

Azolla Fodder Plot – A Profile

1. Introduction

In the recent past agriculture as a profession is losing its charm among the farmers. This has been attributed to several reasons; important among them are spiraling cost of inputs coupled with uncertainty in the price of the product. This has been aggravated by non-availability of assured irrigation due to depletion in ground water. This has in turn manifested as distress among the farmers in substantial areas in Andhra Pradesh, Maharashtra, Karnataka and Kerala, which are otherwise considered as agriculturally developed areas. A couple of committees have gone into the root cause of distress and suggested that alternate income generating opportunities can be a major remedy for such disappointment among the farming community. Animal husbandry is one such alternative available to such distressed farmers. Again, availability of quality fodder to the animals is the major impediment in scientific management of animals because India, having only 2.4% of the world's geographical area sustains 11% of the world's livestock population. It accounts for 55% of the world's buffalo population, 20% of the goat population and 16% of the cattle population. This has put unbearable burden on our natural vegetation.

Azolla, hitherto used mainly as a green manure in paddy has tremendous potential to meet the growing demand for fodder among the small farmers taking up animal husbandry.

2. About Azolla

Azolla is an aquatic floating fern, found in temperate climate suitable for paddy cultivation. The fern appears as a green mat over water. The Blue Green Algae cyanobacteria (*Anabaena azollae*) present as a symbiont with this fern in the lower cavities actually fixes atmospheric nitrogen. The rate of nitrogen fixed is around 25 kg/ha.

As green manure, *Azolla* is grown alone for two to three weeks in flooded fields. Afterwards, water is drained out and *Azolla* fern is incorporated in the field before transplanting of paddy. Otherwise, 4-5 q of fresh *Azolla* is applied in standing water one week after planting of paddy. Dry *Azolla* flakes can be used as poultry feed and green *Azolla* is also a good feed for fish. It can be used as a bio-fertilizer, a mosquito repellent, in the preparation of salads and above all as a bio-scavenger as it takes away all heavy metals.

3. Advantages of Azolla

1. It easily grows in wild and can grow under controlled condition also.
2. It can easily be produced in large quantity required as green manure in both the seasons – Kharif and Rabi.
3. It can fix atmospheric CO₂ and nitrogen to form carbohydrates and ammonia respectively and after decomposition it adds available nitrogen for crop uptake and organic carbon content to the soil.
4. The oxygen released due to oxygenic photosynthesis, helps the respiration of root system of the crops as well as other soil microorganisms.
5. It solubilises Zn, Fe and Mn and make them available to the rice.
6. Azolla suppresses tender weeds such as *Chara* and *Nitella* in a paddy field.
7. Azolla releases plant growth regulators and vitamins which enhance the growth of the rice plant.
8. Azolla can be a substitute for chemical nitrogenous fertilizers to a certain extent (20 kg/ha) and it increases the crop yield and quality.
9. It increases the utilisation efficiency of chemical fertilizers.
10. It reduces evaporation rate from the irrigated rice field.

4. Nutrition value in Azolla

Azolla is very rich in protein (25-35%), Calcium (67 mg/100g) and Iron (7.3 mg/100g). The comparative analysis of the nutrient content of azolla vis-à-vis other fodder source is depicted in the following table.

Table: Comparison of biomass and protein content of Azolla with other fodder

S.No.	Item	Annual production of biomass (MT/ha)	Dry matter content (MT/ha)	Protein content (%)
1	Hybrid Napier	250	50	4
2	Kolakattao grass	40	8	0.8
3	Lucerne	80	16	3.2
4	Cowpea	35	7	1.4
5	Subabool	80	16	3.2
6	Sorghum	40	3.2	0.6
7	Azolla	1,000	80	24

Source : Dr P Kamalasanan et al. 2004 "Azolla -A sustainable feed substitute for livestock", Spice India.

In addition to their farming activity, small and marginal farmers are generally capable of rearing 2 to 3 units of cow/ buffaloes. For traditional methods of rearing, the feed requirements are met out from agriculture residues and very rarely the farmers can afford to provide green fodder and oil cakes. In rare cases, green fodder is provided to the animals in the form of grass collected from the field or in few cases fodder is grown in the backyard. Even then the supply of green fodder is restricted to 5 to 6 months when water is available. Azolla fodder plot, if set up by these small farmers can cater to the fodder requirements of remaining part of the year. Azolla can be supplemented with regular feed of the animal @ 2-2.5 kg of azolla per animal.

Azolla, if grown for fodder is essentially required to be grown in hygienic environment and there should be regular supply through out the year. The fodder plots should preferably be near the homestead, where the female member of the family can attend to nurturing and maintenance.

5. Cultivation process

The biomass production under natural condition i.e. in rice field is only 50 g/sq.m/day as against optimum production of 400 g/sq.m/day. The production efficiency can be increased by reducing contamination and competition with other algae. This can be achieved by growing Azolla in pits lined with synthetic polythene sheet in courtyard /back yard preferably in open space or on terrace where availability of sunlight is adequate.

Although production of azolla is good in nursery plots, production of azolla as green manure in paddy fields; 10% area of the paddy field is cordoned off and azolla is grown. The land should be puddled and leveled so that standing water is uniform through out the field. Azolla inoculum is sprinkled in the plot and 45 kg of single super phosphate per acre is applied in the field. The land used for cultivation of azolla is not wasted because after broadcasting azolla in the transplanted paddy crop (four days after transplantation) the plot itself may be used for cultivation of paddy. Even the water bodies, ditches in the vicinity can also be used for production of azolla.

Azolla cultivated for fish feed, is grown *in situ* in the pond. A part of the pond is earmarked and is cordoned off by rope made up of straw. Once the mat is formed azolla is released slowly to the pond by lifting the rope.

Setting up of Azolla fodder plot does not require expertise and farmers themselves can handle it with ease. If set up in backyard, the area should be leveled and lined with bricks. The side of the plots should be raised to enable the

water to stand. Alternatively, the fodder plot can be in a pit with depth of 0.2 m. A polythene sheet is spread over the bed in such a way that 10 cm of standing water can be maintained. Width of the bed is maintained at 1.5 m to enable the cultural operation from both sides. Length may be varied depending upon the fodder requirement of the unit. For two cows, two units of beds of length 2.5 m each with an area of around 8 sq m can meet 50% of the green fodder requirements.

Once the bed of size 2.5 m x 1.5 m is ready, about 15 kg of fine sieved soil is spread over the bed, which will provide nutrient to the azolla plant. About 5 kg of pre-decomposed (2 days) cow dung is mixed with the water, which provides carbon source for the azolla. About 40 g of nutrient mix (made by mixing 10 kg Rock phosphate, 1.5 kg Magnesium salt and 500 g of Murate of potash) is added to the azolla bed. The solution is fortified with micronutrient of desired quantity. This not only takes care of the micronutrient requirement of azolla but also the cattle when it is fed with the azolla. Sufficient water is added to make the water level of the bed to 10 cm.

Production of azolla scientifically and on a continuous basis requires cement concrete tanks of size 2 m long, 1 m wide and 0.5 m deep. Due care should be taken so that water can stand in the tank. Ten or more tanks can be constructed in one place covering an area of 25 sq. m. The lay out of the tanks are shown in the photograph. Arrangements for water to each tank should be made by laying pipe and tap from the over head tank.

Soil is distributed evenly across the bottom of the tank. The depth of soil layer should be about 10 cm. Cow dung is to be added at the rate of 1 to 1.5 kg per sq m of the tank area (2 to 3 kg of cow dung per tank). Single Super Phosphate (SSP) is to be added at the rate of 5 g per sq m of the tank area every week. (10 g SSP per tank). Fill the tank with water till the water collects to a height of 10 to 15 cm above the soil. Allow the soil particle to settle down. Prepare the fresh Azolla inoculum by adding 2 g of carbofuran to prevent pest infestation. Remove the layer of foam and scum that forms on the surface of the water. The foam impedes the growth and root penetration of azolla. Allow the tank to stand overnight. On the following day, spread around 200 g of fresh Azolla inoculum over the surface of the water. It takes about 2 weeks for Azolla to form a mat over the water surface. Water level in the tank should be maintained especially during summer months. To reduce excessive ambient light, a shade made out of coconut leaves may be laid above the tank. This also prevents dew formation on the growing Azolla during winter.

About 1.5 kg of mother culture of azolla seed material brought from azolla mother nursery is spread uniformly over the bed after stirring the water in the azolla bed. Care should be taken about the source of the azolla seed.

Initially, azolla will spread over the entire bed and will take the shape of thick mat within seven days. Ideally it will give 10 kg of azolla within seven days. During the initial seven days azolla is not harvested. Water level is maintained by applying water everyday. After the seventh day, 1.5 kg of azolla can be harvested every day. Azolla should be harvested in plastic trays with sieve. Harvested azolla should be washed in fresh water before it is fed to the cattle. Washing is necessary to remove the smell of cow dung. The azolla wash can be used as bio-manure for plants grown nearby. Azolla harvested can be mixed with the commercial feed in 1:1 ratio.

Cow dung and mineral mixture removed by azolla mass has to be supplemented at least once in seven days after harvest. A mixture made of cow dung, mineral mixture, soil and water should be added once in seven days.

After every 60 days, soil is removed from the bed and another 15 kg of fresh fertile soil is added into the bed to avoid nitrogen build up and also provide nutrient to the azolla. Fresh inoculation of azolla after removing soil and water should be made at least once in six months repeating the whole process afresh.



Pic.1. Azolla fodder plot in backyard



Pic.2 Azolla fodder plot in courtyard.

6. Precaution to be adopted

1. Maintenance of pure culture free from contamination is essential for good yield.
2. Azolla should be harvested regularly to avoid overcrowding.
3. Temperature is an important factor for good growth. It should be around 35 degrees Celsius. The fodder plot is to be covered with a plastic sheet in cold regions so as to reduce the impact of cold weather.

4. Places with direct and adequate sunlight should be preferred. A shady place yields less.
5. pH of the medium should be between 5.5 to 7.
6. Suitable nutrients such as cow dung slurry, micronutrients should be supplemented as and when required.

7. Costing of fodder plot:

The cost involved in setting up fodder plot varies between Rs 1500 to Rs 2000. The primary cost is in the form of manual labour, which can be contributed by the family labour. While estimating the cost of fodder plot, two units of fodder beds have been considered to maintain regular yield of azolla fodder. Number of units can be increased depending upon the number of cattle and fodder requirements. The details of the costs are as given below:

Sl	Particulars	Quantity	Rate	Amount (Rs)
1	Cost of trench making (2.25 m x 1.5 m x 0.2 m)	2 trenches	Rs 80.00 (one manday)	80.00
2	Poly sheet (3 m x 2 m)	2 sheets	Rs 300	600.00
3	Fertile soil	15 kg /trench	Rs 80.00 (one manday)	80.00
4	Cow dung	5 kg per trench	Rs 3	30.00
5	Fertilizer			
	SSP 5 kg each	10 kgs	Rs 10	100.00
	Mineral mixture 2 kg each	4 kgs	Rs 100	400.00
6	Azolla culture	Lump sum		100.00
7	Poly net			400.00
8	Pandal making	Optional		--
9	Miscellaneous			10.00
	Total			1800.00

Azolla as fodder has been experimented in many places; important being Vivekananda Ashram in Kanyakumari, Coimbatore District Co-Operative Milk Producers' Union Ltd., livestock programme implemented by BAIF in Guntur etc. In Andhra Pradesh, Azolla fodder cultivation is being taken up in Gangavaram, V. Kota and Punganur mandals in Chittoor through Mandal Mahila Samakhya with the cooperation of Animal Husbandry and Rural Development Departments of Government of Andhra Pradesh.

NABARD as part of the livelihood activity under Watershed Development Fund (WDF) has encouraged *azolla* fodder plots in various watersheds. NABARD supports such innovations as demonstration unit in the watershed villages where dairy activity has gained momentum. Watershed villages like Kothapalli in T Sundupalli mandal of Kadapa district and Renumakulapalli of Thamballapalle mandal of Chittoor district have set up demonstration units. These demonstration units have inspired other dairy farmers to set up azolla units. As per the assessment, each unit of azolla fodder plot of size 2.5 X 1.5 m costs Rs 1800. The major cost is towards plastics and seed material. The advantages as evinced by the farmers are that it provides green fodder through out the year and farmers without much skill can set it up.

Individual dairy farmer can take up this activity to supplement feed requirement of the cattle. Alternatively, an entrepreneur can take up azolla cultivation as income generating activity in larger scale to supply feed to dairy farmers in a cluster. With such innovative initiatives, the dream of Dr Verghese Kurien, the father of white revolution can be fulfilled to a greater extent.

DISCLAIMER

The views expressed in this model project are advisory in nature. NABARD assume no financial liability for anyone using this project report for any purpose. The actual costs and returns will have to be taken on a case by case basis considering the specific requirements of projects.

Additional Information about Azolla

Inoculum rate= 250g/sq.m
Yield = 10t/ha/week or 1kg/sq.m/week in one layer
Sale price= Rs. 1 to 1.2/kg (100 Australian dollar/t in Vietnam)
Bavistin - Rs.550/kg
Furadan - Rs. 65/kg
SSP - Rs 5/kg
Ratio of Inoculum to fresh azolla= 1:4