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# Production and Nutritive Value of Floating Bed Fodder (German and Dhal Grasses)

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**Abstract**

Floating Beds (FB) were prepared in Jaintapur and Kanaighat and one in the Sylhet Agricultural University (SAU) campus of Sylhet region in Bangladesh. German and Dhal grass were cultivated on those floating beds. There were about 11Kg/sqm and 5.75 Kg/sqm of average fodder production per bed in German and Dhal grass respectively. German grass showed superiority in production and nutritional quality compared to Dhal and local grasses and considered as suitable fodder for FB cultivation. *In vitro* degradability (IVD) was higher in floating bed German grass than local grasses. By analyzing water quality of the wetland in which fodder bed was constructed it has been revealed that the Dissolved Oxygen (DO) level of the floating bed was at a range in which the fish population had a threat to survive. So, these abandoned ponds were utilized by constructing a floating bed for fodder production. There was a positive correlation between IVD and DO of water. Experimental bucket silage production was carried out for storing German grass and found the potentiality for preserving the grass without any nutrient loss for a long period. Presence of *Lactobacillus spp.* in silage lowered its pH during ensiled at anaerobic condition and helped to preserve the quality. Confirmation and screening of *Lactobacillus spp.* in silage was carried out by culturing the microorganisms in a selective De Man, Rogosa & Sharpe (MRS) media followed by different biochemical tests. The FB method of fodder cultivation can be helpful to survive on climate change vulnerability and to ensure sustainable livestock production in haor and low-lying areas.

**Keywords:** *In vitro* degradability; Water quality; Bucket silage; *Lactobacillus*

**Abbreviations:** LAB: Lactic Acid Bacteria; FBF: Floating Bed Fodder; IVD: *In Vitro* Degradation; BOD: Biological Oxygen Demand; DO: Dissolved Oxygen; MRS: De Man, Rogosa & Sharpe

## Introduction

For sustainable livestock production, climate change acts as a major obstacle in a number of countries. Many countries in the different regions of the world are vulnerable to the impacts of global warming and climate change due to their geographic location, the dominance of floodplains, and low elevation from the sea, high population density, high levels of poverty and overwhelming dependence on nature, its resources and services. Every year different locations are being affected by flood during the rainy season at various locations. The scarcity of green grass increases as the grazing lands and pasture lands are submerged under water during a flood. Many parts of these countries are waterlogged for several months every year during monsoon and the poor peoples of that area suffer a lot mostly to fulfill their various needs. Many of the people have livestock which gives them food, daily income, and financial backup. During the rainy season, their livestock suffers mostly from a lack of food and waterborne diseases. As pasture lands become submerged under water, it limits the livestock to avail green grass. Alternative ways should be developed as sustainable livestock production cannot be achieved by feeding the livestock with low nutrients forages and insufficient feeds during the flood period. These techniques must be inexpensive and easily adopted by farmers so that they can easily produce good quality and sufficient amount of forage that can meet the need in case of flood or another emergency crisis. To ensure food security for flood-prone and water lodged areas, floating bed (FB) vegetable cultivation has been developed [1]. FB is an innovative technique that can be a good tool for ensuring livestock production when flood submerged the pastureland followed by a severe scarcity of grass to feed the livestock. So it is important to develop ideas that can help the farmers to afford quality and sufficient available forage when flood affect the grazing land. Floating bed (FB) for fodder production is a technique that can be a good tool for livestock production when flood submerged the pastureland followed by a severe scarcity of grass to feed the livestock [2]. Floating bed agriculture is a locally adopted production system in southern Bangladesh. Use of such cultivation practice allow the farmers to cultivate crops against the obstacle of a disaster like a flood, also it is cheap, easy and widely accepted by the local farmers and nowadays practiced in many parts of Bangladesh [2,3]. During monsoon, when farmers face the problem of feed shortage for their livestock, high nutritional fodder production on FB can be a good adaptation program. *Islam et al.* [2] reported that German grass (*Echinochloapolystachya*) is suitable for FB as it is aquatic or semiaquatic fodder that has also good nutritional value. Dhal grass (*Hymenachneamplexicaulis*) could be another candidate suitable for FB as it is a wetland grass inhabiting margins of swamps, river floodplains, and drainage canals, mostly in water to about 2 m deep, occasionally extending into water 3-4 m deep. It can be grown for pasture in natural or artificially inundated pond areas [4].

*Islam et al*. [2] observed the production of German grass on the floating bed. Water qualityand the season can vary the production and degradability of these grasses that need to be checked. Again, maintaining green fodder availability round the year is a challenge in livestock farming. For proper livestock farming, it is desirable that surplus green grass to be preserved with a minimum loss of nutrients to supply during lean periods when the availability of organic fresh forage is negligible. For forage preservation, silage production may be a key component of high input systems. It has allowed farmers to intensify the productivity of the land and the productivity of the cows independently from each other. As silage making allows storage and preservation of feed resources for months, farmers can focus to maximize the yield of digestible nutrients (energy, protein, etc.), can maximize milk production per cow throughout the year. Fermentation in silage reduces harmful nitrates accumulated in plants during droughts [5]. Therefore, to ensure the feed security of livestock during the rainy season, two upazila of Sylhet district in Bangladesh namely Kanaighat and Jaintapur were selected. There several floating beds were developed for cultivating fodder (German and Dhal grass) as well as silage production and subsequent research works were carried out for microbial and biochemical assessment of the forage.

## Materials and Methods

### Selection of Study area and Contract Farmers

A survey was performed among the villagers from the different unions under Kanaighat and Jaintapur upazila Sylhet, Bangladesh. A prepared questionnaire was used to evaluate the socioeconomic status of the villagers. Farmers who have a minimum of five cattle, have a pond nearby and interested to improve their animal management system to develop their cattle stock were selected.

### Training to the Farmers

A day-long training program was organized at Jingabari and Darbast union Parishad complex of Kanaighat and Jaintapur upazila respectively. All Farmers, selected according to survey, gathered together in the training program.

### Preparation of Floating bed

Seven floating beds in Jaintapur, four in Kanaighat and one at Sylhet Agricultural University (SAU) campus, were prepared according to *Islam et al*. [2]. The size of each floating bed was nearly about 18.5sqm (200 square feet) but the shape of each floating bed was varied with the shape of the pond on which a bed was floated. Material required for a floating bed were bamboo, plastic net, banana plant, soil, cow dung, water hyacinth, rope, and knife. A bamboo frame was prepared and covered with a plastic net. Four pieces of mature banana plants were fixed below the bamboo frame for primary floating management of the bamboo frame. In some beds, empty plastic water bottles were used as an alternative to the banana trees to float the bed for a long time. Water hyacinths were stocked on the floating bamboo frame with around one feet height to make the first layer of the floating bed. Then the top layer of floating bed about 3 inches was prepared with soil and cow dung.

### Fodder Plantation on the Floating bed

German and Dhal grass was found as suitable for FB fodder cultivation [2,6]. Cuttings of German and Dhal grasses were prepared. Each cutting contained three complete internodes with four nodes. The cuttings were planted alternatively on row by row. The distance of one row to another was about 0.25m. German grasses were planted on four floating beds and Dhal grasses were planted on three floating beds at Jaintapur. Among the four-floating bed with German grass, two were used with a plastic bottle instead of Banana plant. The floating beds at Jaintapur were constructed from July to September when there was flood water available in this area. In Kanaighat only German grass was planted. Among the four-floating bed, two were constructed in October, that is late rainy season and two were constructed in December, i.e. in the winter and dry season to check the production difference in the different season. One floating bed was constructed at SAU campus with German grass in the rainy season.

### Care and Management of Floating Bed Fodder Cultivation

There was regular check-up of the bamboo frames that was supporting the structure of the floating bed. The beds were always kept enough away from the pond bank to secure the beds from cattle attack.

### Determination of Water Quality of the Floating Bed

The water sample was collected from the ponds where the floating bed was constructed. Two 300ml biochemical oxygen demand (BOD) bottle was filled with the sample water. One bottle was kept for measuring dissolve oxygen (DO) and another one was incubated at room temperature in a dark place for five days. One ml of manganese sulfate was added into the bottle by pipetting. One ml of freshly prepared solution of potassium hydroxide and


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potassium iodide was then added. The bottle was shaken to mix the reagents and allowed to stay for five minutes. Light yellow colored precipitate produced to indicate the presence of dissolved oxygen. One ml of concentrated sulphuric acid was added into the BOD bottle and shaken vigorously to mix it well and waited for twenty minutes. After that, the hundred ml of water from BOD bottle was taken into a conical flask and 5-6 drops of the freshly prepared starch solution were added. The solution was then titrated by using 0.025 N sodium thiosulfate drop by drop from the burette. The color changed from blue to color less indicates the titration point. The initial and final burette reading was then calculated to measure the DO of water. After 5 days, the incubated bottle was then tested by the discussed procedure to measure the DO of the incubated BOD bottle. The difference between the DO of the first day and DO after 5 days indicate the BOD of the water sample [7].

### Sample Collection and Fodder Production Evaluation

The first harvest/cut was carried out according to table 1 after plantation. Samples from floating bed among the farmers of Kanaighat and Jaintapur upazila were collected for the study of present research work for production, microbial and nutritional evaluation. Similarly, three local grasses namely Durba, Binna, and Katu, grown naturally in Kanaighat and Jaintapur area, were collected. All the German and Dhal grasses were harvested by cutting at the fourth node (between fourth and fifth internodes) from the base/root. For local grasses, only the Aerial part was collected.

Fodders produced on 1sqm space were taken and weighed to evaluate production performance. Spring balance of 20kg was used for this purpose. Then the collected fodders were shifted to Biochemistry laboratory of SAU for nutritional analysis.

## Nutritional Evaluation of the Fodders

### Sample Preparation

The fodders from the first cut of the floating beds were collected for the analysis. For preparation, the whole grass sample was cut in pieces of less than one cm size with a knife. After taking samples for dry matter and ash test, rest of the samples were dried at 105 °C for overnight, grinded with blender machine and kept separately in an airtight sample bottle. Eleven samples of floating bed from Jaintapur and Kanaighat region, one from SAU campus and three local grasses from the Jaintapur and Kanaighat area, a total of 15 samples were processed. From each of the samples, with three replication cycle, fodders were prepared for proximate analysis and in vitro trial.

### Proximate Analysis

The proximate analysis including dry matter (DM), Ash, crude protein (CP), and ether extract (EE) of the fodder samples was performed according to *Islam et al. & Khan* [2,8].

### *In vitro* Evaluation of the Fodders

#### Collection of rumen fluid from Cattle

Rumen fluid (RF) was collected from healthy slaughtered cattle. The RF was then transported in the insulated flasks under anaerobic conditions to the laboratory that was preheated at 39 °C with water. The RF was strained through a porous cloth into the pre-warmed McDougall buffer at a 1:4 ratio to prepare the inoculums [9]. The flasks were then screw capped and kept at 39 °C in a water bath until used.

### Measurement of *In Vitro* Degradability of Fodders by Rumen Fluid

*In Vitro* degradability (IVD) was performed according to Khan and Chaudhry [9]. For the 24-hour IVD test, 0.3g of the sample was shifted to a 50ml falcon tube and 30ml of buffered inoculum was poured on it. The tube was screw capped and mixed by up-down movement and incubated 24 hours at water bath. Sample from each tube was filtered by a suction pump and the filter paper with residue was dried in an oven and the dry matter was checked and calculated.

### Silage Production from Fodder

A technique called ‘Bucket Silage’ was used for the production of silage using German grass collected from a floating bed. A freshly new bucket (25L) was used for storing the silage. About 24kg chopped fodder material was uniformly mixed with one kg molasses.

The grass materials were chopped to a short length (1-3cm) and filled into a bucket and sealed tightly to make the bucket airtight to maintain anaerobic condition for fermentation. The bucket was then kept for 28 days for the ensiling the fodder.

## Screening and Confirmation of Lactic Acid Bacteria (LAB)from Silage

### Culturing in MRS Media

Microorganisms from silage were first cultured in nutrients broth and after 24 hours of incubation microbes from the nutrients broth, was cultured in *lactobacillus* specific MRS media. After 3 days of the inoculation whitish round culture were appeared, these were then subsequently subcultured.

### Biochemical tests for Confirmation of LAB from Silage

For the confirmation of the presence of *Lactobacillus spp*. gram Staining, catalase test, oxidase test, indole test, methyl red (MR) test, voges–proskauer (VP) test and carbohydrate fermentation test were performed.

### Statistical Analysis

Microsoft Excel was used for statistical analysis. Dissolved oxygen (DO) was compared with *in vitro* degradability (IVD), in data analysis following correlation. Single factor ANOVA was used to measure significant variation among the various samples.

## Result

### Fodder Production from Floating Bed

The production of fodder from the floating beds significantly ($P<0.05$) differed from each other and also differed from floating bed in SAU campus (Table 1). Production of floating bed German


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grass was higher compared to the floating bed Dhal grass and local grasses (Durba, Katu. Binna). The maturity of grass took longer time (90 days) in Kanaighat which were planted in winter. The picture of mature grass in a floating bed is given in Figure 1.

**Table 1:** Production of grasses from different sources.

| Season | Origin of Sample | | First Cutting after days | Production (kg/sqm) | IVD 24 hours (g/kg) |
|---|---|---|---|---|---|
| Rainy | Jaintapur (German) | | 63±2.88 | 13±3.46 | 216.03±24.45 |
| Winter | Kanaighat (German) | | 90 | 11.5±4.95 | 154±13.67 |
| Late Autumn | Kanaighat (German) | | 63±3 | 10.5±6.36 | 236.33±35.3 |
| Rainy | Jaintapur (Dhal) | | 62±2.88 | 5.73±0.45 | 216.89±11.6 |
| Rainy | FBS (German) | | 60 | 13 | 255.3±3.5 |
| Rainy | Local | Durba | - | 0.13 | 206.5±5.2 |
| Rainy | | Katu | - | 0.11 | 206.66±4.73 |
| Rainy | | Binna | - | 1.5 | 212.16±4.85 |
| | | | | p > 0.005 | p > 0.005 |

**Figure 1:** Growth of FB German grass after full maturity.

## Determination of Water Quality

By analyzing water quality of the wetland in which fodder bed was constructed it has been revealed that the DO level of the floating bed was at a range in which the fish population had a threat to survive. So, these abandoned ponds were utilized by constructing a floating bed for fodder production. Water sample of floating bed quality had revealed in Table 2.

**Table 2:** The relation between water quality vs IVD.

| Origin of Sample | DO 1 (mg/L) | BOD (mg/L) | pH | IVD |
|---|---|---|---|---|
| Kanaighat (German) | 1.81±0.22 | 0.76±0.10 | 7.12±0.35 | 195.17±52.33 |
| Jaintapur (German) | 2.10±0.3 | 1.06±0.43 | 7.35±0.53 | 216.03±24.45 |
| Jaintapur (Dhal) | 1.97±0.83 | 0.76±0.03 | 7.4±0.62 | 216.89±11.6 |
| FBS (German) | 4.2±0.2 | 1.3±0.02 | 7.2±0.02 | 255.3±3.5 |

**Table 3:** variation in proximate composition and IVD from different grasses.

| Season | Origin of Sample | | First Cutting after days | Production (kg/sqm) | IVD 24 hours (g/kg) |
|---|---|---|---|---|---|
| Rainy | Jaintapur (German) | | 63±2.88 | 13±3.46 | 216.03±24.45 |
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| | | | | p > 0.005 | p > 0.005 |



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### Proximate Analysis and In Vitro Degradability of Forages

Though the difference was not significant, the DM was lowest in German grass from Jaintapur region than other grasses. After 24 hours, IVD was higher in some of the German grass of floating bed field (FBF) and in the floating bed Sylhet Agricultural University campus (FBS) than local grasses (Table 3). There was a higher value of IVD of silage than German and local grasses (Table 3).

### Production of Silage

After 28 days of ensiling in airtight bucket the quality of good silage (Figure 2) was ensured by the characteristics such as the appearance of the silage was greenish brown, absent of mold, there was a smell of lactic and acetic acid (like dahi and vinegar) indicating good quality silage, When the silage was squeezed, the silage breaks slowly into pieces, indicated good quality. In vitro degradability study showed that silage also made the fodder more digestible (Table 3).

**Figure 2:** Silage produced after 28 days ensiled in airtight bucket.


**Figure 3:** Colony of *lactobacillus spp.* in MRS

### Screening of *Lactobacillus spp.*

After 2 days of incubation on MRS media bacterial culture appeared as small, white creamy, colonies (Figure 3) indicating the presence of *Lactobacillus spp*. The result of the biochemical test (Table 3) confirmed the presence of *Lactobacillus spp*. grown on De Man, Rogosa & Sharpe media (MRS) agar media.

## Discussion

The variation in fodder production was due to the dissimilarity in size, care taken by the farmers and seasonal variation at which floating beds were constructed. The floating beds in Kanaighat region were constructed at the beginning of winter which reduced the production comparing to the floating beds at SAU and Jaintapur region. So, to get a better result in fodder production from floating bed, current research suggested that floating bed should be constructed and fodder harvesting should be performed within the rainy season or the summer. To maintain the structural integrity of the floating bed it is suggested that plastic bottles should be used as an alternative to the banana tree to float the bed properly for a prolongedperiod of time since it was found that the banana tree was susceptible to rotting. Local grasses had a slightly higher average DM comparing to the floating bed fodder ($P<0.05$) (Table 3) as local grasses were grown naturally in soil. DM of German grass that was produced in winter or dry season was higher. Among the FBF there were lower IVD in which fodder was grown and harvested during winter but was a higher IVD value in fodder which was harvested at rainy season (Table 1).

In silage, fodder was fermented and the cellulosic materials slightly breakdown through lactic acid producing bacteria and that makes fodder easily digestible [10]. The present study revealed that there was a positive correlation between IVD and DO of water ($r=0.746$) that had the floating bed i.e. the fodder sample from floating bed had a less IVD that had a low DO value. So, the fodder sample from FBS had highest IVD among the floating bed samples as it had a maximum DO value. The quality silage can be a good alternative for the storing fodder materials during the lean period to increase feed security for livestock. Proximate analysis study revealed that it had higher nutritional value than normal grasses. Molecular biology techniques can be carried out to identify the specific strain of *Lactobacillus* present in the silage in future research work. So, it can be used as a probiotic to convert low-quality forage materials into a nutrient rich one [11].

## Conclusion

Farmers of Kanaighat and Jaintapur were very much interested after watching the innovative technique of fodder production in floating bed. It was a completely new practice for them. As this technique didn't require any chemical fertilizers and construction required only locally available materials it was very much cost effective and easy to develop for the poor farmers. So, farmers can adopt floating bed for producing fodder even in the flooded period and silage during the lean period to preserve feeds as a tool for sustainable livestock production. Future research can be carried out on the influence of these floating bed fodders on growth and milk production performance in the ruminant.


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