International Scholars Journals

International Journal of Agricultural Extension and Rural Development ISSN 2756-3642 Vol. 10 (1), pp. 001-006, Sep, 2023. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

HYDROPONICS FARMING FOR NUTRITIOUS FODDER AND CARBON FOOT PRINT MANAGEMENT

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Accepted 24 September, 2023

Abstract

Feed scarcity has been observed as the main limiting factor to improving livestock productivity. Area under fodder crops, permanent pastures & grazing and cultivable wastelands which are the major source of cattle feed is shrinking drastically due to increase in demand for real estate and infrastructure. A new study from the UN Food and Agriculture Organization (FAO) indicates that the supply chain is the fastest-growing source of greenhouse gas (GHG) emissions from global food systems, outpacing agricultural activity and land use changes. Great potential exists for reducing greenhouse gas emissions in the animal agriculture industry. Advancements in agricultural technologies can potentially lead to the production of nutritious foods without requiring extensive land clearing for pasture and feed. Incorporating hydroponic systems into fodder agriculture has the potential for reducing the impact of livestock agriculture, as it can contribute to reductions in GHG emissions and climate mitigation objectives.

Keywords: Hydroponics, climate, carbon, fodder, paddy

Introduction

The livestock's growth and development is conditioned by the adequate availability of feed and fodder. As per the 20th Livestock Census, the total livestock population in India is 535.78 million, which is an increase of 4.6 per cent over the previous Census in 2012.

The availability of feed and fodder remains a major area of concern; there is a gap between its demand and supply in the country. NitiAayog (2018) in its latest report estimated a deficit of dry fodder (10%), concentrates (33%) and green fodder (35%). As per the estimates of the Indian Council for Agricultural Research (ICAR)-affiliated National Institute of Animal Nutrition and Physiology (NIANP), the deficit in the requirement and the availability of dry fodder, green fodder and concentrates during 2015 was to the extent of 21 per cent, 26 per cent, and 34 per cent, respectively. This is likely to increase to 23 per cent, 40 per cent, and 38 per cent, respectively, by 2025. This shortage is due to increasing pressure on land for growing food grains, oilseeds and pulses and inadequate attention being given to the production of fodder crops. While the number of livestock is growing rapidly, the grazing lands are gradually diminishing due to pressure on the land for agricultural and non-agricultural uses.

Due to unavailability green fodder, especially during summer months, dairy farmers have been feeding animals a disproportionate amount of concentrate to sustain growth in milk production. The concentrate feeding indeed increases milk production, but it also leads to rumen acidosis and causes severe health problems in dairy cows. This practice imbalances the intestinal micro organisms and releases more toxins, which in turn lead to subsequent liver damage. So, proper ration balancing in livestock is also required to reduce these risks. Promotion of cultivation of varieties of green fodder such as Napier, marvel grass, moringa, maize, bajra, jowar, cow peas, velvet beans, thorn-less cactus, oats, berseem, rye grass and Chinese cabbage could help farmers get adequate fodder supplies [1].

India may have to import milk, if it cannot increase fodder supply for its 299 million cattle, as rising pressure on land reduces pastures nationwide. Fodder shortages may knock India off its position as the world's top milk producer. Currently fodder is in short supply–green (63%), and dry (24%). Only 4% of total cultivable land in India is used for fodder production, a proportion that has remained stagnant for the last four decades. Considering the demand for milk, land under fodder production needs to be doubled. Shortages are forcing

states to now source fodder from elsewhere.

The quality of fodder is a concern. If India fails to achieve substantial production growth, the country would need to resort to significant imports from the world market which has the potential to cause prices to spurt since India is a large consumer [2]. The low cost of growing fodder crops compared to non-fodder crops can provide a scope to increase productivity by investing more on inputs such as irrigation, fertilizer and other such practices for fodder cultivation. Feed scarcity has been observed as the main limiting factor to improving livestock productivity. Area under fodder crops, permanent pastures & grazing and cultivable wastelands which are the major source of cattle feed is shrinking drastically due to increase in demand for real estate and infrastructure. Further, large amount of useful paddy straw for livestock is being burnt in the major Paddy producing states of India. The Paddy straw is one of major source of dry fodder for bovine in India, but handling and marketing constraint at farmer level is the major reason behind burning of the same in field. The impact of climate change in several regions are now visible and it is posing challenge to livestock & live stock systems [3].

It is associated with various adverse impacts on agriculture, water resources, forest and biodiversity, health, coastal management and increase in temperature. Climate change would represent additional stress on the ecological and socioeconomic systems that are already facing tremendous pressure due to rapid industrialization, urbanization and economic development.

Climate change and its impact

After decades of incremental but insufficient progress, public and private action on climate change is now reaching a tipping point. Prime Minister Narendra Modi's announcement of enhanced targets for climate action by India, particularly for achieving net-zero emissions by 2070, has highlighted the importance of long-term planning for decarbonising the economy. He said India's per capita carbon footprint is 60 per cent lower than the global average. India has done well and is on a path to fulfilling its Paris Agreement commitments for 2030. However, the road ahead will be challenging, and therefore, a coordinated strategy for decarbonising the economy efficiently and effectively will be required [4].

A new study from the UN Food and Agriculture Organization (FAO) indicates that the supply chain is the fastest-growing source of greenhouse gas (GHG) emissions from global food systems, outpacing agricultural activity and land use changes. Of 16.5 billion tons of

emissions, the largest share - 7.2 billion tons, or 44% was reported from within the farm gate, including crop and livestock production processes and on-farm energy use. Land use change - such as deforestation accounted for 3.5 billion tons (21% of agrifood's total emissions). So where is most of the growth in food-related GHG emissions coming from? The FAO study found that 5.8 billion tons (35% of agrifood's total) in 2019 came from supply chain factors: pre- and post-production processes including manufacturing of fertilizers, food processing, packaging, transport, retail, household consumption, and food waste disposal [5]. Farmers are not practicing any post harvesting technique of fodder production.

Offsetting GHG emissions produced through the transportation of fodder products

Great potential exists for reducing greenhouse gas (GHG) emissions in the animal agriculture industry. Approximately 70% of all agricultural land is used for some aspect of livestock production, and it represents 14.5% of human- induced GHG emissions, with feed production and enteric fermentation from ruminants representing the two main sources, 45% and 39% of sector GHG emissions. Accordingly, targeting the feed chain of animal agriculture can potentially reap near-term gains toward climate change objectives. Advancements in agricultural technologies can potentially lead to the production of nutritious foods without requiring extensive land clearing for pasture and feed; thus, these technologies may be able to serve as strategies for achieving both agricultural and land efficiency objectives. Applying this perspective to hydroponic farming positions the technology within the "land sparing" versus "land sharing" framework, in which land sparing practices increase agricultural intensity and yield in smaller areas to reserve space for habitat, and land sharing consists of ecologically sound practices that reduce impacts and incorporate biodiversity in farmland. Although promising, hydroponic technologies are emerging and evolving, and their potential contribution to climate objectives need validation.

Through hydroponics it is easier and quick to produce nutritive green fodder. Maize, Ragi, Bajra, Cowpea, Horse gram, Sun hemp, Jowar and Foxtail millet seeds are found to be suitable to grow by hydroponic method. The studies have demonstrated that the incorporation of hydroponic systems into fodder production can provide added value in terms of climate mitigation benefits. In the case of feeding livestock, hydroponic systems could be a particularly valuable strategy, as they have the potential to offset GHG emissions produced through the transportation of fodder products. It is important to note that indoor, hydroponic farming is an evolving technology, and its ability to augment and semi-localize production will improve with technological advancements. As evidenced by the study, incorporating

hydroponic systems into fodder agriculture has the potential for reducing the impact of livestock agriculture, as it can contribute to reductions in GHG emissions and climate mitigation objectives. The research estimated that the hydroponics farm produced 7.4% fewer GHG emissions (per nutrient mass) than was found with conventional barley grain fodder farming, and greater reductions can be achieved with improved seed-to-fodder output, indicating that transitioning to such systems can result in GHG reductions and (ultimately) climate mitigation benefits [6].

Conclusion

After decades of incremental but insufficient progress, public and private action on climate change is now reaching a tipping point. A new study from the UN Food and Agriculture Organization (FAO) indicates that the supply chain is the fastest-growing source of greenhouse gas (GHG) emissions from global food systems, outpacing agricultural activity and land use changes. Great potential exists for reducing greenhouse gas (GHG) emissions in the animal agriculture industry. Applying this perspective to hydroponic farming positions the technology within the "land sparing" versus "land sharing" framework, in which land sparing practices increase agricultural intensity and yield in smaller areas to reserve space for habitat, and land sharing consists of ecologically sound practices that reduce

impacts and incorporate biodiversity in farmland. Incorporating hydroponic systems into fodder agriculture has the potential for reducing the impact of livestock agriculture, as it can contribute to reductions in GHG emissions and climate mitigation objectives.

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