Introduction of Azolla Technology in Rice Ecosystem of Gadchiroli through Farmer's Field Demonstrations

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ABSTRACT

Azolla technology was introduced in rice ecosystem of Gadchiroli District of Vidarbha region of Maharashtra where tribal farmers dominate the cultivation of rice being the largest grown field crop of the area. A series of field demonstrations were carried out for three years; 2020-21 to 2022-23 in all the twelve tehsils of the district. Twenty farmers from villages of each tehsil were chosen for the demo of Azolla application to standing transplanted paddy fields. Every year four Tehsils with 80 -82 farmers were selected and in three years 242 farmers were given the demo in their field on one acre each with suitable control plots. Azolla treated plots were given only 75kg N /ha along with Azolla culture spread in the plots while control plots were given the recommended dose of 100 kg N/ha. Paddy grain yield increased from 12.87 per cent in Chamorshi Tehsil to a maximum of 22.90 per cent in Sironcha. The overall increase during 2020-21 was 158 kg/acre, next year it was 221 kg/acre and in the final year 2022-23 it was 181 kg/acre. Nearly 17 per cent increase in yield with saving of 25kg N/ha enhanced the income of farmers by Rs 4087/acre. The soil pH, organic carbon and available N also increased in the very first year of Azolla addition. Further analysis of adoption and knowledge indices depicted that farmers whole heartedly supported the technology and even the farmers who were non beneficiary of actual demo did adopt the technology through dissemination from the demo farmers. Thus, introducing the Azolla technology as a biofertilizer, in rice ecosystem of Gadchiroli may prove to be an excellent alternative to inorganic fertilizer application.

Key words : *Azola, Rice Ecosystem, Field Demonstration*

INTRODUCTION

Azolla is a free-floating water fern that floats in water and fixes atmospheric nitrogen in association with nitrogen fixing blue green alga Anabaena Azolla e. Azolla fronds consist of saprophyte with a floating rhizome and small overlapping bi-lobed leaves and roots. Rice growing areas in South East Asia and other third world countries have recently been evincing increased interest in the use of the symbiotic N2 fixing water fern Azolla either as an alternative nitrogen source or as a supplement to commercial nitrogen fertilizers. Azolla is used as biofertilizers for wetland rice and it is known to contribute 40-60 kg N/ha per ha (Kannaiyan,1993; Yadav *et al.,* 2014;Thapa and Paudel, 2021). In many Asiatic rice growing countries, Azolla has been long used as green manure for crop production and a supplement to diets for pigs and poultry. Some strains of Azolla can fix as much as 2-3 kg N/ha/day or1100 kg N/ha/ year (Pullin and Almazan, 1983; Kumar and Nayak, 2019)). Rice is very important staple food crop of eastern Vidarbha region of Maharashtra. Out of 9.2 lakh ha area under rice crop in the state, nearly 59 per cent area is in Vidarbha. Gadchiroli, a tribal dominated district, though for economic activities dependent and forest produce, has 1.80 lakh ha area (90.3%) under rice crop and the tribal farmers are dependent on rice as the staple food. However, there are no new technologies in rice cultivation. Farmers are using the inorganic fertilizers as the source of nitrogen and over the years the factor productivity of N fertilizers is going down making farmers to enhance the dosages to get same level of grain output. While the Azolla technology is getting popular in major rice growing states of the country, it was thought essential to introduce the Azolla

application in rice farming in Gadchiroli District as a new beginning of reducing the use of inorganic fertilizer.

METHODOLOGY

A massive demonstration project was undertaken for three years in all the talukas of Gadchiroli to educate empower and encourage farmers to undertake the use of Azolla in their rice farming. The paper depicts the adoption and impact of the technology in the district.

Azolla culture maintained at College of Agriculture Nagpur in small cement tanks (Fig.1) was supplied to KVK farm, Gadchiroli and multiplied in big 6x4x3 cubic feet large tanks at KVK farm(Fig.2). Since the technology was being introduced for the first time, it was necessary to train the farmers for multiplication and supplementation in rice fields. Hence series of trainings before actual demos were conducted at the KVK premises. Nearly thirteen on-farm and fifteen off-farm trainings were organized despite hindrances in the mobility in the first two years of the project due to Covid-19 pandemic restrictions. At the training, the demo farmers were supplied with specially designed plastic beds of 7x 4x1 cubic feet, culture of Azolla and relevant literature. The demo farmers were asked to multiply the culture in plastic beds at their farms. Monitoring of the use by farmers was also ensured in all the three years of field demonstrations. During the crop season demonstrations were conducted in villages of Ettapalli, Sironcha, Dhanora, Mulchera, Kurkheda, Armori, Wadsa, Chamorshi, Korchi, Bhamaragadh, Aheri and Gadchiroli Tehsils of Gadchiroli district. From each Tehsil 20 farmers were chosen for field demonstration exceptDhanora tehsil where 22 farmers joined the demos. Thus, in all 242 farmers took part in the field demos of Azolla technology. During 2020-21 crop seasons, villages from 4 tehsils viz; Ettapalli, Mulchera, Aheri and Dhanora were selected for the demos. Next year, 2021-22 another set of villages from 4 tehsils, Sironcha, Armori, Wadsa, and Kurkheda were chosen. In the third year, 2022-23, villages from Chamorshi, Bhamaragadh, Korch and Gadchiroli tehsils were included in the demos. One acre demo plots were given 50kg N/ha as basal dose+ Azolla spread in the field on standing water at 30 days after transplanting with additional 25 kg N/ha. Each farmer was asked to keep a control plot where his regular practice of 100 kg N/ha without Azolla was allowed for comparison. All other practices of nutrients, crop protection was as per the recommended practices of the KVK. Data was recorded on organic carbon, pH, and available N in the beginning and after harvest. Grain yield of paddy was recorded by each farmer separately for demo and control plots. Analysis of adoption, acceptance behaviour of Azolla technology was done with the help of Statistician.

RESULTS AND DISCUSSION

1. Paddy Yield in Demonstration Plots in farmer's field

Being a massive demonstration program, to cover the entire district of Gadchiroli, each year beginning from 2020-21 to 2022-23 were divided in four tehsils for implementation of the program. During 2020-21, the yield obtained in 82 farmers' fields of Ettapalli, Mulchera, Dhanora and Aheri was pooled together and are given in Table 1. At all the locations Azolla treated plots significantly out yielded the untreated plots. The mean grain yield of Azolla treated plot was 1136 kg/acre as against 978 kg of control plots. Similar results were obtained in next years' demo (2021-22) conducted in 80 farmers field of Kurkheda, Sironcha, Armori and Wadsa tehsils (Table 2). The overall yield of paddy was much better than previous year but the Azolla treated plots gave markedly superior grain yield than the respective control. During the third year of demos conducted during 2022-23 crop season at Chamorshi, Bhamaragadh, Korch and Gadchiroli, the yield data revealed that significantly higher yield by nearly 182kg/acre was obtained in Azolla treated plots over the control (Table3).

Table 1
Comparison of treated and untreated plot yield (Kg/acre) at different location from 2020-2021 (Four Tehsil).

Treatment	2020-2021				Mean
	Ettapalli	Mulchera	Dhanora	Aheri	
Control	837	1042	1006	1025	978
Azolla	980	1210	1170	1185	1136
S.E. (±m)	5.90	16.60	4.39	8.56	8.86
CD (P= 0.05)	17.80	50.02	13.23	25.79	26.71

Table 2
Comparison of treated and untreated plot yield (Kg/acre) at different location from 2021-2022 (Four Tehsil)

Treatment	2021-2022				Mean
	Kurkheda	Sironcha	Armori	Wadsa	
Control	920	1315	935	1078	1062
Azolla	1058	1617	1140	1316	1283
S.E. (±m)	9.29	18.00	11.67	15.78	13.69
CD (P= 0.05)	28.08	63.84	35.17	47.57	43.67

Table 3
Comparison of treated and untreated plot yield (Kg/acre) at different location from 2022-2023 (Four Tehsil)

Treatment	2022-2023				Mean
	Chamorshi	Bhamaragadh	Korchi	Gadchiroli	
Control	1188	1055	1154	1165	1141
Azolla	1341	1254	1354	1339	1322
S.E. (±m)	6.47	16.68	13.27	10.34	11.69
CD (P= 0.05)	19.51	50.26	40.06	31.16	35.25

Table 4
Pooled mean yield data of three years obtained from Azolla demos in farmer's field

Year	Total demo farmers	Mean yield Kg/acre		S.E. (±m)	CD (P= 0.05)
		Control	*Azolla* -T		
2020-21	82 (4)	978	1136	8.86	26.71
2021-22	80 (4)	1062	1283	13.68	40.68
2022-23	80 (4)	1141	1323	11.70	35.20
Mean of demos		1060	1248	11.41	34.20

(Figures in brackets are number of Tehsils)

Pooled mean data of three years demos in farmers field as influenced by year are compiled in Table 4. This further proved that Azolla technology has been highly beneficial in enhancing the yield of paddy even with 25 Kg N/ha less dose of inorganic fertilizer. From the demo of 242 farmers the Azolla treated plots gave a mean grain yield of 1248 kg/acre as against 1060kg/acre in control plots. A significant increase of 186kg/acre means a benefit of Rs 4087 per acre by considering the selling price of Rs 2197/quintal. Several studies in the past have shown that Azolla as biofertilizer can save nearly 25kg N/ha in paddy farming, increase the paddy yield (Raja *et al.,* 2012; Roy *et al.,* 2016) and this has been recommended to save the inorganic N use in the country (Choudhary *et al.,* 2017; Thapa and Poudel, 2021).

Further studies on the available N as well as other soil parameters like pH, organic carbon were also analysed from the field samples from all 242 farmers field plots before carrying out the demo and after the harvest. The data are presented in Table 5 after the compilation. It was clearly revealed that soil pH improved from 6.31 to 6.69 by application of Azolla. Similarly, there was 0.09 per cent increase in organic soil carbon and 10 kg/ha enhancement of available nitrogen in soil. These benefits appear small in the beginning but continuous use of Azolla every year will improve soil heath. Raja and coworkers (2012) demonstrated that Azolla enriched the soil by 50 kg N /ha and reduced the N requirement of rice by 20-30 kg N /ha with increase in yield to the tune of 20-30 per cent.

Table 5
Influence of Azolla application on soil parameter in demonstrations plots of farmers

Year	Samples from Tehsils	Soil PH		Organic C (%)		Available N (Kg/ha)	
		Before	After	Before	After	Before	After
2020-21	Ettapalli, Mulchera, Dhanora, Aheri	6.42	6.76	0.48	0.55	212	237
2021-22	Sironcha, Armori, Wadsa, Kurkheda	6.14	6.57	0.46	0.57	223	245
2022-23	Chamorshi, Bhamaragadh, Korchi, Gadchiroli	6.28	6.69	0.44	0.55	225	229
	General mean for District	6.31	6.69	0.46	0.55	219	229

2. Adoption of the Azolla technology amongst the beneficiary and non- beneficiary farmers of Gadchiroli

A ground survey was conducted using specific parameters to know the adoption of the technology. The beneficiary farmers numbering 242 in all the 12 tehsils were interviewed as to the continuation of the technology without any support. Firstly, assessment of the knowledge of technology gained by the demo farmers was done through an interview schedule asking the questions related to technology. Out of 242 farmers 195 demo farmers responded to the questionnaire. The knowledge index and the adoption index are given Table 7. It revealed that nearly 46 per cent increase in knowledge index was visible while adoption index was as high as 67 per cent.

Going beyond the beneficiary farmers who attended the training but were not involve in the demos (non-beneficiary) were also interviewed about the technology acceptance. Such 119 farmers were also given the questionnaire to find out if they

are ready to use the technology on their own. Nearly all the non-beneficiary tribal farmers were positive to the use of Azolla. Some farmers did use Azolla application in 2022-23 in their rice fields and got convinced about the use of the technology for increasing yield. Table 8 gives the summary of such 23 farmers mean paddy yield along with monetary benefit.

Table 7
Adoption behaviour of beneficiary farmers towards Azolla Technology

Mean Index	Before Demo	After Demo	% Increase	'Z' value
Knowledge Index	65.45	95.41	45.76	-15.77**
Adoption Index	42.09	70.11	66.57	-15.41**

Table 8
Impact of Azolla Technology on Non-beneficiary farmers

Components	No *Azolla* Treated	*Azolla* Treated	% Increase
Yield (q/acre)	11.1	12.2	10.9
Increase (Rs/acre)	20,508	22,304	08.8

Senthilkumar and Manivannam (2016) did excellent analysis of adoption of Azolla cultivation in the farmers' fields. They found that farmers once get the culture do maintain and multiply successfully and then self-adopt the technology. Mandal (2018) wrote a popular article for rice farmers to adopt smart farming by cultivating Azolla. The studies expect to the farmers to adopt the technology as a regular practice in rice farming.

CONCLUSION

The present mega demonstrations carried out in all the Tehsils of Gadchiroli district on the utility of Azolla in rice ecosystem will pave way for replacement of nearly 25kg N per ha and improve the soil heath without compromising on the grain yield. Being the first-time introduction in the area, it is expected that rice growing districts of eastern Vidarbha shall soon adopt the technology and make rice cultivation more sustainable and profitable.

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