**Livestock Management in Drought-Prone Regions: Analysing Breeding and Housing Practices in Karnataka**

***Suggested Title: Livestock Resilience in Drought-Prone Karnataka: A study on Breeding and Housing Practices***

**Abstract:**

This study investigated strategies for managing livestock in drought-prone areas of Karnataka, India. The study was conducted across four districts, namely Kolar, Chikballapur, Chitradurga, and Tumkur. A total of 200 farmer respondents were selected based on their experience and herd size. The findings indicate a preference for crossbred cattle due to higher milk yields, while exotic breeds are less favoured due to their vulnerability to heat stress. All respondents relied on manual heat detection methods, and there was variability in breeding timing post-heat detection. Artificial insemination was universally adopted, but conception rates varied significantly. Most farmers did not synchronize breeding with fodder availability, and few followed scientific housing practices. The study highlights the need for improved livestock management strategies, including enhanced housing and breeding practices, to mitigate the impacts of drought on livestock productivity and farmer livelihoods. ***Suggested addition to abstract: It is crucial for stakeholders, researchers, policy makers and agricultural organizations to collaborate in developing targeted interventions that could enhance livestock management in drought-prone regions.***

**Key words:** Drought, Livestock, Breeding, Feeding.

**Introduction**

Indian agriculture is considered as complex, diversified, and risk-prone because of its wider geographical diversity, irregular monsoon pattern, and unequal rainfall distribution. Globally, drought impacts more individuals than any other type of natural disaster. However, it remains the most complex and least comprehended among all natural disasters (Mishra et al., 2010). Droughts pose a significant threat to livestock and crops worldwide, impacting approximately 55 million people each year as they severely affect agricultural productivity and human livelihoods globally (WHO, 2021). Severe droughts in India have been estimated to reduce the country's Gross Domestic Product by 2 to 5 percent annually (UNDRR, 2021). Given that approximately 68 per cent of India's net sown area is vulnerable to drought, affecting around 50 million people each year, droughts are a common occurrence across the nation.

India has the largest livestock population globally, with approximately 535.78 million animals. The country's economy significantly relies on this sector (20th Livestock Census 2019). Livestock serves as a source of livelihood for nearly two-thirds of the rural population in India and provides employment opportunities for approximately 8.8% of the country's total population (Singh et al., 2020). During a drought, livestock are both the victim and the hope. Drought can sometimes lead to a high number of casualties. When cattle are under heat stress, their milk production typically declines. Water shortages driven on by droughts result in lower milk production (Siemes, 2008). Droughts cause livestock population fluctuations through increased mortality and reduced birth rates (Oba, 2001). Livestock are often referred to as "moving banks" due to their ability to serve as a readily disposable asset during emergencies. For landless agricultural laborers, they frequently represent the only capital resource available (Dash S., 2017; Suthar et al., 2019). The success of milk production hinges on four key aspects of animal husbandry: breeding, feeding, healthcare, and management practices. The economic return from each animal is influenced by various performance traits, making effective management of production and reproduction crucial for successful dairy operations (Meena et al., 2015; Meena et al., 2017).

In Karnataka, agriculture is largely dependent on rainfall, with a significant portion of the net sown area receiving either medium or low rainfall. Specifically, 24.30% of this area experiences medium rainfall, while 66.30% is in low rainfall zones, making much of the state vulnerable to drought. As a result, about 54% of Karnataka's land is drought-prone, positioning it as the second most drought-affected state after Rajasthan (Rani et al., 2023). Drought is expected to severely affect cattle due to reduced availability of feed and fodder, limited access to drinking water, increased prevalence of parasite and vector-borne diseases, and loss of resources. As a result, farmers often resort to selling their cattle due to food shortages and recurring droughts. Understanding scientific livestock management practices could enhance the resilience of farming communities during such drought conditions. Proper housing and effective breeding management are crucial for maximizing the potential of dairy animals (Sinha et al., 2009). Adequate housing helps reduce energy loss by maintaining a stable environment and decreases the occurrence of diseases (Sabapara et al., 2010). Keeping the above facts in view, a study was undertaken to explore the existing breeding and housing management practices by livestock owners in drought conditions.

**METHODOLOGY**

The present study was conducted in Karnataka, India, purposively for exploring effective strategies in managing livestock to withstand drought conditions. Based on the frequency of drought occurrence, 4 districts, namely Kolar, Chikballapur, Chitradurga, and Tumkur, were selected. From each district, 5 blocks were selected based on frequent drought proneness; the blocks that fall under the over-exploited category suggested by GEC-2015 were selected (Dynamic Ground Water Resources of Karnataka, Central Ground Water Board, 2021). From each block, ten farmer respondents were selected. Farmer respondents were selected based on Farmers having ten years of experience in livestock rearing, herd size of four or more than four, possessing android smartphones, office bearer or members in past or present in any local organization. So, 200 Farmer respondents were selected from 20 blocks for the study. The farmers were interviewed personally and focus group discussion during January- March 2022. After data collection, it was compiled, tabulated and analyzed, keeping in view the objectives of the study. Frequency distribution, percentage and ‘t’ test analysis, etc., were computed by using Statistical Package for Social Sciences (SPSS) software for analysis of the data.

*Please consider the following:*

*1. The manuscript does not mention whether informed consent was obtained from the respondents prior to the conduct of the interview and focus group discussion. The respondents should be fully aware of the research purpose, their involvement and also their right to withdraw at any time. Participation should be voluntary.*

*2. No statement regarding how the confidentiality of the respondents was maintained. There is a need to protect the identity of the participants.*

**Results and Discussions**

**1. Existing Breeding Management** **practices followed by the farmers**

From Table 1 indicate that 59.00% of respondents preferred crossbred cattle, followed by indigenous breeds (26.00%) and exotic breeds (15.00%). This preference could be attributed to the higher milk yield of crossbred animals compared to indigenous cattle breeds. However, the low adoption of exotic breeds suggests that farmers recognize their lower adaptability to drought-prone regions, as exotic breeds often suffer from heat stress, water scarcity, and reduced fertility in harsh climates. These observations align with the findings reported by Barman et al., (2023). When it came to heat detection, all respondents (100%) relied on manual observation, due to a lack of knowledge about scientific heat detection methods such as heat mount detectors, pedometers, and progesterone tests, consistent with the study by Sabapara et al., (2010). The preferred timing for breeding after heat detection was mostly at the onset of heat (51.00%), followed by 12-18 hours (27.00%) and 24 hours (22.00%) post-detection. This variation suggests that farmers' understanding of optimal insemination timing for conception success is inconsistent. Scientific studies indicate that the best time for artificial insemination is 12–18 hours after the onset of heat, maximizing conception rates. The primary source of semen was local paravets (59.00 %), with 28.00% of respondents obtaining semen from government institutes and 26.00% from private sources. None of the respondents sourced semen from non-governmental organizations. All respondents (100%) favored artificial insemination as the mating system, with no instances of natural mating or a combination of both. The exclusive preference for AI may be due to government initiatives promoting AI for genetic improvement, the availability of AI services, and farmer awareness of its benefits in controlling diseases. Regarding conception rates, 35.00% of respondents reported an average of three artificial inseminations per conception, followed by two AI per conception (33.00%), four AI per conception (17.00%), and one AI per conception (15.00%). This variation may be due to heat stress, nutritional deficiencies, and poor estrus detection in drought conditions. High ambient temperatures and poor nutrition negatively impact reproductive efficiency, increasing the number of inseminations required for successful conception.

In pregnancy diagnosis, 65.00% of respondents conducted the diagnosis 2-4 months after artificial insemination, 24% did so after 1 month, and 10 % were unable to diagnose pregnancy accurately. Late pregnancy diagnosis can lead to delayed rebreeding cycles, extended calving intervals, and economic losses. The majority of the respondents (81.00%) never synchronized the breeding of animals with the availability of fodder. Only a few respondent, 4.50 percent of respondents synchronized the breeding period with fodder availability. This suggests a lack of awareness about the benefits of aligning calving cycles with feed availability, which could improve milk yield and reproductive efficiency

The majority of respondents (62.00%) serviced their animals 60-80 days post-calving, which is optimal for reproductive recovery and improved fertility; while 38.00% did not consider this timeframe possibly due to poor heat detection, nutritional stress, or lack of veterinary guidance. Additionally, 69.50% of respondents-maintained animal breed records, with 65.50% doing so manually and only 4.00% using mobile records. None of the respondents preferred maintaining animal breeding records on a computer. The low adoption of digital record-keeping suggests that technological awareness and accessibility remain limited in rural farming communities.

**Table 1: Existing Breeding Management practices followed by the farmers (n=200)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl. no** | **Breeding management practices** | **Frequency** | **Percentage (%)** |
| **1** | **Breed Preference** | | |
| Indigenous breed | 52 | 26.00 |
| Crossbreds | 118 | 59.00 |
| Exotic breeds | 30 | 15.00 |
| **2** | **Heat detection** | | |
| Manual observation | 200 | 100.00 |
| Teaser bull | 0 | 0.00 |
| **3** | **Breeding time after heat detection** | | |
| Onset of heat | 102 | 51.00 |
| 12-18 hours | 54 | 27.00 |
| 24 hours | 44 | 22.00 |
| **4** | **Source of Semen** | | |
| Government | 56 | 28.00 |
| Private | 26 | 13.00 |
| NGO’s | 0 | 0.00 |
| Local para vets | 118 | 59.00 |
| **5** | **Mating System** | | |
| Natural mating | 0 | 0.00 |
| AI | 200 | 100.00 |
| **6** | **AI per Conception** | | |
| One | 30 | 15.00 |
| Two | 66 | 33.00 |
| Three | 70 | 35.00 |
| Four | 34 | 17.00 |
| **7** | **Pregnancy diagnosis** | | |
| After one month of AI | 49 | 24.50 |
| 2-4 months | 131 | 65.50 |
| Never | 20 | 10.00 |
| **8** | **Synchronise the breeding period with the availability fodder** | | |
| Always | 9 | 4.50 |
| Sometimes | 29 | 14.50 |
| Never | 162 | 81.00 |
| **9** | **Servicing of the animal after 60- 80 days after calving** | | |
| Yes | 124 | 62.00 |
| No | 76 | 38.00 |
| **10** | **Maintenance of animal breeding records** | | |
| Yes | 139 | 69.50 |
| No | 61 | 30.50 |
| a) Manual | 131 | 65.50 |
| b) Computer | 0 | 0.00 |
| c) Mobile | 8 | 4.00 |

**2. Existing Housing management practices followed by the farmers**

From table 2 revealed that the majority of livestock farmers (76.50%) did not follow scientific housing management practices, while only 20.50% adhered to scientific housing methods. This highlights a lack of awareness, financial constraints, and traditional reliance on informal housing systems. The predominant (61.00%) housing systems were random, followed by conventional (28.50%), and loose types (10.50%), indicates a lack of structured planning in livestock housing. Random housing often results from limited land availability and economic constraints. Loose housing, though beneficial for heat dissipation and better animal welfare, is adopted by only 10.50% of farmers, possibly due to lack of technical knowledge or space constraints. The majority (54.00%) of the sheds were oriented in the east-west direction, with 33.50% facing north-south and 12.50% at random orientations, emphasized that east-west orientation reduces heat stress by minimizing direct sun exposure. The variation in orientation suggests inconsistent awareness of optimal housing design for thermal comfort. This aligns with the observations reported by Sinha et al. (2019).

The majority (65.00%) of the shed floors were made of stone slabs, while 10.50% used cement concrete and 24.50% utilized litter materials, and none of them used tiles as a flooring material. Stone slab flooring is preferred due to cost-effectiveness and durability, whereas concrete flooring, though hygienic, is less common due to high installation costs, findings are consistent with Sabapara et al. (2010). Asbestos was the most common roofing material (45.00%), followed by thatched (25.00%), corrugated (19.00%), and cement (10.50%) roofs. The preference for asbestos and thatched roofs may be due to their cost-effectiveness and easy availability, but they offer poor insulation against extreme temperatures. Cement roofing, though more durable, has a lower adoption rate (10.50%) due to its high cost. All (100.00%) farms provided adequate shed ventilation, which is essential for maintaining air quality and reducing heat stress, but only 11.00% modified the structures to protect animals from extreme weather conditions, indicating that most farmers lack awareness or financial resources to invest in heat mitigation strategies.

To protect animals from extreme hot, majority (89.00%) of the respondents did not modify shed, but only 11.00 percent of respondents modified shed. During the summer, no respondents used sprinklers or ceiling fans to alleviate heat stress, contrary to Knapp and Gummer's (1991) recommendations. Half the respondents (51.50%) cleaned their sheds twice weekly, 26% cleaned weekly, and 22.50% cleaned regularly. The fact that no sheds were left uncleaned suggests some level of awareness regarding hygiene's importance in disease prevention. However, regular cleaning practices could still be improved to minimize disease risks. Disinfection practices varied, with 42.50% of sheds disinfected monthly, 38.50% fortnightly, 15.50% weekly, and 3.50% twice weekly. While monthly disinfection is common, more frequent disinfection could enhance disease prevention, particularly in drought conditions when water scarcity may lead to higher contamination risks. These results emphasize the need for improved housing management practices to enhance livestock welfare and productivity in drought-prone areas.

**Table 2: Existing Housing management practices followed by the farmers (n=200)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl. no** | **Housing management** | **Frequency** | **Percentage (%)** |
| **1** | **The scientific method of the housing system** | | |
| Yes | 47 | 23.50 |
| No | 153 | 76.50 |
| **2** | **Type of housing system** | | |
| Loose | 21 | 10.50 |
| Conventional | 57 | 28.50 |
| Random | 122 | 61.00 |
| **3** | **Orientation of house** | | |
| East West | 108 | 54.00 |
| North south | 67 | 33.50 |
| Random | 25 | 12.50 |
| **4** | **Type of flooring material** | | |
| Cement concrete | 21 | 10.50 |
| Stone slabs | 130 | 65.00 |
| Tiles | 0 | 0.00 |
| Litter bed | 49 | 24.50 |
| **5** | **Type of roofing material** | | |
| Cemented | 21 | 10.50 |
| Asbestos | 91 | 45.50 |
| Corrugated | 38 | 19.00 |
| Thatch | 50 | 25.00 |
| **6** | **Adequate ventilation** | | |
| Yes | 200 | 100.00 |
| No | 0 | 0.00 |
| **7** | **Modification suitable to hot conditions** | | |
| Yes | 22 | 11.00 |
| No | 178 | 89.00 |
| **8** | **Sprinkler and Ceiling fan during heat tress** | | |
| Yes | 0 | 0.00 |
| No | 200 | 100.00 |
| **9** | **Animal shed clean** | | |
| Regularly | 45 | 22.50 |
| Twice in a week | 103 | 51.50 |
| Weekly | 52 | 26.00 |
| 10 | **Disinfectant the house** | | |
| Twice in a week | 7 | 3.50 |
| Weekly | 31 | 15.50 |
| Once in a fortnight | 77 | 38.50 |
| Once in a month | 85 | 42.50 |

**Conclusion**

This study highlights several key findings related to livestock management practices in drought-prone regions of Karnataka, India. The preference for crossbred cattle over indigenous and exotic breeds is driven by higher milk yields, while the low adoption of exotic breeds reflects concerns about their adaptability to harsh climates. The reliance on manual heat detection methods and inconsistent timing for breeding after heat detection indicate a need for education on scientific methods to improve conception rates. The exclusive use of artificial insemination is likely due to government initiatives and awareness of its benefits. However, challenges persist in conception rates, pregnancy diagnosis, and breeding synchronization with fodder availability, which can lead to economic losses. The majority of farmers lack awareness about synchronizing breeding cycles with feed availability, which could enhance milk yield and reproductive efficiency. Most livestock farmers do not follow scientific housing management practices, relying on traditional methods due to financial constraints and limited awareness. While all farms provided adequate ventilation, few modified structures to protect animals from extreme weather conditions, and none used cooling systems like sprinklers or fans. The study underscores the importance of improving livestock management practices, particularly in housing and breeding strategies, to enhance animal welfare and productivity in drought-prone areas. It suggests that educational programs and policy support could help farmers adopt more effective and sustainable practices, ultimately contributing to better resilience against drought conditions.

*Make a statement regarding conflict of interest. Add “****no conflict of interest****” if none.*

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