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## Economical analysis of growing crossbred pigs fed with Azolla based diet: Original research paper

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### Abstract

The study was conducted to calculate the economics of Azolla production and its effect on feeding cost of swine. *Azolla pinnata* was included as a protein replacer in the concentrate feed at the rate of 15% in the feed of growing pigs. The duration was 150 days, 14 growing crossbred Large White Yorkshire pigs randomly divided into 2 groups (G1 and G2) with seven pigs in each group. The quantity of Azolla required for the experiment was grown and the unit cost of fresh Azolla produced was (₹) 1.36 and dry Azolla was (₹) 13.6. Average total feed intake (kg) per pigs during the experimental period in G1 and G2 was 284.84 and 288.59, respectively. Total feed cost in G1 and G2 (₹) was 6096.00 and 5838.00, respectively. The total live weight gain (kg) during the experimental period 54.13 and 58.22 in G1 and G2 groups, respectively. The total cost (₹) per kg body weight gain was calculated as 112.62 and 100.27 in G1 and G2 groups, respectively. *Azolla pinnata* is unconventional protein source 15% in diet reduces the feed cost in swine rearing.

**Keywords:** Crossbred pigs, *Azolla pinnata*, protein replacer, swine production

### Introduction

Reduction of feed cost has prime importance in pig production. Feed cost constitutes almost 70 per cent of the total expenditure on pig production. Azolla has long been used as green manure. Since, Azolla contains most of the nutrients which are required for all classes of livestock including poultry [2]. It is very rich in proteins, essential amino acids, vitamins (A, B<sub>12</sub> and β carotene) and growth promoter intermediaries and minerals vitamins, calcium, phosphorus, potassium, iron, copper, magnesium etc. [9]. Azolla can be easily digestible by the livestock, owing to its high protein (about 20-25%) and low lignin content. There are varieties of unconventional feedstuffs available which find use as protein and energy source for Azolla is a free floating aquatic fern belonging to family *Azollaceae*, order *Pteridophyta* distributed throughout the tropical, subtropical and temperate fresh water ecosystems. It is used as nitrogen source for paddy cropping systems [10]. Various reports indicated that Azolla can be added in the pig ration upto 20% and it can replace soyabean protein upto 20% level without any change of performance of growing and finishing pigs [4].

### Materials and Methods

The work was undertaken at the Livestock farm, Adhartal, College of Veterinary Science & Animal Husbandry, N.D.V.S.U., Jabalpur (M.P.). The experiment was conducted on 14 Large White Yorkshire crossbred pigs divided into two groups (G1 and G2) with seven pigs in each group for 150 days. Grower ration with 18.00% crude protein was formulated using maize, de-oiled rice polish, wheat bran, ground nut cake based on the recommendation of [6]. Data analyzed, using ANOVA described by [11].

**Table 1:** Grouping of animals with cost of (₹/kg diet)

Groups	No. of growing pigs	Diet	Cost (₹/kg diet)
Group-1	7	Basal diet	21.40
Group-2	7	15% dried Azolla + 85% basal diet	20.23

### Preparation of Azolla meal

The size of Pond is 32 (2m x 2m x 0.2m) was dug and cover by a silpauline sheet to cover the pit. It is a polythene tarpaulin which is resistant to the ultra violet radiation in sunlight. About 15 kg of sieved fertile soil was uniformly spread over the silpauline sheet. Slurry made of 5 kg manure and 30 gm of super phosphate in 10 liters of water poured into the sheet. More water was poured to make water level to reach about 10 cm. About 500gm of fresh and pure culture of Azolla were inoculated in the pit. Micro nutrient mix containing trace elements were added weekly intervals to enhance mineral content of Azolla.

### Azolla harvesting

Azolla rapidly grow and fill the pit within 10-15 days and harvested at 10 days interval in a plastic tray having holes of 1 sq. cm mesh size to drain the water. It is washed to get rid of the dung smell. Azolla multiplied rapidly and filled the pits within 7 days. Fully grown Azolla was harvested every week and washed thoroughly with clean water, weighed and sun dried for 2 to 3 days such that it becomes crispy while green colour still retained in the dried Azolla.

### Analysis of feed and Azolla meal

Concentrate mixture and sun-dried Azolla were analyzed to know the dry matter, crude protein, ether extract, crude fibre, nitrogen free extract and total ash content as per the methods described in the manual of Association of Official Analytical

Chemist <sup>[1]</sup>.

### Results

#### Proximate analysis

Chemical composition of concentrate mixture and Azolla are depicted in table 1. Dry matter content of the concentrate mixture and sun-dried Azolla was 92.12 and 92.27 per cent, respectively. Other compositions such as crude protein, crude fibre, nitrogen free extract and ash were 18.13, 9.00, 6.60, 54.86, and 11.41, respectively for concentrate mixture and 20.51, 3.92, 16.27, 51.47, 14.80, respectively for Azolla.

**Table 2:** Proximate compositions (%) of concentrate mixture and Azolla

Compositions	Concentrate mixture	Sun-dried Azolla
Dry matter	92.12	92.27
Crude protein	18.13	20.51
Ether extract	9.00	3.92
Crude fibre	6.60	16.27
Nitrogen-free extract	54.86	51.47
Ash	11.41	14.80

Diets was formulated as mention in table 2. With yellow maize, undecordicated groundnut cake (GNC), wheat bran, de-oiled rice polish, jawala fish (60%protein), mineral mixture and common salt as per <sup>[6]</sup>. Diets was formulated with CP 18%. The cost of the experimental diets was calculated based on the existing price of the ingredients during the experimental period

**Table 3:** Composition (%) of concentrate mixture

Ingredient	Concentrate mixture with cost	
	Proportion (Kg)	Rate (₹/kg)
Yellow maize	37	15.87
Wheat bran	16.5	12.77
Rice polish	14	15.77
Undecordicated GNC	14	36.47
Jawala fish (60% Protein)	6	39.75
Mineral mixture	2	124
Comman salt	0.5	8.90
De-oiled rice polish	10	11.95
Total	100	21.39

### Azolla Production

Two types of animal excreta namely cattle and buffalo dung used for the experiment shows in table 3. Each type of animal excreta was used in four ponds. Azolla was harvested from each pond at 10 days interval for two months period. Average Azolla production (kg/pit/10 days) were 5.55±0.11 and 6.20±0.12 from buffalo and cattle dung, respectively. Average Azolla production was significantly ( $p < 0.05$ ) higher from cow dung in comparison to the other buffalo dung.

**Table 4:** Average Azolla production from buffalo, cow dung (kg/pit) animal excreta, at 10 days interval from a pit size of 2m×2m×0.2m

Months	Buffalo dung (kg/pit)	Cow dung (kg/pit)
1 <sup>st</sup>	5.30±0.10	6.00±0.11
2 <sup>nd</sup>	5.80±0.12	6.40±0.10
Average	5.55±0.11	6.20±0.12

a, b & c means with different superscripts differ significantly within a row ( $p < 0.05$ )

### Growth Performance

Overall growth performance of growing crossbred pigs is presented in table 4. Initial and final body weight of the pigs of both the groups did not differ significantly. Feed intake,

feed conversion ratio and protein efficiency ratio were not significantly different among the groups.

**Table 5:** Growth performance of growing Crossbred Pigs fed different levels of Azolla in the diets

Parameters	G1	G2
Initial weight (kg)	32.43±1.45	32.00±1.91
Final weight (kg)	87.72±2.71	91.18±3.77
Total weight gain (kg)	55.28±1.28	59.18±2.32
Total feed intake (kg)	284.84±0.84	288.59±0.84
Feed conversion ratio	5.46±0.20	5.24±0.17
Protein efficiency ratio	1.20±0.09	1.26±0.04

### Economics of Azolla production by using Cow dung

From the result of the first phase, it was observed that cow dung was better for Azolla production in comparison to buffalo. Thus, cow dung was used for Azolla cultivation for the rest of the experimental period i.e. five months. Detail economics of Azolla production from cow dung is presented in the table 5. Cost of per kg fresh Azolla was ₹1.36. Pigs were fed sundried Azolla meal during the whole experimental period. Cost of per kg dried Azolla was ₹13.61.

**Table 6:** Economics of Azolla production by using Cow dung in a pit size of 2m×2m×0.2m

S. No	Particulars	Cost	Quantity	Amount (₹)
1	Capital expenditure			
2	Labour charge for bed preparation (one labour can dig 2 pit in a day)	250/ man/ day		125.00
3	Cost of silpauline sheet 6m <sup>2</sup>	60/m <sup>2</sup>	1	360.00
4	Total capital expenditure			485.00
5	Recurring expenditure (for 5 months period)			
6	Cow dung @ 10kg twice a month	0.25/kg	100 kg	25.00
7	Super phosphate @ 30 g twice a month	15/kg	300 g	4.50
8	Mineral mixture @ 30 g twice a month	60/kg	300 g	18.00
9	50% depreciation of the capital expenditure for 5 months			75.00
10	Total recurring expenditure for 5 months		122.50	
11	Yield of fresh Azolla (4.5 kg at every 7-8 days) from a pit		90kg	
12	Unit cost of fresh Azolla (₹ per kg)			1.36
13	Yield of sun dried Azolla (on 10% DM basis) (kg)		9	
14	Unit cost of sun dried Azolla (₹ per kg)			13.61

### Economics of Azolla feeding

Economics of Azolla feeding is presented in the table 6. Average total feed intake (kg) per pigs during the experimental period was 284.84 and 288.59 in G1 and G2 groups, respectively. Total feed cost (₹) was 6096.00 and 5838.00 in G1 and G2 groups, respectively. The total live weight gain (kg) during the experimental period was 54.13 and 58.22 in G1 and G2 groups, respectively. The total cost (₹) per kg body weight gain was calculated as 112.62 and 100.27 in G1 and G2 groups, respectively. Lowest cost (₹) of feed per kg body weight gain was observed in G2 group (100.27), whereas highest value observed in G1 group

(112.62). The average percent decrease of feed cost (₹)/kg body weight gain in G2 was 10.96 in comparison to the control group (G1). Average recurring cost in G1 and G2 was 6896.00 and 6638.00 in G1 and G2 groups, respectively. The average percent decrease of recurring cost (₹)/kg body weight gain in G2 was 10.50 in comparison to the control group G1. Average recurring cost per kg pork production in G1 and G2 was 188.82 and 167.01 in G1 and G2 groups, respectively. The average percent decrease of recurring cost (₹)/kg body pork yield in G2 was 11.55 in comparison to the control group G1

**Table 7:** Economics of feeding growing crossbred pigs fed different levels of Azolla in the diet

Parameters	G1	G2
Total feed intake (kg)	284.84	288.59
Total feed cost (₹) (@#21.40 and 20.23/kg feed for G1 and G2, respectively)	6096.00	5838.00
Total weight gain (kg)	54.13	58.22
Cost of feed (₹)/kg body weight gain	112.62	100.27
Per cent decrease of feed cost per kg body weight gain	-	10.96
Labour cost (₹) (50 pigs/labour, labour cost @₹7500/month) for five months	750.00	750.00
Miscellaneous cost (₹) (e.g., electricity, medicine etc., @₹10/pig/month)	50.00	50.00
Total recurring cost (₹)	6896.00	6638.00
Recurring cost (₹) /kg body weight gain	127.40	114.02
Per cent decrease of recurring cost per kg body weight gain	-	10.50
Average dressing percentage (%)	67.47	68.27
Average pork yield (kg)	36.52	39.75
Total recurring cost (₹) / kg pork	188.82	167.01
Percent decrease of recurring cost per kg pork yield	-	11.55

### Discussion

#### Azolla production by using animal excreta

In this study, the growth potential of Azolla using animal excreta was evaluated. Average fresh Azolla yield (kg/pond/10 days) by using animal excreta of buffalo and cattle was 5.55±0.11 and 6.20±0.12, respectively. The fresh Azolla yield significantly ( $p < 0.05$ ) higher in cow dung when compared to buffalo. The overall Azolla yield is comparable with the findings of the other studies [7].

#### Dietary Composition

Proximate compositions of the sun-dried Azolla were estimated during the study period. Dry matter content of the concentrate mixture and sun-dried Azolla was 92.27 per cent, respectively. Other compositions such as crude protein (%), ether extract, crude fiber (%), nitrogen free extract (%) and ash (%) were 20.51, 3.92, 16.27, 51.47 and 14.80, respectively. The results of the experimental study are in

accordance with the reports of [8]. Proximate compositions of the concentrate mixture were analyzed during the study period.

#### Economics of Azolla Production

From the result of the first phase, it was observed that cow dung was better for Azolla production in comparison to buffalo. Thus, cow dung was used for Azolla cultivation for the rest of the experimental period i.e. five months. Cost of per kg fresh Azolla was ₹1.36. Pigs were fed sundried Azolla during the whole experimental period. Cost of per kg dried Azolla was ₹13.61. The cost of Azolla production was lower in comparison to the present study as reported by [4]. They reported that cost of fresh Azolla was ₹ 0.56/kg and dried Azolla was ₹ 5.65/kg.

#### Economics of Azolla feeding to the crossbred pigs

Feed cost contributes about 70 per cent of the total

expenditure of pork production. Thus, cost of feed is considered to be the key factor in determining the profitability of pork production. Thus, primary purpose of using any unconventional source of feed is to reduce the cost of pork production by reducing cost of animal feed without affecting the growth rate of the pigs<sup>[12]</sup>.

### Conclusions

Azolla can be easily digestible by the livestock, owing to its high protein that reduces the feed cost in swine rearing. Cow dung proved to be a best fertilizer for Azolla production. This point is more promising as cow dung is cheaply available and it is readily usable. Azolla can replace 15% concentrate mixture without affecting body weight gain. Addition of Azolla to the diet of the growing crossbred pigs substantially reduces feed cost as well as recurring cost per kg body weight gain and per kg pork production.

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