

Azolla: a sustainable feed for livestock

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The demand for milk and meat in India is creating new potential in the profitability of animal husbandry as an occupation. Yet, at the same time, there is a substantial decline in fodder availability. The area under forest and grasslands is decreasing as is the amount of various crop residues available for feed, largely due to the introduction of high yielding dwarf varieties. The shortage of fodder is therefore compensated with commercial feed, resulting in increased costs in meat and milk production. Moreover, as commercial feed is mixed with urea and other artificial milk boosters, it has a negative effect on the quality of milk and the health of the livestock.

The search for alternatives to concentrates led us to a wonderful plant *azolla*, which holds the promise of providing a sustainable feed for livestock. Azolla is a floating fern and belongs to the family of Azollaceae. Azolla hosts a symbiotic blue green algae, *Anabaena azollae*, which is responsible for the fixation and assimilation of atmospheric nitrogen. Azolla, in turn, provides the carbon source and favourable environment for the growth and development of the algae. It is this unique symbiotic relationship that makes azolla, a wonderful plant with high protein content.

Nutrient content and its impact on growth

Azolla is very rich in proteins, essential amino acids, vitamins (vitamin A, vitamin B12 and Beta- Carotene), growth promoter intermediaries and minerals like calcium, phosphorous, potassium, ferrous, copper, magnesium etc. On a dry weight basis, it contains 25 - 35 percent protein, 10 - 15 percent minerals and 7 - 10 percent of amino acids, bio-active substances and bio-polymers. The carbohydrate and fat content of azolla is very low. Its nutrient composition makes it a highly efficient and effective feed for livestock (see Table 1). Livestock easily digest it, owing to its high protein and low lignin content, and they quickly grow accustomed to it. Moreover it is easy and economic to grow.

Table 1. Comparison of biomass and protein content of azolla with different fodder species (t/ha)

	Annual production of biomass	Dry matter content	Protein content
Hybrid napier	250	50	4
Lucerne	80	16	3.2
Cowpea	35	7	1.4
Sorghum	40	3.2	0.6
Azolla	730	56	20

The Natural Resources Development Project (NARDEP), Vivekananda Kendra, carried out trials in Tamil Nadu and Kerala using azolla as a feed substitute. The trials on dairy animals showed an overall increase of milk yield of about 15 percent when 1.5 - 2 kg of azolla per day was combined with regular feed. The increase in the quantity of the milk produced



Close-up view of an azolla plant. The size of the plants are 1 - 3 cm.

was higher than could be expected based on the nutrient content of azolla alone. Hence, it is assumed that it is not only the nutrients, but also other components, like carotinoids, bio-polymers, probiotics etc., that contribute to the overall increase in the production of milk. Feeding azolla to poultry improves the weight of broiler chickens and increases the egg production of layers. Azolla can also be fed to sheep, goats, pigs and rabbits. In China, cultivation of azolla along with paddy and fish is said to have increased the rice production by 20 percent and fish production by 30 percent.

Azolla production

NARDEP has been working on azolla for the last three to four years, studying its potential as a feed and exploring cost effective methods for the mass multiplication of azolla in farmers' homesteads.

In our method, a water body is made, preferably under the shade of a tree, with the help of a silpauline sheet. Silpauline is a polythene tarpaulin which is resistant to the ultra violet radiation in sunlight. A pit of 2 x 2 x 0.2 m is dug as a first step. All corners of the pit should be at the same level so that a uniform water level can be maintained. The pit is covered with plastic gunnies to prevent the roots of the nearby trees piercing the silpauline sheet, which is spread over the plastic gunnies. About 10 - 15 kg of sieved fertile soil is uniformly spread over the silpauline sheet. Slurry made of 2 kg cow dung and 30 g of Super Phosphate mixed in 10 litres of water, is poured onto the sheet. More water is poured on to raise the water level to about 10 cm. About 0.5 - 1 kg of fresh and pure culture of azolla is placed in the water. This will grow rapidly and fill the pit within 10 - 15 days. From then on, 500 - 600 g of azolla can be harvested daily. A mixture of 20 g of Super Phosphate and about 1 kg of cow dung should be added once every 5 days in order to maintain rapid multiplication of the azolla and to maintain the daily yield of 500 g. A micronutrient mix containing magnesium, iron, copper, sulphur etc., can also be added at weekly intervals to enhance the mineral content of azolla.

NARDEP method of azolla production

1. It is important to keep azolla at the rapid multiplication growth phase with the minimum doubling time. Therefore biomass (around 200 g per square meter) should be removed every day or on alternate days to avoid overcrowding
2. Periodic application of cow-dung slurry, super phosphate and other macro and micronutrients except nitrogen, will keep the fern multiplying rapidly.
3. The temperature should be kept below 25 °C. If the temperature goes up the light intensity should be reduced by providing shade. If possible, it is best to place the production unit where it is shady.
4. The pH should be tested periodically and should be maintained between 5.5 and 7.
5. About 5 kg of bed soil should be replaced with fresh soil, once in 30 days, to avoid nitrogen build up and prevent micro-nutrient deficiency.
6. 25 to 30 percent of the water also needs to be replaced with fresh water, once every 10 days, to prevent nitrogen build up in the bed.
7. The bed should be cleaned, the water and soil replaced and new azolla inoculated once every six months.
8. A fresh bed has to be prepared and inoculated with pure culture of azolla, when contaminated by pest and diseases.
9. The azolla should be washed in fresh water before use to remove the smell of cow dung.

Using azolla as livestock feed

Azolla should be harvested with a plastic tray having holes of 1 cm² mesh size to drain the water. Azolla should be washed to get rid of the cow dung smell. Washing also helps in separating the small plantlets which drain out of the tray. The plantlets along with water in the bucket can be poured back into the original bed. When introducing azolla as feed, the fresh azolla should be mixed with commercial feed in 1:1 ratio to feed livestock. After a fortnight of feeding on azolla mixed with concentrate, livestock may be fed with azolla without added concentrate. For poultry, azolla can be fed to layers as well as broilers.

Though there is no large-scale incidence of pests and diseases in silpauline based production system, pest and disease problems have been noticed during intensive cultivation. In case of severe pest attack the best option is to empty the entire bed and lay out a fresh bed in a different location.

With this method the cost of production of azolla is less than Rs 0.65 per kilogram, which is equivalent to US\$0.015 (see Table 2).

Table 2. Economics of azolla production with NARDEP method

Cost of production in 4 units during one year	Amount (Rupies)
1. Cost of 120 gauge silpauline 2.8 x 1.8 x 4 m	400.00
2. Labour charges for bed preparation	100.00
3. Cow-dung	146.00
4. Superphosphate	7.50
5. Magnesium Sulphate	4.00
6. Micro-nutrients	15.00
7. New azolla 200 g x 8 = 1600 g	5.00
Total cost of production	677.50
Total production in 4 units (1 kg/unit/day for 350 days)	1050
Cost/kg	0.65 Rs/kg

44 Rs = 1 US\$

Conclusion

Azolla can be used as an ideal feed for cattle, fish, pigs and poultry, and also is of value as a bio-fertilizer for wetland paddy. It is popular and cultivated widely in other countries like China, Vietnam, and the Philippines, but has yet to be taken up in India, in a big way. Dairy farmers in South Kerala and Kanyakumari have started to take up the low cost production technology and we hope that the azolla technology will be taken up more widely by dairy farmers, in particular those who have too little land for fodder production.

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Trying it out

After reading the article on azolla in the March 2002 issue of the LEISA India, the LEISA India columnist and organic farmer Mr. Narayan Reddy decided to test the production of azolla on his farm. As his grandchildren were visiting, they were set to dig the first bed of 2 x 3 x 0.15-0.2 m. To simplify the construction, Mr. Reddy made some adaptations: He lined the bed with a simple plastic sheet, fixed the sheet with the dug out soil together with some concrete along the edges, taking care that the plastic above the water was well covered – as otherwise the sun will rapidly deteriorate the plastic. After fixing the plastic, about 2 - 3 cm of stone free soil was carefully put back in the bottom of the bed which was filled with water. The water depth is important; too little water will allow the azolla roots to grow into the mud, making it difficult to harvest. Too much water will reduce the production as the roots do not reach close enough to the nutrients at the bottom. After filling the bed, Mr. Reddy went off to the closest university to ask for some azolla plants and put them in the water. He added 0.5 - 1 kg of neem cake to prevent possible pest problems and every three weeks he adds slurry of cow dung and water (10 kg fresh cow dung).

One and a half years later Mr. Reddy is enthusiastic about azolla. He feeds it to his cows and chickens and after getting used to the azolla (in the beginning he mixed the azolla with concentrate) the animals love it. He has had to fence the bed to keep them out. He also uses the azolla for salads, after washing it in fresh water and removing the root.

He empties and cleans the bed once every half year and starts it up again with some plants, neem cake and cow dung. When the temperatures soar in the summer, the bed is covered with a roof of loose palm leaves to give some shade and reduce light and temperature. However, the use of a simple plastic sheet for lining makes the bed very vulnerable – it can easily be damaged during harvesting or cleaning and Mr. Reddy therefore makes sure that he carries out these tasks himself.

With this simple system, the only costs are for the plastic sheet and for 2 kg of neem cake per year – plus his own labour.

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