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Role And Prospects In Integrated Farming Systems- Azolla

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Abstract:

Azolla, a floating fern commonly referred to as azolla, is classified within the family Salviniaceae. This aquatic plant serves as an excellent source of protein, encompassing nearly all essential amino acids and a range of minerals, including iron, calcium, magnesium, potassium, phosphorus, and manganese, among others. Additionally, it possesses significant amounts of β-carotene (a precursor to vitamin A) and vitamin B12. Azolla is regarded as particularly promising due to its ease of cultivation, substantial productivity, and superior nutritional value. To enhance its production, it is imperative to establish optimal cultural practices, assess its seasonal availability, and determine manure requirements. Consequently, Azolla emerges as a potential nutrient source, boasting a considerably high feeding value for livestock. Furthermore, there exists a compelling argument for the necessity of systematic research involving prolonged feeding trials utilizing Azolla.

Keywords- Azolla, Environmental Conditions, Nutrient value, Net Income

1.Introduction

The leukocyte counts also demonstrated the effects of an Azolla-enriched diet, characterized by an elevation in monocyte and neutrophil populations in fish that were exclusively nourished with Azolla, while concurrently, lymphocyte levels diminished in fish subjected to the same dietary condition. Comparable observations were documented in goldfish that were provided with an Azolla-based diet (Vasudhevan et al., 2013).

1.1 External output

Monoculture systems predominantly depend on external inputs; conversely, integrated systems facilitate the recycling of nutrients, thereby contributing to a reduction in production costs while enhancing economic yields.

The gross income generated from the combination of rice, Azolla, and fish was 25.7% greater than that from the sole rice crop and 6.9% higher than that from the rice-fish system alone.

1.2 Nutrient value

The impact of Azolla on serum protein concentrations in ichthyological species has been inadequately explored. Nonetheless, in the case of the grass carp, no statistically significant variations were observed in the concentrations of albumin, globulin, and total protein when comparing individuals nourished with A. filiculoides to those provided with commercial pellets over a duration of 90 days (Nekoubin and Sudagar, 2013).

Because of this mutually beneficial interaction, Azolla has a high protein content. Azolla is a promising plant with high nutritional value and ease of cultivation (Lumpkin, 1984; Kathirvelan et al., 2015).

1.3 Net Income

The net income exhibited a similar pattern. Consequently, the rice, Azolla, and fish integration yielded an average of Rs 8,817 per hectare more than the rice monoculture and Rs 3,219 per hectare more than the rice-fish system. This model has been advocated for widespread implementation throughout Tamil Nadu (Gill et al. 2001).

1.4 Revenue

A significant advancement has been made by those who incorporated fish into the livestock-crop system; in addition to producing more fertilizer from the fish waste, they also increased their revenue due to the larger and faster output of fish and their comparatively higher market values (Gill et al. 2001).

1.5 Essential amino acids and minerals

Azolla is a floating fern that is a member of the Salviniaceae family. Azolla has nearly all of the essential amino acids and minerals, including iron, calcium, and magnesium, and is a strong source of protein like Potassium, phosphorus, manganese, and other elements in addition to significant amounts of vitamin B12 and β-carotene, a precursor to vitamin A. Because of its great yield, strong nutritional content, and simplicity of growing, azolla is seen to be the most promising.

1.6 Habitat

Azolla is a little floating fern that is commonly referred to as azolla. It is a member of the Salviniaceae family, which includes seven species of aquatic ferns. Azolla develops in thick areas of rivers that resemble a red or green carpet. It is often found throughout India and typically grows in areas with standing water, such as streams, canals, ponds, etc., where water is present for an extended amount of time under the shade of trees or sunlight (Masoodi and Khan, 2012).

1.7 Morphological characters

Azolla plants' roots stay afloat in water. Azolla has a triangle shape, measuring 1.5–3 cm in length and 1-3 cm in width. Blue-green algae develop alongside azolla. Azollae Anabaena. There is a symbiotic link between algae and Azolla (Becking, 1979; Reynaud and Franche, 1987; Aber etal., 2016).

1.8 Absorbed gases

1.8.1 Carbon

Azolla strains have the capacity to fix up to 2-3 kg of nitrogen per hectare each day. Azolla gives blue green algae carbon and a conducive atmosphere for growth.

1.8.2 Nitrogen

It absorbs and fixes nitrogen from the atmosphere, breaks it down by enzymes, and then transforms it into soluble ammonia (Van Hove, 1989).

Additionally, using Azolla raises the soil's organic matter and potassium levels (Bhuvaneshwari and Singh, 2015).

1.9 Feeding Habit

Azolla can be a great feed alternative for cattle, buffalo, sheep, goats, pigs, poultry, and fish because of its easy cultivation and high biomass output (Becerra et al., 1995; Hossiny et al., 2008; Indira et al., 2009; Leterme et al.,2010).

2. TAXONOMY

Class - Pteridophyta

Order - Salvinales

Family - Azollaceae/Salviniaceae

Genus - Azolla

Sub Genus - Eu-Azolla

3. METHODOLOGY

3.1 Cultivation of Azolla

a) Small aquatic bodies should be established that as we are using a small body like tub.

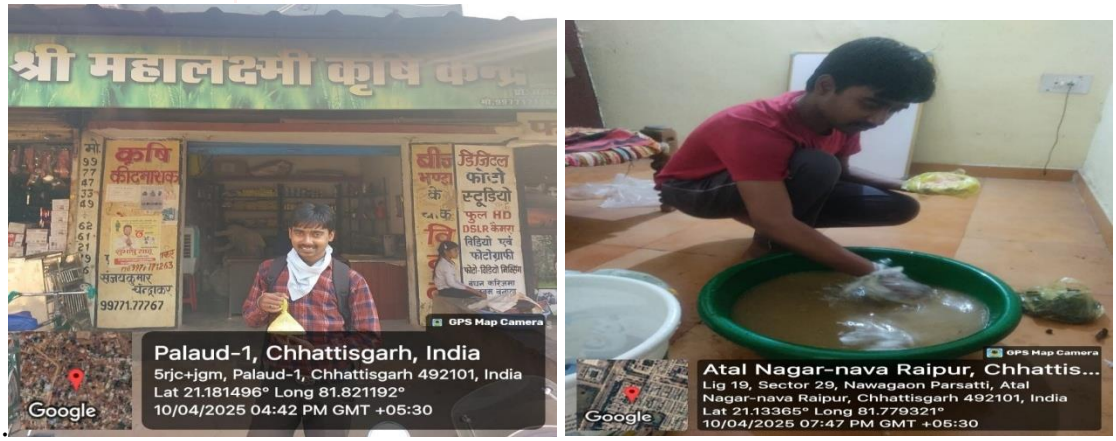

Figure 1. a. Purchasing super phosphate from shop, b. Preparing medium for growing azolla

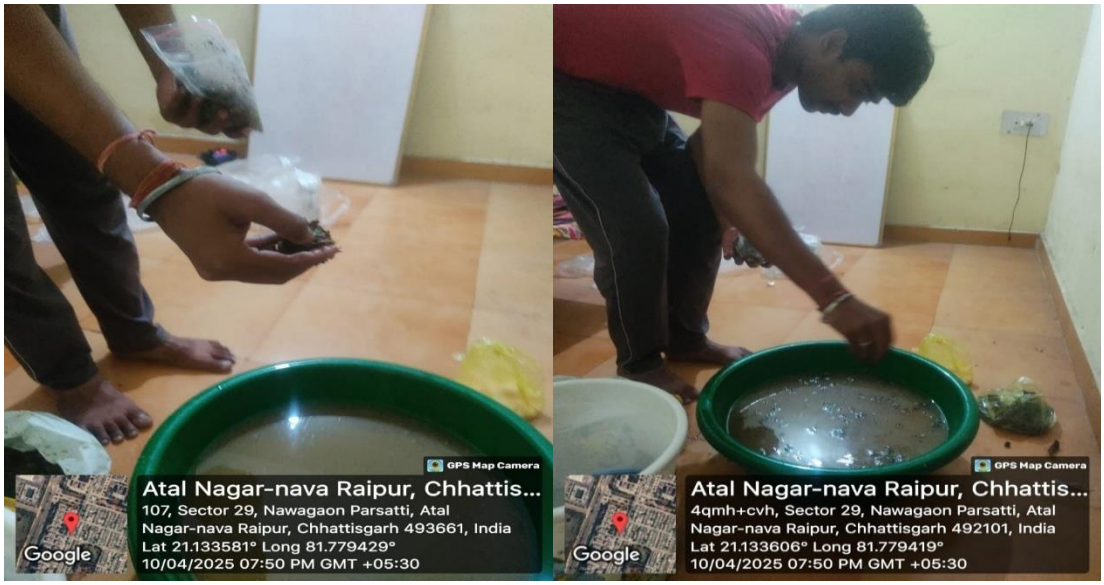

Figure 2. a. Adding cow dung in a medium as manure, b. Sowing azolla seeds in a prepared medium

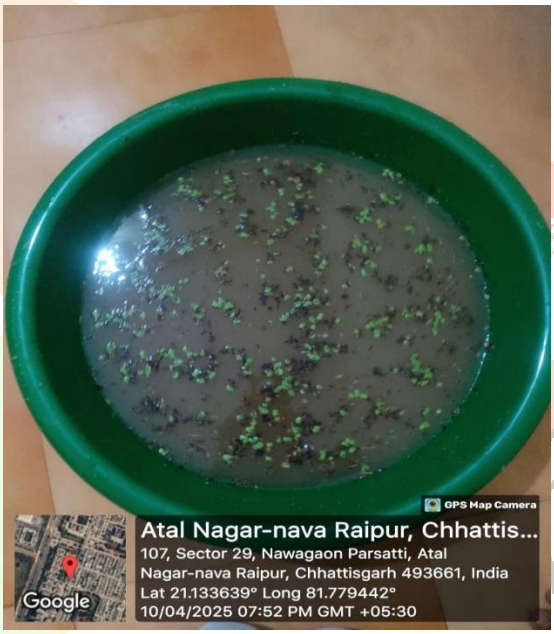

Figure 3. Appearance of growth of azolla

b) An adequate quantity of water 3/4th of total volume of water tub should be introduced, ensuring a standing water depth of 10 to 15 centimeters

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c) The cultivation of green Azolla, at a density of 5 to 10 grams while using water tub, should be supplemented with single super phosphate as a phosphorus nutrient source of 15 to 21 grams, and subsequently introduced where the water level is maintained at 15 centimeters.

d) The rapid proliferation of Azolla organism's results starts seen within 2 days in the formation of a verdant mat resembling carpet-like coverage in the tub within a span of 9 to 10 days.

e) Azolla can be employed as a bio-fertilizer through its conversion into compost.

f) During the hot season (summer), Azolla can be harvested at consistent intervals of 21 days.

g) Conversely, during the winter season, the growth rate of the Azolla plant diminishes due to moisture stress and reduced temperatures; therefore, harvesting should occur at 30-day intervals during this period.

3.2 Environmental Conditions that Required for Higher Yield of Azolla

a) Certain conducive conditions must be established to facilitate the optimal growth of Azolla, which necessitate careful provision to ensure robust proliferation.
b) Water must consistently be present in the pond to promote the multiplication of Azolla branches. The preservation of a pure culture devoid of contamination is crucial for achieving higher yields
c) Regular harvesting of Azolla is imperative to prevent overcrowding within the pond. Temperature serves as a significant determinant for optimal growth. A mean temperature ranging from **25 to 35ºC** is deemed most advantageous for maximal growth.
d) This ideal environmental temperature should be **(18°C to 28°C)** sustained within this specified range through the implementation of green nets.
e) During colder seasons, the Azolla Pond ought to be covered with a plastic sheet to mitigate the effects of low temperatures. Locations that receive direct and adequate sunlight **(25-50% of full sunlight)** are preferred for cultivation.
f) Conversely, shaded areas should be selected when sunlight is excessively intense.
g) While Azolla plants necessitate sunlight, they exhibit a preference for growth in slightly acidic soil, with a **pH range of 5.3 to 5.8,** particularly in shaded conditions. Azolla requires phosphorus to support its regular growth and reproduction in acidic soils.
h) In addition to phosphorus, appropriate nutrients, such as cow dung slurry and micronutrients, should be administered at regular intervals to ensure optimal growth conditions.
i) Humidity should **(85-90%).**
j) Water level: - azolla requires sufficient water, with a recommended minimum depth of **5 inches.**

3.3 Benefits of Azolla

It possesses the ability to assimilate atmospheric nitrogen and carbon dioxide, thereby synthesizing carbohydrates and ammonia, respectively, and post-decomposition, it enriches the soil with bioavailable nitrogen for crop absorption and organic carbon content.

The oxygen generated through the process of oxygenic photosynthesis facilitates the respiratory functions of the root systems of crops as well as various soil-dwelling microorganisms.

Azolla releases phytohormones and vitamins that promote the growth of rice plants.

It serves as a nutritional resource for waterfowl, fish, shrimp, insects, worms, snails, crustaceans, etc., providing them with habitat.

4. RESULTS: -

Results start seen within 2 days in the formation of a verdant mat resembling carpet-like coverage in the tub within a span of 9 to 10 days.

Using only 15 grams in tub we can grow 3-5 kg according to nutrient provided to within the tub.

S.no.	Days	Growth of azolla seen
1.	1st	Not seen
2.	2^{nd}	Very slow
3.	3rd	Starts growing
4.	4th	$2/6^{th}$ of tub
5.	5 to 6th	Half of tub
6.	7 to 8th	$3/4^{th}$ of tub
7.	9 to 10th	Almost full tub

Azolla can additionally be desiccated and preserved as a promising feed component for aquaculture feed formulation, which has been demonstrated to augment fish biomass production by 28.2% within a polyculture system involving carp (Catla catla, Labeo rohita, and Cirrhinus mrigala) and enhance farmers' net profit by 38.64%, when incorporated into the grow-out feed at a ratio of 10% (Dhawan et al., 2010).

5. CONCLUSION: -

Azolla exhibits considerable potential as a viable and cost-effective nutritional source for a variety of animal species.

Existing scholarly literature suggests that Azolla serves as an economically advantageous and effective feed supplement for diverse animal species, providing significant quantities of protein, amino acids, vitamins, and minerals, which collectively contribute to a reduction in feeding costs. Consequently, Azolla holds promise as a prospective ingredient for the diets of various animal types.

Of significant practical significance in the production systems of rice is the nitrogen-fixing symbiotic aquatic fern Azolla. The symbiotic association of Azolla with the cyanobacterium Anabaena azollae facilitates the fixation of 2-4 kg of nitrogen per hectare per day (Lumpkin and Plucknett, 1982).

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