments

	Buffaloes	Cows
Household Expenses		
<i>What are your monthly household expenses?</i>	4,427.17	6,655.70
<i>Does selling milk help with your household expenses?</i>	88%	93%
<i>Do you think your children will continue to sell milk in the future?</i>	73%	67%
Annual Net Income (excluding labor costs)	(28,215.19)	31,745.57
Monthly Net Income (excluding labor costs)	(2,351.27)	2,645.46
Annual Net Income (including labor costs)	(42,531.20)	(11,639.65)
Annual Net Income (including labor costs)	(3,544.27)	(969.97)
<u>Adjusted Milk Cost (Rs./L) excluding labor</u>	44.24	26.77
<u>Adjusted Milk Cost (Rs./L) including labor</u>	51.77	30.66
Adjusted Annual Net Income (excluding labor costs)	(21,872.04)	53,959.63
Adjusted Monthly Net Income (excluding labor costs)	(1,822.67)	4,496.64
Adjusted Annual Net Income (including labor costs)	(36,188.04)	10,574.40
Adjusted Annual Net Income (including labor costs)	(3,015.67)	881.20

Figure 2:

Distribution of Number of Buffaloes



Distribution of Number of Cows

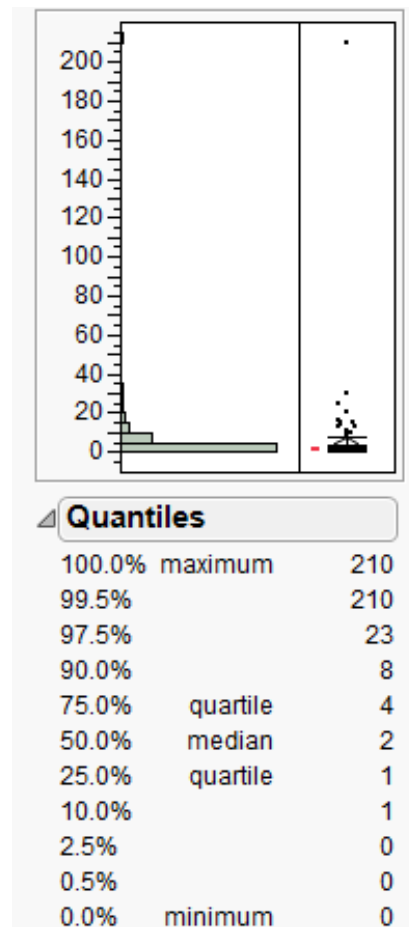


Figure 3: Adjusted Cow Milk Cost vs. Three variables (Number of Cows, Amount of Cow Fat, and Average Purchase Price of Cow)

Summary of Fit				
RSquare		0.023686		
RSquare Adj		-0.01816		
Root Mean Square Error		39.81909		
Mean of Response		29.26041		
Observations (or Sum Wgts)		74		

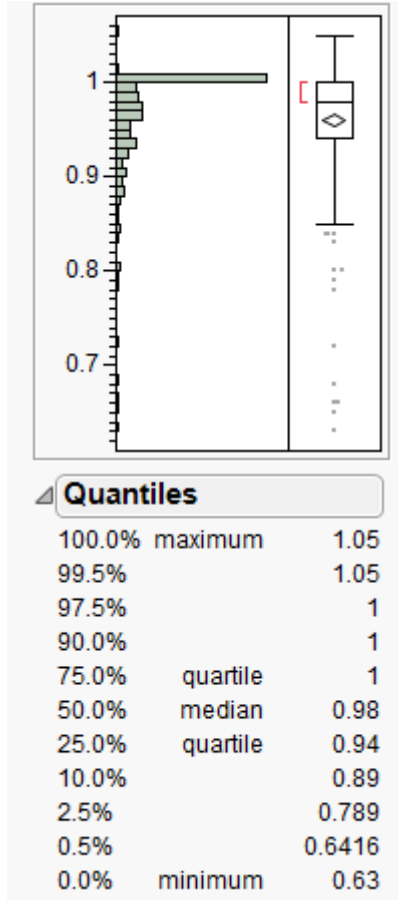
Analysis of Variance				
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	2692.73	897.58	0.5661
Error	70	110989.22	1585.56	Prob > F
C. Total	73	113681.95		0.6392

Lack Of Fit				
Source	DF	Sum of Squares	Mean Square	F Ratio
Lack Of Fit	59	108383.32	1837.01	Prob > F
Pure Error	11	2605.91	236.90	0.0004*
Total Error	70	110989.22		Max RSq 0.9771

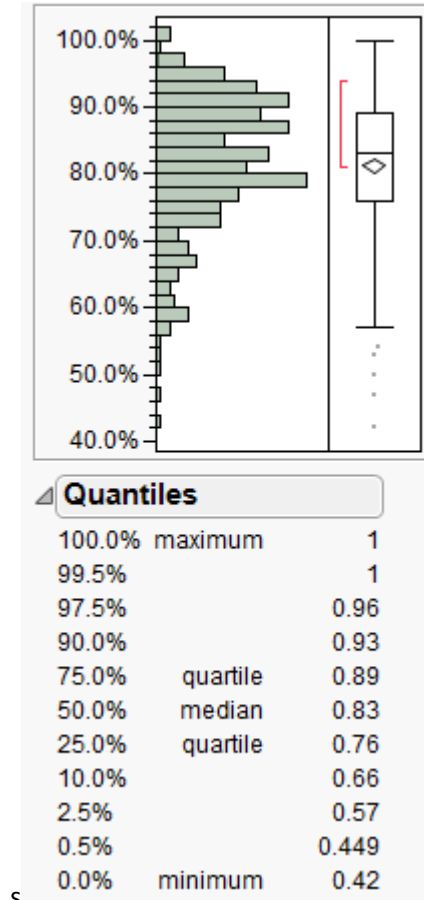
Parameter Estimates					
Term	Estimate	Std Error	t Ratio	Prob> t	
Intercept	53.754594	32.79721	1.64	0.1057	
Number of Cows	-0.054086	0.191041	-0.28	0.7779	
Amount of Cow Fat	-820.8549	742.2853	-1.11	0.2726	
Average Purchase Price of Cow	0.0003422	0.000515	0.66	0.5086	

Figure 4:

**Distribution of Feed Costs
(% of Total Costs ex. labor)**



**Distribution of Feed Costs
(% of Total Costs inc. labor)**



S

Table 4: Sensitivity Table for Feed Costs

Feeding Costs	Buffalo Monthly Net Income (Adjusted)	Buffalo Rate of Return (Annual)	Cows Monthly Net Income (Adjusted)	Cow Rate of Return (Annual)
0%	6,097.18	172%	22,965.39	210%
10%	5,305.19	152%	21,118.51	191%
20%	4,513.20	133%	19,271.62	173%
30%	3,721.21	113%	17,424.74	154%
40%	2,929.22	94%	15,577.86	135%
50%	2,137.23	74%	13,730.97	116%
60%	1,345.24	55%	11,884.09	97%
70%	553.24	35%	10,037.20	78%
80%	(238.75)	16%	8,190.32	60%
90%	(1,030.74)	-4%	6,343.44	41%
100%	(1,822.73)	-23%	4,496.55	22%

- Rate of Return = Annual Net Income/Investment
- Investment = Market Price of Animals * Number of Animals
- Estimated Market Price of Animal (Cow or Buffalo) = Rs. 25000 (from the survey)

In the results above, we surveyed over 300 milk producers. Most of the milk producers had only one type of animal (cow or buffalo), but when they had both types of animals, the costs were split between the two types of animals. In order to calculate the amount of milk produced by an animal in a given year, we assumed that the lactation period was equally divided between the summer and winter seasons. In addition, we assumed each animal was kept for the all the lactation period over its lifetime (10-12). Each lactation period was assumed to last a year. If the animal was purchased, it was depreciated over the entire lactation period time frame. If the farmer did not indicate the number of lactation periods expected over an animal's life time, the animal was depreciated over ten years. The fixed assets such as a shed were depreciated over fifteen years. The labor costs are calculated by assigning an hourly wage to the amount of hours the villagers puts in to take care of the animals. The hourly wage is the $(100/365)*NREGA$ hourly wage to reflect the fact that NREGA only guarantees employment for 100 days out of the calendar year. NREGA is the National Rural Employment Guarantee Act passed by the Government of India which guarantees employment for one individual of a household for 100 days at Rs. 100/8-hr day. The feed costs were estimated using market prices for the inputs (included in the appendix), multiplied by the amount of each fed to the animals.

As the distribution of the animals indicates, most farmers owned only one or two buffaloes, and about 4 to 5 cows. Unlike buffalo owners, cow owners had a greater distribution in the number of cows they owned. As such, there are limits to the conclusions we may draw about economies of scale, but suffice to say those will be limited to cow owners' data only. As the data indicates, cows produce twice the amount of milk as buffaloes do. Conversely, cow's milk has about half the fat content as a buffalo's milk. The amount of money a farmer earns from the cooperative depends on the fat content of the milk and the amount of milk provided to the dairy. Furthermore, each farmer generates Rs. 500 annually from each animal he owns by selling animal waste as manure. Additionally, the farmer also receives a 20% bonus at the end of the year from the cooperative, which has been calculated on the value of the milk the particular farmer has provided to the union. The data indicates that buffalo milk is much more expensive to produce than cow milk. Each animal has similar costs per animal (Rs. 48,000 for buffaloes and Rs. 46000 for cows), and as result, the difference in costs is primarily due to the amount of milk produced by buffalo as opposed to a cow. Buffalo milk does command a higher procurement price than cow milk since buffalo milk has a greater percentage of fat than cow milk. Despite the

higher procurement price, the data suggests that owning a buffalo results in negative income (even before labor costs are factored in). One might suggest that there might be an inclination to move away from buffaloes to cows; however, we don't see that in the data. There are more farmers who own buffaloes than cows. An explanation as to why this is the case is explored further in the discussion section. In addition, the data indicates (not surprisingly) that most milk farmers do not have insurance (95% and 90% for buffaloes and cows respectively). This might be attributed to the fact that the insurance premium for any particular animal is Rs. 1200 for coverage of Rs. 20,000. The insurance premium would reduce the monthly net income of farmers (who own cows and generate positive income) by 20%, making it unlikely to be bought by many. However, many farmers indicated that they would like to buy insurance, but insurance companies no longer offer them. A possible explanation was offered by a professor at IRMA who had done similar research in Rajasthan. He commented that there was a moral hazard problem because the insurance company could not accurately judge the health of an animal, and it was difficult to determine whether the animal died of natural causes or otherwise. As such, most insurance companies had stopped issuing such contracts except in areas where there was a strong local authority, which would hold the policyholder accountable. Another point to highlight from the data is that the feed costs (includes all types of fodder and feed) comprises over 90% of the total costs (ex-labor), and between 57%-95% of the total costs (inc-labor).

Discussion

Before we start detailed discussion on this topic, we should acknowledge the fact that milking is a secondary source of income for most farmers. They are unlikely to pursue this activity if it does not generate positive net income for their household. However, my data seems to suggest the opposite when labor costs are included for both cows and buffaloes. Given that the total costs including labor result in a negative income for both cow and buffalo owners, this is an economic activity that generates wages (similar to a job) rather than a business. Let us for a moment ignore labor costs and assume that whatever positive income the farmer generates is fair compensation for his effort. The data indicates that buffalo owners still do not generate a positive net income, yet most of the farmers are buffalo owners. Unless they are doing this activity for altruistic purposes which we already know they are not, then there must be an alternative explanation. One could point to the fact that the feed costs (which comprise almost all of the

costs) were improperly calculated. Maybe some of the fodder is not fed throughout the entire calendar year. That would be a possible explanation, however, the results already control for it. An alternative explanation could either be that the farmers have exaggerated the amount of fodder they feed the animals or that most farmers do not pay the market prices of fodder. As the sensitivity table indicates, if the fodder costs are 50% of what I have estimated them to be, a buffalo owner will generate Rs. 1100 (of monthly income) for one buffalo and Rs. 2400 for one cow. The results are similar to what I found in my earlier study in which I indicated that the margins for cow and buffalo milks are similar, and as a result, one prefers the animal with the higher milk output. The results indicate that there should be an incentive away from buffalo ownership towards cow ownership. However, there is no way to measure this trend unless one has data about animal ownership over the years to see whether such a trend is taking place. If in fact, the true fodder costs faced by many of these farmers are 50% of what I have estimated, milking remains a profitable enterprise. However, if the costs are closer to what I estimate, then it is likely that many of these animal owners will exit the business in the upcoming years. Interestingly, a couple of farmers commented on the fact that if one had to buy all the ingredients at the prevailing market price, they would not make any money. This would suggest that many farmers buy at least some of these ingredients at below market prices. Many farmers grow their own dry and green grass, which make up over 50% of the fodder costs, at 20% of the market prices for those ingredients. The value of 20% of the market price only includes the price of seeds, fertilizer, and water required to grow these ingredients. It does not include the price of the land in its computation. For the purposes of this activity, we have assumed that the farmer already owns this land and is not using it for any other purposes, diminishing the possible opportunity cost. By growing their own dry and green grass, the overall fodder costs are closer to the 50% threshold in the sensitivity table, leading to lucrative rates of return (74% and 114% for buffaloes and cows) and significant secondary income. If one is a landless farmer, the only way for one to make money in the milking enterprise is to receive certain ingredients at a below market cost. It is certainly the case that some farm hands (who are landless) are allowed to take some green and dry grass with them to feed their animals at little to no cost. It is likely the case that overall feed costs for them are closer to 70-75% of the estimated feed costs, making it just the case that milking is a profitable enterprise. Most of the landless owners are ones who own

buffaloes rather than cows. If the farm hands are no longer allowed to take these grasses at little or no cost, they will likely be driven out of the milking enterprise.

The above analysis assumes that milk procurement prices will not be increasing any time soon. Milk demand is expected to rise 29% over the next five years to 150 million tones, where as production is not expected to ramp up as quickly. This will put an upward pressure on the end price the consumer has to pay, which will end up benefiting the milk farmers. The increased demand on milk will cause the supply side to ramp up as well. If that is so the case, there will be increased demand for feed. The supply of feed will determine how high its price can go, which can potentially diminish the overall profit opportunity in the milking business. If the profit opportunity does survive, it is likely the case that the consumer will end up paying significantly higher prices for milk than he is currently paying. It is likely that the supply of feed is limited as well given that India is primarily utilizing its irrigable land for agricultural purposes for humans rather than growing fodder. What is one to do in such a scenario?

One may state that higher prices for a commodity due to increased demand and low supply is basic economics and hence, are justified. However, one ignores the nutritional importance of milk in the Indian diet, emphasized by milk producers setting aside a portion for their children. It is an important source of protein and other vitamins, which might make it difficult to replace in a vegetarian diet. Many Indian consumers, especially lower-income ones, of milk may no longer be able to afford the commodity because of higher prices. The Indian state might be truly worried about this particular aspect of the problem if the prices truly start to make milk unaffordable to wide swath of the population.

There are a number of ways in which the Indian state might respond to this problem. In the short-run, the Indian state could open up the domestic milk market to the rest of the world in a limited manner. There could be a quota of importing milk powder to meet the increased demand and keep a check on prices. For example, if there is a gap between production and consumption of 10 million tones, the government could set a quota of 7 million tones. The remaining 3 million tones would put upward pressure on the prices, creating an incentive for milk farmers to ramp up production as the milk prices continue to rise, albeit at a slower pace. Secondly, the cooperative establishment could incentivize milk farmers to increase productivity of their animals by providing low interest loans. There is a lot of room to increase the

productivity of Indian cows and buffaloes. According to my data, the buffaloes produce on average between 4-5 liters of milk in a day. A recent article cited that the government of Punjab was taking steps to allow importation of Pakistani buffaloes, which produce 36 liters of milk in a day. A report back in 1996 stated that high yielding animals are likely to consume more fodder and feed than the animals they are replacing. The cooperative should likely target farmers who already own land because their feed costs are 50% of the market value of the feed. One could also suggest that the cooperative could encourage increased ownership of animals. However, the data (at least for the cow owners) indicates that having a greater amount of animals does not lead to lower cost. As we stated later, the conclusions one can draw from this are limited since the distribution of the number of cows owned by milk farmers is quite skewed. This means that there are few savings to be drawn from having a greater number of animals. However, having a greater number of animals incentivizes the farmer to set aside a piece of his land particularly for fodder production reducing his overall costs. If he doesn't have a greater number of animals, setting aside a piece of land might result in a higher opportunity cost and he may decide against doing so.

Thirdly, since the supply of the irrigable land that can be set aside for fodder is limited, the government might feel the need to subsidize fodder. However, I argue there is little need to do so. The higher demand for fodder will be an incentive itself to farmers in the form of higher prices. Milk producers, who own land, will set aside more of their land to produce fodder pushing down its demand. The government could create incentives for farmers who produce fodder to improve the productivity of fodder farms, and form partnerships with private players to set up additional feed processing facilities.

Government and Cooperative Response

As discussed in the introduction, the government has moved in this regard by introducing a National Dairy Plan, the first phase of which is being partly funded by the World Bank. The plan is aimed at increasing the quality of the animal through artificial insemination, and setting up plants to augment cattle feed. Though the dairy plan does state so otherwise, the government could also consider investing in research to increase the yield per acre of fodder and feed in addition to setting up feed plants.

I had the opportunity to share my preliminary findings with Mr. Rahul Kumar, Managing Director of Kaira District Co-operative Milk Producers' Union Ltd. He mentioned that he too expected milk demand to double in the next decade. He expects consolidation in the milking arena from smaller producers to medium size producers and increase in number of milk farms. In order to meet the new demand, there will be need to be increase in the number of animals/producer as well as an increase in the productivity of each of those animals. He envisions increased productivity through higher breed of cows, and introduction of milking machines (which cost Rs. 48000 and can milk four cows at a time, and are subsidized to cost Rs. 24000 to a farmer). Amul is taking steps to support the transition from smaller (1-2 animals) which constitute 80% of Amul's procurement to larger farmers which constitute about 20% of its procurement. It is envisioning giving smaller milk coolers to milk farmers and collecting their output directly, instead of those milk producers visiting their milk dairy (resulting in higher transportation expenses and wastage of time). Furthermore, the cooperative has partnered with banks to provide low cost loans to farmers, who are deemed credit worthy by their local village society. The credit worthiness of farmers is determined by the secretary of the village milk collection society, who oversees the daily collection of milk in the local village dairy. These loans cost roughly 10% (1% above the existing rate) instead of the loans a farmer would be able to get otherwise (at 13-14%) if he is able to pass all the hurdles the banks throw at him. Amul facilitates farmers getting loans by guaranteeing that they will pay by deducting their principal and interest from the amount of milk they pour at the dairy. Loan is necessary because most of these farmers (80% who own 1-2 animals) do not accumulate capital over the course of the year through selling of milk because the net income they generate through this activity goes into running their households. Thus loans are necessary in order to buy a better breed and quality of animals (which cost more) as well as to increase the number of animals they currently own. Mr. Kumar agreed with the fact that there will be consolidation over the next 10 years as individuals realize the economies of scale and they will move in this direction due to high labor and feeding costs. He also agreed with the finding that individuals who are able to sustain this activity need to have some amount of token land where they can grow some of the fodder because home grown fodder costs significantly less than (1/5 of market price) the price it is available in the market.

Possible Challenges

The above steps face a couple of challenges, excluding the ones pertaining to implementation.

1) **Real Estate Prices:** In the area that I surveyed, real estate prices have skyrocketed in the past few years. According to farmers, farmers with land are selling a portion of their land holdings, which are being converted from agricultural to residential land diminishing the overall land area for agriculture. This will result in a local shortage of fodder, and put an upward pressure on fodder prices. Even if the upward pressure on prices does not materialize, it will force several milk producers to purchase fodder at market prices diminishing their net income and some instances even making milking unsustainable. When I discussed this phenomenon with Mr. Rahul Kumar, he stated that high real estate prices are prevalent only in villages in close proximity to urban centers. He stated that farmers internally are not selling their land because there are few purchasers of those land holdings. However, this problem does result in the need to produce more fodder from a smaller pool of irrigable land. The dairy plan could potentially also focus improving the productivity of the remaining irrigable land set aside for fodder and cattle feed.

2) **Rate of Return:** As discussed in the above paragraph, land prices affect the rate of return that is required by farmers to be in this business. If a farmer has a choice between either earning 9% (fixed deposit rates in India) on the money he has received by selling the land or milking, it will depend on the rate of return. In the sensitivity table, the rates of return were calculated only for an annual year. In the following example, I calculate a return for a piece of land that the farmer could use for his milking enterprise. The cost of construction of a shed would Rs. 1 Million and purchasing 10 cows would cost anywhere between Rs. 250,000 – Rs. 400,000. Let us use the market price that we used earlier which is Rs. 25, 000 for an animal. We will peg the monthly net income earned from an animal at Rs. 2500, and multiplied by 10 each month will result in a monthly income of the farm of Rs. 250,000. We realize that the rate of return is a comfortable 20%, and the farmer would be happy to pursue such an activity. The rate of return calculated in this instance is an internal rate of return. However, we must not forget the fact that this would elevate milking from a secondary source of income to a primary source of income. We must also remember that milking would experience higher volatility than placing one's money in a fixed

deposit account. However, the differential is large enough that the farmer would be tempted to enter the milking industry.

Construction of Shed	-1,000,000
Purchasing 10 Cows	-250,000
Income in Year 1	300000
Income in Year 2	300000
Income in Year 3	300000
Income in Year 4	300000
Income in Year 5	300000
Income in Year 6	300000
Income in Year 7	300000
Income in Year 8	300000
Income in Year 9	300000
Income in Year 10	300000
Rate of Return (IRR)	20%

3) **Labor Shortage:** In the above example, we have calculated monthly net income excluding labor costs. We have operated under the assumption, that this activity will be pursued by members of the household who otherwise have no other outlet to generate activity. However, this would not be a correct assumption when discussing a milk farm. The family is likely to hire a farm hand, and due to labor shortages in the area, likely to pay him around Rs. 4000/month to take care and run the enterprise. Let us see how that affects internal rate of return.

Construction of Shed	-
	1,000,000
Purchasing 10 Cows	-250,000
Income in Year 1	252000
Income in Year 2	252000
Income in Year 3	252000
Income in Year 4	252000
Income in Year 5	252000
Income in Year 6	252000
Income in Year 7	252000
Income in Year 8	252000
Income in Year 9	252000
Income in Year 10	252000
Rate of Return (IRR)	15%

The inclusion of labor costs reduced the internal rate of return by 25%. If the farmer has to pay the farm hand a Rs. 1000/month, IRR drops to 14%. The IRR in milking is still higher than that rate of return offered by the checking account, but if he sells his land for a high enough price, his absolute monthly income could be higher than the one generated via milking.

Conclusion

Though the above steps might suggest that the government is intervening heavily in the dairy market, such is not the case. The market is still what dictates the steps the supply side of the equation might take to rectify the problem. The above policies allow the sector to be ready for the changes that are likely to occur over the next few years. The sector will likely make these changes regardless due to the upward price pressure, but these policies may allow certain segments of the population to continue to be able to afford and consume milk. The reader should be aware of the fact that the cooperative studied in this case is one of the most productive, successful dairy cooperatives in India and take that into consideration when extrapolating the results of this study.

Appendix

Table 5: Market prices of items at which cost of feed was calculated

Cost Line Itmes	IN
Amount Doctor charges per visit	50.00
Cost of Amuldaan (per kg)	9.50
Cost of Dry Grass (market price/pura)*	8.00
Cost of Green Grass (market price/mandh)**	30.00
Cost of Makai Khor (market price/kg)	20.00
Cost of Kapas Khor (market price/kg)	18.00
Cost of Makai Phatri (market price/kg)	10.00
Cost of Tuver Chuni (market price/kg)	13.00
Hourly Cost of Labor (NREGA) (INR 120 for 8 hr day for 100 days)	4.11
*1 pura = 0.8kg; **1 mandh = 25kg	

Table 6: Cow Milk Procurement Prices in the Kheda District as of December 1st, 2011

Cow Procurement Prices: December 1st, 2011	
Fat %	Price (INR/L)
3.00%	17.88
3.10%	18.09
3.20%	18.30
3.30%	18.51
3.40%	18.72
3.50%	18.93
3.60%	19.14
3.70%	19.35
3.80%	19.56
3.90%	19.77
4.00%	19.98
4.10%	20.19
4.20%	20.40
4.30%	20.61
4.40%	20.82
4.50%	21.03
4.60%	21.24
4.70%	21.45
4.80%	21.66
4.90%	21.87
5.00%	22.08

Table 7: Buffalo Milk Procurement Prices in the Kheda district as of December 1st, 2011

Buffalo Procurement Prices: December 1st, 2011	
Fat %	Price (INR/L)
5.10%	21.40
5.20%	21.82
5.30%	22.25
5.40%	22.68
5.50%	23.34
5.60%	23.77
5.70%	24.20
5.80%	24.63
5.90%	25.07
6.00%	25.50
6.10%	25.93
6.20%	26.36
6.30%	26.79
6.40%	27.22
6.50%	27.65
6.60%	28.09
6.70%	28.52
6.80%	28.95
6.90%	29.38
7.00%	29.81
7.10%	30.24
7.20%	30.68
7.30%	31.11
7.40%	31.54
7.50%	31.97
7.60%	32.40
7.70%	32.83
7.80%	33.26
7.90%	33.70
8.00%	34.13
8.10%	34.56
8.20%	34.99
8.30%	35.42
8.40%	35.85
8.50%	36.28
8.60%	36.72
8.70%	37.15
8.80%	37.58
8.90%	38.01

9.00%	38.44
9.10%	38.87
9.20%	39.30
9.30%	39.74
9.40%	40.17
9.50%	40.60
9.60%	41.03
9.70%	41.46
9.80%	41.89
9.90%	42.32
10.00%	42.76

Figure 5: Survey Administered to Farmers (in English)

Name: _____ House Number: _____
 Village: _____ District: _____

*All data is to separated for cows and buffaloes. If someone owns both types of animals, the cost should be segregated to both animals, except for amount of time allocated to maintaining them.

*All quantities are in metric units (g, kg, liter) and Indian Rupees (INR)

	Cow	Buffalo
How many animals do you have? (list only adults)		
How much milk do all of your animals (combined but separate for cows and buffalos) give during summer time? (In the entire day: both morning and evening) both times)		
How much milk do all of your animals (combined but separate for cows and buffalos) give during winter time? (In the entire day: both morning and evening) both times)		
How much milk do you sell to the milk collection center in a day (morning and evening) during the summer time?		
How much milk do you sell to the milk collection center in a day (morning and evening) during the summer time?		
What is the SNF content of the milk that you provide to the collection center?		
What is the Fat content of the milk that you provide to the collection center?		
What is the procurement price that you receive for your milk?		
How many months does the animal give milk continuously for? (i.e. lactation period)		
How many such periods does the animal have during its lifetime?		
How many of the animals that you currently own did you purchase?		
What is the purchase price of the particular animal? If more than one, list each price individually.		
Do you keep the animal after it completely stops giving milk?		
If you give away the animal, where do you send it?		
If you have sold the animal, how have you made? (or would make if plan to sell it)		
Costs:		
What is the monthly cost of water (for the animals)?		
What is the cost of maintain the stable/shelter (for the animals)?		
How much Amuldan do the animals eat in a day? (combined)		
• What is the cost of Amuldan (one bag)? How many kgs per bag?		
How much dry grass do the animals eat in a day? (combined in kg)		
• What is the cost of dry grass (per kg) if you buy it?		
• What is the cost of dry grass (per kg) if you grow it?		
• What else could you have grown instead of dry grass?		
• What would it sell for?		

• How much could you have sold the other crop for?		
How much green grass do the animals eat in a day? (combined in kg)		
• What is the cost of green grass (per kg) if you buy it?		
• What is the cost of green grass (per kg) if you grow it?		
• What else could you have grown instead of dry grass?		
• What would it sell for?		
• How much could you have sold the other crop for?		
How much Makai Khor do the animals eat in a day? (combined in kg)		
What is the cost of Makai Khor? (per kg)		
How much Kapas do the animals eat in a day? (combined in kg)		
What is the cost of Kapas? (per kg)		
	Cow	Buffalo
Costs continued:		
How much mineral powder do you feed the animals? (combined in kg)		
What is the cost of mineral powder? (per kg)		
What else do you feed the animals?		
How much do you feed it (in a day combined)?		
What is the cost? (per kg)		
Do you have insurance for the animals? (Yes or no)		
What is the annual insurance premium (per animal per coverage)?		
How many times do you call the doctor for check up on the animals? (in a year)		
What is the cost of each doctor's visit?		
What is the annual cost of medications for the animals?		
Do you ever call the specialist doctor (outside of Amul)?		
How many times does the specialist doctor visit in a year?		
What is the cost of specialist's doctor?		
How much time (throughout the day) do you spend taking care of the animal?		
Does anybody else assist you?		
How many individuals assist you?		
How much time do they spend taking care of the animals (throughout the day)?		
Do you pay any of these individuals?		
How many individuals do you pay?		
How much do you pay them? (per hour/per day)		
When the animal is not giving milk (out of the lactation period), do you still provide the following? In the same amount? (Make a note of change in quantity)		
• Amuldaan? (yes or no)		
• Dry Grass? (yes or no)		
• Green Grass? (yes or no)		
• Makai Khor? (yes or no)		
• Kapas? (yes or no)		
• Any other items? (yes or no)		

If you keep the animal after it completely stops producing milk do you still provide the following? In the same amount? (Make a note of change in quantity)		
• Amuldaan? (yes or no)		
• Dry Grass? (yes or no)		
• Green Grass? (yes or no)		
• Makai Khor? (yes or no)		
• Kapas? (yes or no)		
• Any other items? (yes or no)		
Household Income:		
How much money do you earn from selling milk to the milk collection center (monthly)?		
What other jobs do you do to earn money besides selling milk to the dairy?		
How much money do you earn from your other activities (jobs) in a month?		
What is the size of your monthly household budget?		
Do you think this activity is a significant source of income for your household?		
If you did not sell milk, what other job (activity) could you do to earn money?		
How much would someone (or you) earn in this other job (in a month)?		
How many hours (in a day) and days in a week would this job require?		
Do you believe your children will continue to sell milk to Amul?		

Figure 6: Copy of the survey administered

નામ:

ઘર નંબર:

ગામ:

જીલ્લો:

*ગાય અને ભેસ ની માહિતી અલગ રાખવી. કોઈ વ્યક્તિ બંને જાત ના પ્રાણી રાખતું હોઈ, તો બંને ની વિગત અલગ રાખવી સિવાય તેમની પાછળ ફાળવેલો સમય.

*બધી વિગતો મેટ્રિક સિસ્ટમમાં રાખવાની (મેટ્રિક એટલે કિ, ગ્રા, લિ) અને કિંમતો રૂપિયામાં.

	ગાય	ભેસ
તમારી પાસે કેટલા જાનવર છે? (ફક્ત પુખ્ત)		
તમારી ભેસો અને ગાયો ઉનાળામાં એક દિવસમાં (સવાર અને સાંજ) કેટલા લીટર દૂધ આપે છે? (ગાય અને ભેસ અલગ બતાવજો)		
તમારી ભેસો અને ગાયો શિયાળામાં એક દિવસમાં (સવાર અને સાંજ) કેટલા લીટર દૂધ આપે છે? (ગાય અને ભેસ અલગ બતાવજો)		
તમે ઉનાળામાં દૂધ કલેક્શન સેન્ટરમાં કેટલા લીટર એક દિવસમાં (સવાર અને સાંજ) દૂધ વેચો છો?		
તમે શિયાળામાં દૂધ કલેક્શન સેન્ટરમાં કેટલા લીટર એક દિવસમાં (સવાર અને સાંજ) દૂધ વેચો છો?		
તમારા દૂધ એસ.એન.એફ. (SNF) કેટલું આવે છે?		
તમારા દૂધ કેટલા ટકા ફેટ (fat) છે?		
તમને દૂધ કલેક્શન સેન્ટર તમારા દૂધ માટે કેટલો ભાવ આપે છે?		
તમારી ગાયો અને ભેસો કેટલા મહિના સળંગ દૂધ આપે છે? (ગાય અને ભેસ અલગ બતાવજો)		
તમારી ગાયો અને ભેસો ના જીવનમાં આવું (સળંગ મહિના દૂધ આપવાનું) કેટલી વાર બને છે?		
તમારી પાસે કુલ ગાયો અને ભેસોમાંથી તમે કેટલી ખરીદી છે?		
તમારી ગાયો અને ભેસો ની ખરીદ કિંમત જણાવો		
તમારું જાનવર દૂધ આપતું બંધ થઈ જાય, પછી તમે તેને રાખો છો?		
જો તમે જાનવરને ના રાખતા હોવ, તો પછી તમે અને ક્યાં મોકલો છો?		
જો તમે જાનવરને વેચતા હોવ, તો કેટલી કિંમત મળે?		
ખર્ચા :		
મહિનાનો પાણીનો ખર્ચ (જાનવર માટે):		
વરસનો તબેલાને (અથવા જ્યાં પણ જાનવર ને રાખતા હોવ) સંભાળ ખર્ચ (જાનવર માટે):		
તમારી ગાયો અને ભેસો એક દિવસમાં કેટલા કી. અમુલદાન ખાય છે? (ગાય અને ભેસ અલગ બતાવજો)		
• અમુલદાનની એક બેગ કિંમત કેટલી? (એક બેગ કેટલા કિલોની)		
તમારી ગાયો અને ભેસો એક દિવસમાં (સવાર અને સાંજ) કેટલું સુકું ઘાસ ખાય છે? (ગાય અને ભેસ અલગ બતાવજો)		
• જો તમે ખરીદતા હોવ, તો એક કિલો સુકા ઘાસની કિંમત :		
• જો તમે વાવતા હોવ, તો એક કિલો સુકા ઘાસની કિંમત :		

તમારી ગાયો અને ભેસો એક દિવસમાં (સવાર અને સાંજ) કેટલું લીલું ઘાસ ખાય છે? (ગાય અને ભેસ અલગ બતાવજો)		
• જો તમે ખરીદતા હોવ, તો એક કિલો લીલાઘાસની કિંમત :		
• જો તમે વાવતા હોવ, તો એક કિલો લીલાઘાસની કિંમત :		
તમારી ગાયો અને ભેસો એક દિવસમાં (સવાર અને સાંજ) કેટલું મકાઈ ખોર ખાય છે? (ગાય અને ભેસ અલગ બતાવજો)		
• એક કિલો મકાઈ ખોરની કિંમત:		
	ગાય	ભેસ
ખર્ચા :		
તમારી ગાયો અને ભેસો એક દિવસમાં (સવાર અને સાંજ) કેટલું કપાસ ખાય છે? (ગાય અને ભેસ અલગ બતાવજો)		
• એક કિલો કપાસની કિંમત:		
તમારી ગાયો અને ભેસો એક દિવસમાં (સવાર અને સાંજ) કેટલું મિનરલ પાવડર ખાય છે? (ગાય અને ભેસ અલગ બતાવજો)		
• એક કિલો મિનરલ પાવડરની કિંમત:		
તમારી ગાયો અને ભેસોનો વીમા છે? (હા કે ના)		
• જો તમે વીમા ઉતાર્યો હોય, તો વાર્ષિક વીમાનું પ્રિમયમ કેટલું?		
• જો તમે વીમા ઉતાર્યો હોય, તો તમે એક જાનવરનો કેટલાનો વીમો ઉતાર્યો છે?		
તમે વરસમાં જાનવરનો ડોક્ટર કેટલી વાર બોલાવો છો?		
• વાર્ષિક દવા અને ડોક્ટરનો ખર્ચો:		
બીજા વધારાના ખર્ચા હોઈ તો જણાવો?		
આખા દિવસમાં (સવાર અને સાંજ) તમે જાનવરની પાછળ કેટલો સમય આપો છો?		
તમારી કોઈ મદદ કરે છે?		
કેટલા લોકો તમારી મદદ કરે છે?		
જે લોકો તમારી મદદ કરે છે, એ જાનવરની પાછળ એક દિવસમાં(સવાર અને સાંજ) કેટલો સમય આપે છે?		
વરસ માં જ્યારે તમારી ગાય કે ભેસ દૂધ ના આપતી હોઈ, તો તમે આમાંથી એને સુ ખવડાવો?		
• અમુલદાન? (હા કે ના)		
• સુકું ઘાસ? (હા કે ના)		
• લીલું ઘાસ? (હા કે ના)		
• મકાઈ ખોર? (હા કે ના)		
• કપાસ? (હા કે ના)		
• બીજું કઈ? (હા કે ના)		
જો તમારું જાનવર દૂધ આપતું બંધ થઈ જાય અને તમે એને રાખો, તો તમે એને સુ ખવડાવો છો?		
• અમુલદાન? (હા કે ના)		
• સુકું ઘાસ? (હા કે ના)		
• લીલું ઘાસ? (હા કે ના)		

• મકાઈ ખોર? (હા કે ના)		
• કપાસ? (હા કે ના)		
• બીજું કઈ? (હા કે ના)		
ઘર આવક:		
તમારી મસિક આવક દૂધ વેચાણ થી:		
તમે દૂધ વેચાણ સિવાય બીજી કઈ નોકરી કરો છો? અને તમારી મસિક આવક?		
તમારી મસિક આવક અને તમારો મસિક ઘર ખર્ચ:		
તમને લાગે છે કે દૂધ વેચાણ થી તમારા ઘર ખર્ચમાં મદદ થાય છે?		
જો તમે દૂધના વેચતા હોત, તો તમે બીજું સુ કામ કરતા હોત? અને તમારી આવક કેટલી હોત?		
તમને લાગે છે કે ભવિષ્યમાં તમારા છોકરા દૂધ નું વેચાણ કરશે?		

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