Original Research Article

ADAPTATION PRACTICES OF DAIRY FARMERS TO CLIMATE CHANGE IN COASTAL TAMIL NADU

ABSTRACT

A study was undertaken to assess the adaptation practices of dairy farmers in response to climate change in Tamil Nadu. For the present investigation, four of the 13 coastal districts, Villupuram, Cuddalore, Ramanathapuram, and Thoothukudi, were selected randomly. Two blocks were randomly selected from each district for the study. From each selected block, two villages were randomly selected from the available number of villages. Therefore, 16 villages were selected for this study. 15 dairy farmers were selected randomly from each village, and 240 respondents were selected for the study. The data were collected using a pre-structured interview schedule. The collected data were then analyzed using appropriate statistical tools to interpret the findings of the present study. It could be concluded that the study area was dominated by crossbred cattle because of their high productivity and "no specific changes of forage in the ration" was practiced by less than half (48.33%) of the dairy farmers during heat/cold stress. 62.92 per cent of dairy farmers did not use feed additives during the distress period and were feeding "crop residues + unconventional stuffs" as a feeding strategy during drought situations. It was surfaced that they were forced to provide water from open sources as sufficient drinking water is not available on daily basis during drought. Most of the dairy farmers (70.42%) followed "consult veterinarian + ethno-veterinary practices" for managing reproductive problems during extremes of weather.

Keywords: *Adaptation practices, Climate Change, Weather Extremes, Drought, Dairy Farmers, Heat/Cold Stress.*

INTRODUCTION

Climate change is any significant long-term change in the expected patterns of average weather of region (or the whole Earth) over a significant period. The Intergovernmental Panel on Climate Change (IPCC) in its 5th assessment report specifies that by the end of this century, average temperature on the surface of the planet may rise between 0.3 and 4.8 ◦C. Climate

change continues to be a pressing global issue, with significant challenges in agriculture in general and dairy farming in particular. (FAO, 2007). The most damaging effects of global climate change are predicted to occur in developing countries because of their over-reliance on low-input rain-fed agricultural production and their low adaptive capacity (Musemwa *et al*, 2012). Developing countries like India are most vulnerable to climate change impacts because they have fewer resources to adopt socially, technologically and financially. (Chakravarty *et al*, 2012). Climate change poses a great challenge to dairy farming because of the sensitivity of dairy animals to excessive temperature and humidity, unpredictable climatic variations. Warmer and drier conditions increase the likelihood of heat stress in cattle. Heat stress adversely affects reproductive performance in dairy animals. **(**Silankove, 2014). Changes in rainfall patterns affects pasture growth patterns thereby affecting the quality and quantity of both feed grains and fodder produced (Coetzer, 2016). Climate change affect quantity and quality of feed and fodder resources such as pastures, forages, crop residues, and the severity and distribution of livestock diseases and parasites and thus the production performance. Under the circumstances discussed above, the need for a study that focuses on adaptation practices of dairy farmers in response to climate change has been studied.

MATERIALS AND METHODS

Tamil Nadu was purposively selected for the study as it has highest number of coastal districts. Comparatively, among the eastern coastal districts, the districts of Tamil Nadu were more vulnerable than the other districts, as they had higher exposure (Maiti *et al*, 2013). Tamil Nadu is one of the states with high and very high climate vulnerable districts (Rao *et al*, 2016). For the present investigation, four of the 13 coastal districts, Villupuram, Cuddalore, Ramanathapuram, and Thoothukudi, were selected randomly. Two blocks were randomly selected from each district selected for the study. From each selected block, two villages were randomly selected from the available number of villages. Therefore, 16 villages were selected for this study. For the selection of respondents, the inclusion criterion was that the farmer should have at least two lactating dairy animals with a minimum of five years of experience in dairy farming. A list of farmers with these conditions at the time of investigation was prepared with the help of veterinary assistants at the village veterinary dispensary units. From the prepared list, 15 dairy farmers were selected randomly from each village, and 240 respondents were selected for the study. The data were collected using a pre-structured interview schedule. The collected data were then analyzed using appropriate statistical tools, such as frequency and percentage, to interpret the findings of the present study.

RESULTS AND DISCUSSION

Adaptation practices according to breeding management

Table 1: Distribution of respondents according to their breeding management

S.no	Adaptation Practices	Frequency	Percentage
1.	**Available breeds in the study area**		
a	Crossbred (HF, Jersey)	135	56.25
b	Crossbred + desi cattle	39	16.25
c	Desi cattle	28	11.67
d	Crossbred + Non-descript animals	28	11.67
e	Non-descript animals	3	1.25
f	Desi cattle + Non-descript animals	7	2.91
2.	**Method of mating followed**		
a	Natural	39	16.25
b	AI	163	67.92
c	Both	38	15.83

1. Available breeds in the study area

A glance at Table 1. shows that majority (56.25%) of the dairy farmers were having crossbred animals, followed by crossbred +desi cattle (16.25%), desi (11.67%), crossbred + Non-descript animals (11.67%), desi cattle + Non-descript animals (2.91%) and Non-descript animals (1.25%) respectively. It could be concluded that the study area was dominated by crossbred cattle because of their high productivity. This finding is in contradiction with Parameshwarnaik *et al*, 2017. Further, it was also observed that only 11.67 percent farmers were keeping desi cattle due to their high cost and low productivity.

2. Method of mating followed

Perusal of Table 1. revealed that the majority (67.92%) of dairy farmers used AI for breeding purposes. This may be due to the availability of effective and accessible AI facilities. (Rajadurai, 2020). This was followed by natural service (16.25%). In contrast, 15.83 per cent of the dairy farmers followed both (Natural + AI). This may be attributed to the types of services available in the area during the animals' heat.

Adaptation practices according to feeding management

Table 2: Distribution of respondents according to their feeding management

S.no	Adaptation Practices	Frequency	Percentage
1.	**Feeding pattern followed during heat stress**		
a	Increasing the proportion of forage in the ration only	2	0.84
b	Increasing the proportion of forage in the ration and decreasing the proportion of concentrate	79	32.92
c	Decreasing the proportion of forage in the ration and increasing the proportion of concentrate	7	2.91
d	No specific changes of forage in the ration	116	48.33
e	As per nutritional requirement		
2.	**Frequency of feeding**		
a	Once a day	1	0.41
b	Twice a day	221	92.09
c	Thrice a day	18	7.50
3.	**Feed additives used during hot/cold weather**		
a	Mineral mixture	89	37.08
b	No feed additive is used	151	62.92
4.	**Coping strategy for shortage of fodder**		
a	Hay making	32	13.4
b	Purchase fodder from market	6	2.50
c	Hay making + purchase fodder from market	164	68.33
d	Hay making + urea treated straws+ purchase fodder from market	8	3.33
e	Hay making + urea treated straws + complete feed blocks + purchase fodder from market	5	2.0

f	Followed no strategy	25	10.42
5.	**Feeding strategy followed during weather extremes**		
a	Crop residues (Bajra, Jowar and Moong)	8	3.33
b	Use of unconventional feeding stuffs likes tree leaves- (Ber, Neem) and Moong straw, grain husk	5	2.08
c	Crop residues+ unconventional feeding stuffs	156	65.00
d	Crop residues+ unconventional feeding stuffs + grazing animals along roads/open fields	44	18.34
e	Unconventional feeding stuffs + grazing animals along roads/open fields + migration	27	11.25
6.	**Source of drinking water**		
a	Public tube well	160	66.67
b	Rainwater harvesting tank	40	16.67
c	Private tube well	20	8.33
d	Public hand pump	20	8.33
7.	**Watering practices during hot weather**		
a	Providing water in trough kept in shed	169	70.40
b	Providing water from open sources	71	29.60
8.	**Frequency of watering**		
a	Twice a day	35	14.58
b	Thrice a day	106	44.17
c	As and when water available	99	41.25

1. Feeding pattern followed during heat stress

Results presented in Table 2., revealed that less than half (48.33%) of the dairy farmers were following feeding pattern as “no specific changes of forage in the ration. (Uma *et. al*, 2017) This might be due to seasonal fluctuations in dairy feed availability, lack of technical knowledge of

production, management, utilization, and conservation of forage; farmers are resource-poor, unable to afford quality feed, and lack of capital to invest in fodder production. This was followed by "increasing the proportion of forage in the ration and decreasing the proportion of concentrate" (32.92%), "as per nutritional requirement" (15.00%) and "decreasing the proportion of forage in the ration and increasing the proportion of concentrate" (2.91%). This finding is in contradiction with Parameshwarnaik *et al*, 2017. While only 0.84 percent of the dairy farmers had followed feeding pattern as "increasing the proportion of forage in the ration only" to their dairy animals. The low feeding of concentrate to animals might be attributed to the low availability of concentrate, high cost of concentrate, and lack of knowledge regarding the positive effect of concentrate feeding on the reproductive and productive performance of animals. In view of the above findings, it is suggested that immediate steps should be taken to educate farmers regarding concentrate feeding for better adaptation of animals to extreme weather conditions.

2. Frequency of feeding

Most (92.09%) dairy farmers provided feed twice a day, followed by three times a day (7.50%) and once a day (0.41%). As majority of the respondents provided feed twice a day, which seems to be not a good practice, they may be made aware of the increasing frequency of feeding by splitting feed for a day. In the latter case, the aim of the farmer was to save the lives of animals instead of production and productivity. It can be concluded that most of the respondents in such areas kept their animals underfed because of the scarcity of feed and fodder and unaffordability to purchase the feed and fodder.

3. Feed additives used during hot/cold weather

This can be observed from Table2. that the majority (62.92%) of dairy farmers did not use feed additives. (Uma *et. al*, 2017). Only 37.08 per cent of dairy farmers used mineral mixtures as feed additives during hot/cold weather. This might be due to a lack of knowledge among the farmers. In the study area, however, feed additives for managing heat or cold stress were provided to the respondents by the State Government Animal Department/NGO, who provocated and provided only mineral mixture to them. They were unaware of other feed additives such as bypass fat and protein, which are more prominent in reducing heat stress.

4. Coping strategy for shortage of fodder during drought

Table2., revealed that majority (68.33%) of the dairy farmers were following "hay making + purchase from market as a coping strategy for shortage of fodder during drought. (Uma *et. al*, 2017). This was followed by "hay making" (13.34%), "followed no strategy" during drought (10.42%). This might be because they had a survival income for their livelihood from other

sources to combat drought, thereby not giving much attention to animals because of their limitations. Furthermore, they were used to conserve/reserve enough feed and fodder for their animals during the lean period. A lesser number of the respondents (3.33%) were following "hay making + urea treated straws + purchase fodder from market" and 2.50 per cent "purchased fodder from market" to mitigate the fodder shortage condition. However, only 2.08 percent of the dairy farmers had followed coping strategy as "hay making + urea treated straws + complete feed blocks + purchase fodder from market".

5. Feeding strategy followed during weather extremes

As shown in Table2., the majority (65.00%) of the dairy farmers were feeding "crop residues + unconventional stuffs" as a feeding strategy during drought situations. This was followed by "crop residues + unconventional feeding stuffs + grazing animals along roads/open fields" (18.34%), "unconventional feeding stuffs + grazing animals along roads/open fields + migration" (11.25%). (Vries. *et al*, 2018). Whereas 2.08 per cent of them had used "unconventional feedstuffs (tree leaves, Moong straw, and grain husk)" as a feeding strategy during drought situations. The tree leaves used for feeding to dairy animals were found to be Khejri (Prosopis cineraria), Babul (Acacia nilotica), Ber (Zizyphus spp.), Ardu (Ailanthus sp) and Neem (Azadirachta indica). Due to drought, the shortage of water is a common phenomenon that inhibits the growth of fodder crops, and almost all grazing land becomes barren without any prominent vegetation for grazing animals. Under these circumstances, to sustain milk production and productivity, respondents were fed dry fodder along with unconventional feedstuffs. They have no alternative, except for dry fodder, owing to their poor affordability. (Patil. *et al*, 2006).

6. Source of drinking water

It was found from the Table2 that major source of drinking water was public tube well (66.67%) followed by rainwater harvesting tank (16.67%). This is in line with the findings of Kant *et. al*, 2014) An equal number (8.33%) of public hand pumps and private tube wells served as the drinking sources. Due to high water table, cost of the drilling tube well is too high thereby, individual farmers were unable to make their own tube wells. Keeping in view the facts, government has developed tube wells in the area to supply drinking water, however, some wealthy farmers managed to have their own tube wells.

7. Watering practices during hot weather

It could also be visualized from the Table2 that majority (70.40%) of the dairy farmers were providing water in trough kept in shed. (Kant *et al*, 2014). While 29.60 per cent of the dairy farmers were providing water from open sources. It could be inferred that a sizeable proportion of the respondents were providing water from open sources which cannot considered hygienic.

However, during discussion with the farmers it was surfaced that they were forced to provide water from open sources as sufficient drinking water is not available on daily basis.

8. Frequency of watering

About 44.17 per cent of the dairy farmers were providing water to animals thrice a day followed by as and when water required by the animals (41.25%). While 14.58 per cent of the dairy farmers had provided water twice a day to their animals (Table2). It is concluded that in accordance with high temperature prevailing in the area, frequency of watering seems to be not sufficient. (Satyanarayana *et al*, 2016) The farmers who were providing water twice a day may be advised to increase the frequency of water to reduce the heat stress of animal.

Adaptation practices according to their shelter management

Table 3. Distribution of respondents according to their shelter management

S.no	Adaptation Practices	Frequency	Percentage
1.	**Type of housing system**		
a	Loose/open house system	41	17.10
b	Conventional house system	151	62.90
c	Partially close and open house system	48	20.00
2.	**The approximate height of the shed**		
a	10 feet	149	62.10
b	11-15 feet	91	0.40
3.	**Floor space available/animal**		
a	As per recommended (3.5 x 7.0 m^2)	9	3.75
b	Less than recommended	209	87.08
c	More than recommended	22	9.17
4.	**Shed orientation for proper light and ventilation**		
a	North-South	115	47.90
b	East-West	42	17.90
c	Any orientation	82	34.20

1. Type of housing system

Majority (62.90%) of the dairy farmers were having “conventional housing system” followed by 20.00 and 17.10 per cent of the respondents followed “partially close & open housing

system" and "loose/open housing system" respectively. This finding is in line with Kant *et. al*, 2017. Close housing system is not suitable for tropical climate. Farmers may be advised to follow loose housing system to mitigate the ill effects of heat stress on animals and this may improve the productivity of the animals. The farmers were also advised to plant plenty of trees in the animal shed to optimize the micro climate of the surrounding of the shed. Trees also act as wind break to save the animals from desiccating westerly during summer.

2. The approximate height of the shed

A glance at Table 3**.** shows that majority (62.10%) of the dairy farmer followed 10 feet height of shed. 37.90 per cent of the farmers had followed 10-15 feet height of shed. It may be inferred that shed height is not appropriate and it might be due to higher cost of construction materials as transportation facilities are scarce in the area. Another reason might be the lack of awareness among the farmers regarding heat regulation and height of the shed.

3. Floor space available/animal

Most (87.08%) of the dairy farmers had followed "less than recommended" floor space in animal house. (Rajadurai, 2018) This may be due to the lack of knowledge among the farmers. Whereas, 9.17 and 3.75 per cent of the dairy farmers followed "more than recommended" and "recommended (3.5 X 7.0 m^2)" floor space per animal; respectively. In majority of the cases sufficient space is not provided to the animal resulted in overcrowding in the shed. This may provide conducive atmosphere for spread of diseases, difficulty in farm operation and ultimately reduction in productive performance of the animals. It may be concluded that farmers are not aware about the space requirement for animals.

4. Shed orientation for proper light and ventilation

The investigation revealed that 47.90 per cent of the dairy farmers followed north south shed orientation followed by "any orientation" by 34.20 and east-west shed orientation by 17.90 per cent. From Table 3, it could be concluded that a large chunk of the respondents were not following proper shed orientation which is found to be the north-south orientation, this adversely affect the climate inside the animal shed.

Adaptation practices on health care management

Table 4. Distribution of respondents according to their healthcare management

S.no	Adaptation Practices	Frequency	Percentage

1.	**Health management during extremes of weather**		
a	Preventive measures (vaccination)	51	21.25
b	Regular endo and ecto parasite control	17	7.08
c	Regular checkup for lameness and mastitis	4	1.67
d	Preventive measures like vaccination + regular endo and ecto parasite control	29	12.09
e	Preventive measures like vaccination + regular endo and ecto parasite control + regular checkup for lameness and mastitis	63	26.25
f	Regular endo and ecto parasite control + regular checkup for lameness and mastitis	7	2.91
g	No practice followed	69	28.75
2.	**Management of reproductive problems during extremes of weather**		
a	Consult veterinarian	4	1.67
b	Ethno-veterinary practices	9	3.75
c	Balanced feed + consult veterinarian	4	1.67
d	Consult veterinarian + ethno-veterinary practices	169	70.42
e	Balanced feed + consult veterinarian + ethnoveterinary practice	43	17.91
f	No attention given	11	4.58

1. Health management during extremes of weather

A sizable proportion (28.75%) of the dairy farmers did not use health management during extremes of weather. (Table 4) It might be due to the farmers were not aware about the health management practices to be followed during extremes of weather. The farmers may be provided the trainings in relation to the health management with special reference to climate variability. As far as health management of preventive measures like vaccination + regular endo and ecto parasite control + regular check-up for lameness and mastitis were concerned, 26.25 per cent of the dairy farmers were using these practices. Whereas 21.25, 12.09, 7.08 and 2.91 per cent of the respondents had followed preventive measures like vaccination, vaccination + regular endo and ecto parasite control, regular endo and ecto parasite control and regular endo and ecto parasite control + regular check-up for lameness and mastitis;

respectively. However, only 1.67 per cent of the dairy farmers did use health management practice as a regular check-up for lameness.

2. Management of reproductive problems during extremes of weather

Most of the dairy farmers (70.42%) followed "consult veterinarian + ethno-veterinary practices" for managing reproductive problems during extremes of weather. (Zhou *et. al*, 2022) This was followed by "balanced feed + consult veterinarian + ethno-veterinary practices" (17.91%), "no attention given" (4.58%) and "ethno-veterinary practices" (3.75%). An equal proportion of the respondents (1.67%) were used practices like "consult veterinarian" and "balanced feed + consult veterinarian".(Table 4). It may be concluded that most of the farmers were consulting veterinarian subject to their availability in the area coupled with ethno-veterinary practices being availability to manage the reproductive problems during extremes of weather.

Conclusion

In the present scenario, most of the respondents did not follow adaptation practices like feed additives, shed orientation, floor space, conventional feed stuffs, feed storage and health management during extremes of weather. Hence, information on climate change and adaptation should be made accessible to farmers using various means like leaflet, folder, hand out and magazine. It could be observed that the respondents developed adaptive measures based on experience and available resources to reduce the climatic effect. (Uma. *et. al*, 2017). Efforts should be made to put in place integrated approaches for the adaptation and sustainable way to achieve this through education and capacity building by involving all the stakeholders. Hence, it is advised that the technology dissemination system must be streamlined by focusing its efforts on mitigating adverse effects of climate variability by suggesting the appropriate strategies achieved through conducting demonstrations, field exhibitions by KVKs, NGO's and veterinary colleges. (Kant. *et. al*, 2014). Researchers need to know that how farmers are likely to respond for climate change, because those responses can amplify the impacts. Policy makers need to know what the farming community wants, to design appropriate policies so that the farming communities adapt to everyday changes in patterns of rainfall, temperature, crops, animals and diseases also deal with the disaster when it occurs. Climate change impacts in rural communities are projected to increase in the coming years and will put more strain on rural economic activities like livestock production (Maluleke et al., 2020). Moving forward, fostering partnerships, enhancing research, and integrating local knowledge will be essential in

developing effective and inclusive adaptation strategies for the dairy sector amidst a changing climate.

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