# IMPACT OF CLIMATE CHANGE AND ADAPTATION MEASURES IN DAIRY SECTOR OF SIKKIM

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Small holder dairy farming is the backbone of the dairy sector of Sikkim

Photo courtesy: Nima Tashi Bhutia

Yaks grazing in the summer pastures in the alpine meadows of West Sikkim. Grazing in forests is now banned and stall feeding of cattle is being promoted

Sikkim is an agrarian economy with predominantly rural population (about 75 %) and two-third of the overall work force depend agriculture and allied activities, with only 16% of geographical area available for cultivation, about 17% of state GDP is being contributed from this sector. Amongst the various professions of socio-economic importance, animal husbandry deserves high priority in the state as it plays an important role in the economic upliftment of the weaker section of society engaged in livestock rearing and processing of animal products. The livestock wealth is an asset to the farmers and provides nutrition, draught power, transportation, employment and economic support. There are extensive alpine meadows at heights varying from 4,000 to 5,000 m. At lower altitudes the village herds are stall-fed. The forest herds are generally grazed.

The dairy animals are a source of cash income and soil nutrients in the form of manure. The dairy cow produces milk, bullocks for draught power and manure. In mixed crop-livestock farming systems, farmers generally keep one or two dairy animals that are mostly stall fed when they are at a productive stage. Other cattle, particularly 'unproductive' animals, are mostly grazed on common land and brought to the homestead at night; some homemade supplement is provided to milking cows.

Over 80 percent of the rural households in the state own livestock and earn supplementary income from them. Livestock production in Sikkim is predominantly the endeavor of the small producers. Small and marginal farmers own nearly 85 percent of all species of livestock and poultry, even though they own or operate less than 55 percent of the farmland and practice mixed crop-livestock farming system, earning substantial incomes and enriching family diets with nutrient rich animal products. As per 18$^{th}$ Livestock census 2007 ,the livestock population in Sikkim is as follows: Cattle-169829, goat-110120, sheep-4879, pig-38930, buffalo-1536, yak-6468 and poultry-255682.

The total asset value of the livestock is estimated to be more than Rs. 995.27 million, out of which 46% is from milk, it is the second largest agriculture produce after to maize. The main livestock produce in Sikkim is milk, eggs, meat, skin, hide, offal, manure and wool.

**THE SIKKIM COOPERATIVE MILK PRODUCERS UNION**

The Sikkim Cooperative Milk Producers Union is the apex organization in the state performing the functions of collection, processing and marketing of milk produced by the rural farmers through a co-operative set up. On the merger of Sikkim with the Indian union in 1975, the idea of forming a Co-operative Milk Union in Sikkim was initiated based on the success of the model achieved in Anand in the State of Gujarat. The Sikkim Milk Union started functioning from the year 1980 with less than 2000 farmers with initial production of about 2000 litre of milk per day. The union has grown over the last 30 years and has more than 10,000 farmers as members with milk procurement of over 14000 litre per day through over 200 milk cooperative societies. The Sikkim Milk Union plays a vital role in sustaining rural livelihoods in the Himalayan Hill State as is evident from the fact that over Rs. 65 lakh every month (an average of about Rs.1000 per milk producing member) is being paid in cash to the rural farmers against their milk production. This is in addition to farmers own consumption and local sale of milk and milk products. Farmers also consume milk, additionally farmers also get the benefit from sale of manure and calf. The primary role of the Sikkim Milk Union is to provide remunerative market for milk producers in the far-flung remote villages and make hygienic milk and milk products available to the urban consumers at reasonable rates. Hence Sikkim Co-operative Milk Producers Union Ltd is one of the major stake holders in the dairy sector.

## EFFECT OF CLIMATE CHANGE IN DAIRY SECTOR OF SIKKIM:

### Increasing summer temperature and torrential rains

The dairy farmers in Sikkim are facing severe constraints in adoption of dairy production technologies and maintaining the quality and clean milk production. Milk being a very nutritious medium to almost all kinds of microorganism, gets spoiled very quickly when it is exposed to outside environment. With summers becoming increasingly warmer, the collection of milk of good quality is a great challenge. Table 1 shows the quantity of milk which was received either sour or curdled during the last four years by Sikkim Union. It is apparent that milk getting spoiled is directly related to summer and rainy season. The quantity of sour milk is increasing every year inspite of various efforts to reduce it. Also torrential rains cause road blocks during the monsoons, which result in delay in transportation of milk. Both these factors contribute to spoilage of milk.

**Table 1.** Sour milk procurement by Sikkim Milk Union (in kg.) over the last four years

| MONTH | 2007-08 | | | 2008-09 | | | 2009-10 | | | 2010-11 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SOUR | TOTAL | Sour % | SOUR | TOTAL | Sour % | SOUR | TOTAL | Sour % | SOUR | TOTAL | Sour % |
| APR | 3859 | 325807 | 1.18% | 5790 | 254691 | 2.27% | 5322 | 203210 | 2.62% | 6495 | 141434 | 4.59% |
| MAY | 9014 | 357136 | 2.52% | 6467 | 312206 | 2.07% | 10006 | 275397 | 3.63% | 8339 | 266458 | 3.13% |
| JUN | 9734 | 362216 | 2.69% | 22592 | 334165 | 6.76% | 24355 | 294866 | 8.26% | 17948 | 271673 | 6.61% |
| JUL | 16491 | 323533 | 5.10% | 27736 | 346632 | 8.00% | 27526 | 307241 | 8.96% | 20913 | 270545 | 7.73% |
| AUG | 10149 | 299358 | 3.39% | 21233 | 310666 | 6.83% | 17361 | 259130 | 6.70% | 10126 | 244654 | 4.14% |
| SEP | 4552 | 198901 | 2.29% | 8077 | 299391 | 2.70% | 11077 | 224785 | 4.93% | 8682 | 214911 | 4.04% |
| OCT | 3455 | 138500 | 2.49% | 2763 | 287535 | 0.96% | 6078 | 190763 | 3.19% | 5079 | 191393 | 2.65% |
| NOV | 1166 | 269914 | 0.43% | 827 | 360283 | 0.23% | 1391 | 265142 | 0.52% | 546 | 273697 | 0.20% |
| DEC | 109 | 160130 | 0.07% | 403 | 391219 | 0.10% | 226 | 229785 | 0.10% | 1765 | 325981 | 0.54% |
| JAN | 1429 | 305561 | 0.47% | 761 | 368581 | 0.21% | 482 | 241290 | 0.20% | 1013 | 336907 | 0.30% |
| FEB | 594 | 274025 | 0.22% | 1044 | 247169 | 0.42% | 1982 | 228319 | 0.87% | 1667 | 277081 | 0.60% |
| MAR | 7018 | 288208 | 2.44% | 1777 | 271982 | 0.65% | 6138 | 232424 | 2.64% | 1407 | 286522 | 0.49% |
| **Total** | **67570** | **3303289** | **2.05%** | **99470** | **3784520** | **2.63%** | **111944** | **2952352** | **3.79%** | **83980** | **3101256** | **2.71%** |

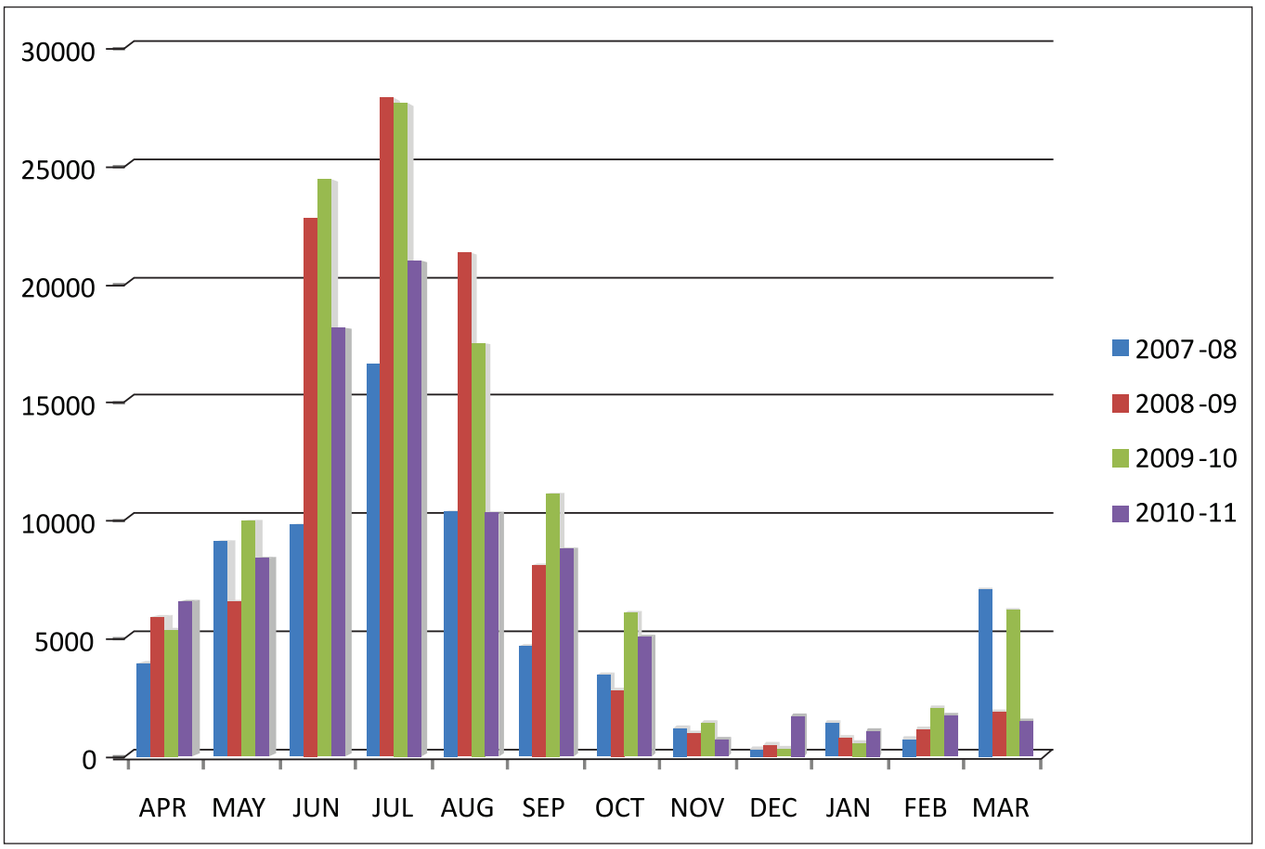


**Chart 1:** Month wise sour milk procurment

The curdled milk received by the Sikkim Milk union is increasing year after year in spite of taking all controlling measures. This is mainly because the rise in temperature and monsoon rainfall which causes road block, thereby resulting in delay in transportation. The curdling of milk can be prevented by improving the quality of milk, by chilling it below 5 degree celsius temperature within 3 hours of milking and also by quickly transporting the milk to the processing centers.

The State is also known for its torrential rains which have increased in the recent years due to climate change. As a result of unexpected torrential and erratic rains, there are frequent landslides. Consequently, the roads are closed and it becomes extremely difficult for the collection vans to reach designated collection centers in time. This transportation delay results in rapid multiplication of bacteria and results in increasing acidity and spoilage of milk. In case of landslides, the milk either need to be quickly trans-shipped and transported with the help of suitable vehicles to chilling centers. Therefore, there is a need to add sufficient (at least 100) number of chilling units and also there should be sufficient (at least 8) trans-shipment vans at vantage points throughout the State.

**ASSESSMENT OF ECONOMIC LOSS DUE TO SOUR MILK:**

The sour milk will have a value of only 30% of the normal milk as it can be used for recovery of butter and making of *churpi* to some extent. Accordingly loss is assessed based on the procurement prices prevailing during the corresponding period. Table 2 provides the economic loss resulting from spoilage of milk due to increasing temperature and road blocks due to landslides and rainfall.

**Table 2 :** Estimated economic loss due to sour milk procurement by Sikkim Milk Union

| MONTH | 2007-08 | | 2008-09 | | 2009-10 | | 2010-11 | |
|---|---|---|---|---|---|---|---|---|
| | Sour Milk in Kg | Economic Loss in Rupees | Sour Milk in Kg | Economic Loss in Rupees | Sour Milk in Kg | Economic Loss in Rupees | Sour Milk in Kg | Economic Loss in Rupees |
| APR | 3859 | 37818 | 5790 | 60790 | 5322 | 59606 | 6495 | 81840 |
| MAY | 9014 | 88337 | 6467 | 67904 | 10006 | 112067 | 8339 | 105065 |
| JUN | 9734 | 95393 | 22592 | 237216 | 24355 | 272776 | 17948 | 226145 |
| JUL | 16491 | 161612 | 27736 | 291228 | 27526 | 308291 | 20913 | 263504 |
| AUG | 10149 | 99460 | 21233 | 222947 | 17361 | 194443 | 10126 | 127588 |
| SEP | 4552 | 44610 | 8077 | 84809 | 11077 | 124062 | 8682 | 109393 |
| OCT | 3455 | 33859 | 2763 | 29012 | 6078 | 68074 | 5079 | 63995 |
| NOV | 1166 | 11427 | 827 | 8684 | 1391 | 15579 | 546 | 6880 |
| DEC | 109 | 1068 | 403 | 4232 | 226 | 2531 | 1765 | 22239 |
| JAN | 1429 | 14004 | 761 | 7991 | 482 | 5398 | 1013 | 12764 |
| FEB | 594 | 5821 | 1044 | 10962 | 1982 | 22198 | 1667 | 21004 |
| MAR | 7018 | 68776 | 1777 | 18659 | 6138 | 68746 | 1407 | 17728 |
| **Total** | **67570** | **662186** | **99470** | **1044430** | **111944** | **1253773** | **83980** | **1058144** |

**EFFECT ON THE QUALITY OF MILK**

The above mentioned climate change related factors pose threat to the dairy business in the Himalayan State of Sikkim. To overcome these threats, it is essential that the following steps be taken:

- Minimizing raw milk's bacterial contamination while milking cows
- Milking of clean, dry teats
- Use of clean, sanitary milking and milk handling equipment

It is critical to use well cleaned, sanitized buckets and equipment to handle raw milk. Minimising the initial bacteria numbers in raw milk helps limit the total number of bacteria that may grow after harvest. Once milking is completed the milk should be transferred as soon as possible to the collecting centre's cooling tank. Milking centres have the same obligation. They should use only clean, sanitary equipment and keep milk as cold as possible. Bacteria growth in raw milk produces different forms of spoilage depending on the type of bacteria involved. Many milk spoilage bacteria produce enzymes that damage the milk fat or proteins. This damage results in inferior product yields.

**Microbial quality of milk**

Milk is a perishable food item containing water, fat, protein and minerals –essential components of human diet. These components also promote rapid bacterial growth. In warm raw milk, bacteria numbers may double every 20 to 30 minutes – leading to very high bacteria counts in a few hours. For example 1000 bacteria in the milk will become 40,96,000 bacteria within a period of six hours and will become 1,04,85,76,000 in 10 hours. It is important to maintain good microbial quality of milk at all levels of its extraction, transportation, storage and

processing. In order to ensure that the high quality standards are maintained it is proposed to set up two labs at the existing processing units at Gangtok and Jorethang.

**Strategy for Climate Change Adaptation in the Dairy Sector:**

**1. Strengthening laboratory facilities for quality assessment:**

The existing laboratory in the two processing untis at Jorethang and Gangtok dairy Plant need to be strengthened to carry out microbial tests such as *Standard Plate Count, Preliminary Incubation Count* (PIC), *Lab Pasteurization Count* (LPC), *Coliform Bacteria Count and Methelene Blue Reduction Tests.* The pooled sample of milk from each society will be collected at various stages of production to assess their microbial quality and to arrive at reasons for the abnormal microbial quality. The societies having problems will be focused specifically to find out the root cause and find a solution. According to the cause, the solution will be worked out to solve the problem of low quality production by the farmers.

**2. Establishment of Milk collection Centers with required technical infrastructure**

The Milk Collection Centres at the required locations need to be established and also the existing collection centres need to be strengthened on scientific lines to provide village level infrastructure. Most of the village Milk cooperative societies do not have their own buildings to run their day today affairs. Many of them run in rented house or in open premises or with charity support in the houses of some generous villagers. It is therefore proposed to provide proper shelter to the village milk cooperative societies. Every Milk Cooperative societies need to be strengthened with infrastructure for milk testing and for regular management needs. Milk testing equipments and the management tools including computers for the needy society is proposed to be provided according to their production capacities and needs.

**Picture 1:** Milk Collection Centers with required technical infrastructure

**Picture 2:** Bulk milk cooling machines installed at a Village Milk Cooperative Society to arrest bacterial growth

**3. Use of cooling systems to arrest bacterial growth:**

Cooling of milk to below five degree celsius will arrest the growth of bacteria. Therefore it is advisable to install bulk coolers at required locations which will enable societies to go for evening and morning collection separately and to chill the milk as soon as it is received. One bulk cooler can cater to two or three societies located close to one other.

**4. Scientific dairy cow management:**

Several quality milk production issues are related to scientific dairy animal management. training is needed for various issues associated with dairy cow rearing from the selection of breeds, feeding, health issues, reproductive management to calving and calf management. Scientific feeding is an essential component for improving milk production. It would be advisable to provide chaff cutters for feeding grass and fodder scientifically. All the scientific management techniques have to be taught to the farmers though capacity building programmes.

**5. Improved milk hygiene and quality**

Milking is an important event in the milk production process that has a very critical role to play in reducing microbial contamination. From cleaning of udder, trying of it, time taken for milking to use of disinfectants need to be carefully examined and an appropriate practical solution should be provided to the farmers. Use of unclean vessel can be a source of bacteria, which multiplies rapidly in the milk, thus spoiling it early. The farmers need to have through understanding on scientific methods of milking and clean milk carriage vessels to improve the hygiene.

**Picture 3:** Milk hygienic kits and milk utensils used for reducing the bacterial load

**6. Milk transportation cans**

Clean and suitable transporting equipments are essential component of transportation of milk. Aluminum Milk transportation cans of 40 L capacity need to be provided to the societies according to the production levels.

**7. Effective transportation of milk**

Quick transportation of milk is very essential to retain the milk quality. Options available for the societies suffering from poor microbial quality need to assessed and a suitable option suggested. To expedite the speedy transportation of milk from the societies to the processing plants, a sufficient numbers of medium sized utility vehicles is needed.

**8. Transfer and practice of quality milk production technologies:**

Capacity Building/ Training programmes need to be organized in each of the societies. The programme has to explain to the farmers the microbial quality of milk, scientific management, breeding practices and the technique of implementation of each of the remedies identified. The knowledge on scientific management of calves, knowledge on scientific dairy management also needs be imparted through the programme. The simple techniques of clean and quality milk production such as clean milking techniques, clean storage techniques, use of clean utensils has to be demonstrated and explained with the use of appropriate tools. The rate at which the micro-organism multiply in milk has to be shown through microscope to all farmers and the acidity changes explained through a hands on exercise. The results of the efforts of scientific management of dairy cows and quality and clean milk production on the economic benefits have to be extended to the farmers in practise.

**Picture 4:** Transfer and practice of quality milk production technologies at the Village Milk Cooperative Society

**9. Capacity building of farmers on climate change adaptation:**

The experts from the Sikkim Milk Union, Animal Husbandry Department and Science and Technology Department need to demonstrate and explain the protocol of practices for quality milk production, Scientific dairy cow management and quality and clean milk production technologies to all the farmers of the village milk cooperative societies and all other interested farmers in the village as a measure to adapt to climate change.

**ADAPTATION STRATEGY FOR THE YEARS TO COME:**

1. As the effect of climate change on dairying is expected to rise in the years to come, the adaptation strategy explained above needs to be included in the standard operating procedure in the collection, processing and marketing of milk. In Sikkim, the Sikkim Cooperative Milk Producers Union Ltd will need to implement this strategy in order to minimize the climate change impacts on the milk production system.
2. Farmers also need to be equipped with management practices suitable to the changing climate conditions.
3. There is a need to provide proper cow shed according to altitude, prevailing temperature and rainfall intensity and frequency. The sheds for the cows need to be designed by the experts accordingly.
4. Feeding pattern, watering requirement and fodder availability needs to be provided accordingly.

**Picture 5:** Capacity building of farmers on climate change adaptation

5. As the change in climate will also affect fertility of animals, scientific breeding practices need to be adopted and there is a need to ensure availability of such services.

**STRENGTHENING EXISITNG PROGRAMMES**

1. The existing milk collection centres need to be strengthened with appropriate infrastructure including local cooling facilities as discussed above to adapt to climate change. Similarly the numbers of such centers also need to be expanded as per the requirement.
2. The milk collection-transportation system has to be designed in such a way that the transportation time for the milk to reach processing centres is minimal.
3. The Animal Husbandry department is extending the breeding services through artificial insemination means, which need to be scientifically refined by appropriately choosing the blood level of suitable animals. The network of such centres also needs to be strengthened.
4. The fodder species in the state of Sikkim need to be scientifically assessed in order to adapt to a changing climate.

**ADDITIONAL INTERVENTIONS:**

1. There is a need for land use planning to ensure adequate feed and fodder availability to the dairy animals throughout the year.
2. A scientific study is required to assess the suitable breed option for dairying for the state of Sikkim in the climate change scenario.

3. The option of processing at the local level and selling milk in a decentralized manner may be assessed for its feasibility.

4. Product diversification also needs to be studied and the new products produced according to consumer requirements, so as to sustain the marketing linkages to the farmers.

5. Capacity building of dairy farmers in all the above issues is also needed.


**Picture 6:** Product diversification according to consumer requirements so as to sustain the marketing linkages for farmers

## CONCLUSION:

Dairy sector in the state of Sikkim is a well-known traditional livelihood activity. It is evident that this sector is being affected by climate change. The measures suggested above may need to be implemented to sustain the livelihood of the people dependent on the dairy sector.

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Small-holder dairy farming in stall-fed conditions with marketing support from Sikkim Milk Union forms an important source of regular income for the rural households

Mountain women play an important role in livestock management including the provisioning of fodder and feed resources