Journal of Agriculture and Life Sciences
ISSN: 2375-4214 (Print), 2375-4222 (Online)

**Original Article | Open Access | Peer Reviewed**

# The Impact of Hydroponic Fodder Varieties on Livestock Productivity: An Economic Perspective in the Semi-Arid Region

**Bashir Alhaji Baba[1], Mohammed Mustapha[2] and Makinta Alhaji Ali[3]**

[1] Department of Agricultural Economics and Extension Research, Lake Chad Research Institute (LCRI), Maiduguri; bashir5880@gmail.com.

[2] Department of Farming System Research, Lake Chad Research Institute, Maiduguri.

[3] Department of Agricultural Technology, Ramat Polytechnic, Maiduguri.



**Address for Correspondence:**

Bashir Alhaji Baba, Department of Agricultural Economics and Extension Research, Lake Chad Research Institute (LCRI), Maiduguri. (bashir5880@gmail.com)

**Article History:**

Received: 13 August 2024; Accepted: 28 August 2024; Published: 4 September 2024

**Abstract** This study investigates the economic viability and growth performance of ram lambs fed hydroponic millet fodder as an alternative to conventional feeding strategies in livestock production. Conducted in two phases, the first phase focused on optimizing the cultivation conditions for hydroponic millet, while the second involved feeding trials with ram lambs across five treatment groups. An analysis of the chemical composition of the fodder revealed significant variations in key nutritional parameters, suggesting the suitability of different varieties for specific livestock needs. Growth performance metrics indicated that certain hydroponic treatments led to superior average daily gains and feed conversion ratios compared to conventional methods. The economic analysis further demonstrated that, despite lower total revenue, hydroponic feeding strategies yielded higher profits due to reduced feed costs. This study underscores the potential of hydroponic millet fodder to enhance both growth performance and profitability in livestock production.

**Keywords** Hydroponic Fodder, Livestock Productivity, Economic, Feed Efficiency, Nutritional Varieties

**Volume 11, 2024**

**Publisher:** The Brooklyn Research and Publishing Institute, 442 Lorimer St, Brooklyn, NY 11206, United States.

**DOI:** https://doi.org/10.30845/jals.v11p5

**Reviewers:** Opted for Confidentiality

**Citation:** Baba, B. A., Mustapha, M., and Ali, M. A. (2024). The Impact of Hydroponic Fodder Varieties on Livestock Productivity: An Economic Perspective in the Semi-Arid Region. *Journal of Agriculture and Life Sciences*, *11*, 38-42. https://doi.org/10.30845/jals.v11p5

## Introduction

The growing global demand for livestock products has placed significant pressure on the agricultural sector to adopt innovative and efficient feeding strategies that can enhance productivity while addressing the challenges posed by limited resources. Traditional feeding methods often face limitations due to seasonal variations, land constraints, and the increasing costs of conventional fodder production. In this context, hydroponic fodder systems have emerged as a transformative solution, enabling the cultivation of high-quality forage in a soilless environment. These systems have gained significant attention in recent years due to their adaptability, efficient resource utilization, and ability to produce consistent yields irrespective of climatic conditions (Patra et al., 2022; Kumar et al., 2021).

Among the various types of fodder that can be cultivated hydroponically, millet-based fodder stands out as a particularly promising option. Hydroponic millet fodder is not only nutrient-dense but also offers a practical solution to address fodder shortages in regions where agricultural resources are constrained, such as semi-arid and arid areas. By providing a reliable and sustainable source of feed, hydroponic millet fodder has the potential to significantly improve livestock performance, including growth rates, feed conversion efficiency, and overall productivity (Singh et al., 2020; Choudhury et al., 2021). Furthermore, its rapid growth cycle and minimal land requirements make it an appealing choice for farmers seeking to optimize fodder production in resource-limited settings (Mustapha, 2023).

This study investigates the multifaceted benefits of hydroponic millet fodder, focusing on its impact on livestock performance and economic viability. Specifically, it aims to evaluate the role of hydroponic millet fodder in enhancing growth performance, feed efficiency, and profitability in livestock farming. By examining these factors, the study seeks to provide a comprehensive understanding of the potential of hydroponic millet fodder as a sustainable and economically feasible feeding alternative for modern livestock production systems.

## Literature Review

Existing research highlights the potential of hydroponically grown fodder to significantly improve livestock productivity by enhancing feed quality and nutrient availability (Zambou et al., 2021; Rahman et al., 2022). Specifically, millet-based hydroponic fodder has demonstrated potential for improving feed intake, weight gain, and overall performance in ruminants. These benefits are particularly valuable for farmers operating in semi-arid regions, where conventional fodder production faces considerable challenges (Ali et al., 2023).

## Materials and Methods

### Hydroponic Millet Fodder Production

The first phase of the study involved the cultivation of hydroponic millet fodder under controlled environmental conditions. Parameters such as light, humidity, and water quality were optimized to ensure uniform growth and nutritional consistency across the fodder varieties. The second phase involved feeding trials conducted on ram lambs, which were divided into five treatment groups (T1-T5) to examine the effects of different hydroponic millet fodder varieties on growth performance, rumen fermentation parameters, and feed conversion efficiency. Data were analyzed using analysis of variance (ANOVA), with statistical significance set at $p < 0.05$. Results were further validated to ensure reliability and accuracy.

## Results

### Chemical Composition of Hydroponic Millet Fodder

The chemical composition of the hydroponic millet fodder varieties is summarized in Table 1. Significant variations were observed in crude protein (CP), dry matter (DM), and other nutritional components across the varieties.

**Table 1: Nutritional Composition of Varieties**

| Millet Varieties | Dry Matter (DM, %) | Crude Protein (CP, %) | Crude Fiber (CF, %) | Ether Extract (EE, %) | Ash (%) | Nitrogen Free Extract (NFE, %) |
|---|---|---|---|---|---|---|
| SOSAT C88 | 85.25 | 12.63 | 3.85 | 3.46 | 3.64 | 62.01 |
| Super SOSAT | 82.85 | 13.57 | 3.69 | 3.83 | 3.88 | 57.88 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Jirani | 86.71 | 13.39 | 3.80 | 3.43 | 3.44 | 62.33 |
| Maiwa | 87.16 | 12.98 | 4.30 | 3.42 | 3.71 | 62.79 |

Source: LCRI, Data 2024

T1: SOSAT C88 millet hydroponic fodder-based supplement, T2: Super SOSAT millet hydroponic fodder-based supplement, T3: Jirani millet hydroponic fodder-based supplement, T4: Maiwa millet hydroponic fodder-based supplement and T5: Farmers practice

Table 2 analyzes the comparative advantages of different fodder varieties based on key nutritional parameters that affect feed utility and livestock output. Variety Super Sosat is optimal for farmers focused on protein and energy efficiency due to its high crude protein (CP) and ether extract (EE) content, reducing the need for expensive supplements. Variety Maiwa excels in dry matter (DM) and non-fiber carbohydrates (NFE), making it ideal for energy-dense feeding systems, particularly in regions prioritizing energy intake. Variety Jirani offers a balanced composition with high CP and NFE, suitable for general feeding needs. Although the variety Sosat C88 has slightly lower CP and NFE, its balanced profile and affordability make it competitive. Selecting the appropriate variety should consider livestock needs, available feed resources, and market prices, with policymakers promoting varieties that enhance sustainable livestock production.

### Growth Performance of Ram Lambs

Table 3 outlines the growth performance metrics, including total feed intake, average daily gain, and feed conversion ratio (FCR), for ram lambs fed with different hydroponic millet fodder treatments.

**Table 3: Growth Performance Parameters Across Different Treatments**

| Treatment | Total Feed Intake (kg) | Average Daily Gain (ADG, kg) | Feed Conversion Ratio (FCR) |
|---|---|---|---|
| T1 | 51.85 | 0.098 | 9.48 |
| T2 | 49.44 | 0.151 | 5.89 |
| T3 | 49.22 | 0.169 | 5.21 |
| T4 | 44.56 | 0.155 | 5.16 |
| T5 | 39.05 | 0.128 | 5.47 |

Source: LCRI, Data 2024

T1: SOSAT C88 millet hydroponic fodder-based supplement, T2: Super SOSAT millet hydroponic fodder-based supplement, T3: Jirani millet hydroponic fodder-based supplement, T4: Maiwa millet hydroponic fodder-based supplement and T5: Farmers practice

The table presents growth performance parameters across different treatments, highlighting Total Feed Intake (kg), Average Daily Gain (ADG, kg), and Feed Conversion Ratio (FCR) for each treatment group. Treatment 1 (T1) had the highest total feed intake at 51.85 kg, while Treatment 5 (T5) had the lowest at 39.05 kg. This suggests that as the treatment number increases, the total feed intake tends to decrease. The ADG was highest in Treatment 3 (T3) at 0.169 kg, indicating that this treatment was most effective in promoting growth. In contrast, T1 had the lowest ADG at 0.098 kg. This suggests a positive correlation between lower feed intake and higher ADG in some treatments. The FCR, which indicates the efficiency of converting feed into body mass, was lowest in T3 (5.21), suggesting that this treatment was the most efficient in terms of feed utilization. Conversely, T1 had the highest FCR at 9.48, indicating poorer feed efficiency. Lower FCR values are generally desirable as they indicate better feed conversion efficiency.

Treatments with lower total feed intake (like T5) did not necessarily correlate with higher ADG, as seen in T3, which had a moderate feed intake but the best growth performance. T3 appears to be the most effective treatment overall, achieving the best balance of ADG and FCR despite not having the highest feed intake. The data suggests that optimizing feed composition and management can significantly enhance growth performance metrics in poultry or livestock production.

The economic analysis, presented in Table 4, compares conventional feeding strategies with hydroponic millet fodder in terms of cost efficiency and profitability.

**Table 4: Economic Comparison of Different Feeding Strategies**

| Feeding Strategy | Cost per Kg (N) | Average Gain (Kg) | Total Revenue (N) | Profit (N) |
|---|---|---|---|---|
| Conventional | 288,750 | 5.0 | 1,443,750 | 577,500 |
| Hydroponic | 173,250 | 8.0 | 1,386,000 | 892,500 |

Source: LCRI, Data 2024

The table presents a comparison of two feeding strategies: Conventional and Hydroponic, based on cost per kilogram, average gain, total revenue, and profit. The Hydroponic feeding strategy has a significantly higher cost per kilogram (N173, 250) compared to the Conventional strategy (N288, 750). However, it also results in a substantially higher average gain (8.0 kg) compared to the Conventional strategy (5.0 kg). Despite the higher cost, the Hydroponic strategy generates a significantly higher profit (N892, 500) than the Conventional strategy (N577, 500). This suggests that the increased investment in the Hydroponic feeding strategy is offset by the higher average gain, leading to greater overall profitability. The Hydroponic strategy demonstrates a higher return on investment due to its increased efficiency in converting feed into animal weight gain. This aligns with economic principles that emphasize maximizing output for a given input. In competitive livestock markets, producers who can achieve higher average gains with efficient feeding strategies are likely to have a significant cost advantage. This can translate into higher profits and greater market share. The data suggests that adopting advanced feeding technologies like Hydroponics can be economically beneficial, despite the initial higher investment. This supports the broader economic argument for investing in agricultural research and development to improve productivity and profitability.

## Conclusion

The findings of this study highlight the advantages of hydroponic millet fodder in improving livestock growth performance and economic outcomes. While the conventional feeding strategy generated higher total revenue, the hydroponic approach proved to be more cost-effective, leading to greater profitability. The enhanced average daily gains and favorable feed conversion ratios associated with specific hydroponic treatments suggest a clear benefit for livestock producers. These results advocate for the integration of hydroponic fodder systems into livestock management practices as a sustainable alternative that can address the challenges of feed scarcity and rising costs.

## Recommendations

Livestock producers should consider implementing hydroponic fodder systems to enhance feed efficiency and reduce costs. This approach not only improves growth performance but also contributes to sustainable agricultural practices.

i. Farmers should select hydroponic millet varieties based on specific livestock nutritional needs and regional market demands. This tailored approach can optimize growth rates and feed utilization, enhancing overall productivity.

ii. Stakeholders, including government agencies and agricultural organizations, should invest in research and development programs focused on hydroponic fodder production. Training programs for farmers on best practices can facilitate the successful adoption of this technology.

iii. Policymakers should create incentives for the adoption of hydroponic feeding strategies, such as subsidies or grants for farmers transitioning to sustainable fodder production systems. This support can help mitigate financial risks and promote wider acceptance of innovative agricultural methods.

**Conflict of Interest:** None declared.

**Ethical Approval:** Not applicable.

**Funding:** None.

## References

Ali, A., Khan, M. A., & Ahmed, S. (2023). Role of Hydroponic Fodder in Enhancing Feed Efficiency in Livestock. *Journal of Animal Science*, 101(2), 123-135.

Choudhury, R., Das, S., & Roy, S. (2021). Soilless Fodder Cultivation: A Sustainable Approach for Resource-Limited Regions. *Journal of Sustainable Agriculture*, 45(3), 215-230.

Kumar, R., Singh, A., & Gupta, V. (2021). Hydroponic Fodder Systems: Enhancing Livestock Productivity in Arid Regions. *International Journal of Livestock Science*, 7(1), 45-58.

Patra, A., Sahu, S., & Mohanty, S. (2022). Innovative Feeding Strategies for Sustainable Livestock Production. *Journal of Animal Nutrition*, 8(4), 300-315.

Rahman, M., Hossain, M. M., & Islam, M. S. (2022). Feeding Strategies for Sustainable Livestock Production. *Agricultural Research Journal*, 58(2), 150-162.

Singh, P., Kumar, R., & Sharma, A. (2020). Impact of Hydroponic Fodder on Feed Conversion Ratio in Ruminants. *Animal Feed Science and Technology*, 267, 114-123.

Zambou, N. F., Tchouanguep, M. F., & Nguema, J. (2021). Hydroponics: A Sustainable Approach for Animal Feed. *International Journal of Agricultural Sciences*, 11(1), 75-85.