Cost and Return Analysis for Irrigated Intensive Napier Grass cultivation in Sadar Upazila of Satkhira District

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1 April 2020

Contents

Acronyms and Abbreviations

AAS	Agricultural Advisory Society
CCB	Cash cost basis
DAE	Department of Agricultural Extension
DM	Dry Mater
FCB	Full cost basis
FGD	Focus Group Discussion
ha	hectare
IT	Information Technology
Kg	Kilogram
MS Excel	Microsoft Excel
SPSS	Statistical Package for Social Science
Tk.	Taka
Tk/ha	Taka/ hectare

Acknowledgement

Author expresses his gratefulness to the respondent farmer Sheikh Muzaffor Rahman for his generous support and help in providing useful data, information along with the attended farmer participants including Mr. Nazrul Islam, who first stated about cultivation of Napier grass at the Focus Group Discussion (FGD) at Indira village in Sadar Upazila of Satkhira District on 9 November 2019. Without their inputs support and follow-up feedbacks over cell phone discussions, was not so efficiently possible to this study successful.

For conducting the interview cum FGD for the study, I gratefully acknowledge the support for conducting interview cum FGD from Mr. Firoz Ahmed, Junior Officer, Lal Teer Seed Ltd., Satkhira and without his generous support this study was not very effectively accomplished.

I do specially acknowledge Mr. Mustafizur Rahman, Manager, Product Development Services, Lal Teer Seed Ltd. Khulna and Mr. Rezaul Karim, ITO, AAS for their generous support in relevant data and information collection from the farmers. Author would like to thanks all those who directly or indirectly helped in executing the study.

Author specially acknowledges to **Mr. Shahjahan Ali**, Seed Technologist and Seed Regulation Specialist for the great contribution in **editing** the report and his contribution is invaluable.

Author also grateful to Mr. Ibrahim Hossain of AAS for his great support in data entry, analysis, summary Table preparation and report preparation.

Executive Summary

Sustainable livestock production is highly dependent on the availability of quality feed and forage resources. Napier grass (***Pennisetum purpureum*** Schumach) is one of the most important tropical forage crops. Napier grass possesses many desirable characteristics, including high yielding, tolerance to intermittent drought and high water use efficiency. It was the ability to withstand repeated cutting and will rapidly regenerate, producing palatable leafy shoots. Napier grass is a monocot perennial C4 grass species native to sub-Saharan Africa from where it is believed to have been distributed to other tropical and sub-tropical regions around the world. To-day it is widely grown in tropical and sub-tropical regions of the world, for use predominantly as animal fodder. Propagation by stem cuttings is currently the dominant practice for cultivation all over the world. Napier grass is mainly used to feed livestock in cut and carrying systems. The yield of Napier grass mainly depends on the type of cultivar used which in turn is influenced by both the environment and management practices are used. Napier grass is ready for harvesting 3-4 months after planting and harvesting can continue at an interval of 6-8 weeks for 3-5 years or more.

Currently, Napier grass has been cultivating by the motivated farmers as commercial fodder crop for livestock all over the country to meet-up the livestock feed demand along with the commercial development of cattle farming. Similarly, motivated farmers in Satkhira Sadar Upazila have been cultivating Napier grass on commercial basis for more than a decade as a high value crop without any risk with available market for the grass throughout the year. Dissemination and scale-up of Napier grass as a profitable crop in Sadar Upazila of Satkhira District are taking place through farmer knowledge based and their initiative during last two decades.

Average gross-return was calculated Tk. 711,061/ha against the average total costs of Tk. 635,959/ha and Tk. 294,319/ha on full cost basis and cash cost basis, respectively for Napier grass cultivation as a first year crop. The average net-returns were calculated Tk.75,103/ha and Tk. 416,741/ha on full cost basis and cash cost basis, respectively for Napier grass cultivation. The higher benefit-cost ratio was calculated on cash cost basis (1:2.42) than full cost basis (1:1.12).

Among the involved eight cost items for Napier grass cultivation as first year crop, the highest proportion of cost of the total cost (Tk.635,959/ha) was calculated for labor used (49.14%) followed by organic and chemical fertilizer used (18-89%), land rent for one year (17.65%), interest on working capital used (8.26%) at the rate of 9% interest rate per annum, irrigation used (3.77%), land preparation cost (1.42%) and planting material used (0.88%).

Out of seven types of advices, the highest number of advices claimed from own or individual farmers (7) followed by other farmers (6), public extension, mainly livestock hospital, Department of Livestock Resource (3), agri-inputs dealers (2) and Private extension workers (1) for Napier grass introduction in Indira village for its production and marketing.

Background

Sustainable livestock production is highly dependent on the availability of quality feed and forges resource. Napier grass (***Pennisetum purpureum*** Schumach), also known as Elephant grass or Uganda grass, is one of the most important tropical forge crops. It is widely used in cut and carrying feeding systems and is of growing importance in other agricultural systems. Napier grass possesses many desirable characteristics, including high yield per unit area, tolerance to intermittent drought and high water use efficiency, making it forage of choice. It has the ability to withstand repeated cutting and will rapidly regenerate, producing palatable leafy shoots.

Napier grass is a monocotyledonous flowering plant belonging to the family Poaceae (the family of grass) and the genus ***Pennisetum***. Napier grass is a perennial C4 grass species native to **sub-Saharan Africa** from where it is believed to have been distributed to other tropical and sub-tropical regions around the world. It has been reported to be adapted to grow across a wide range of soil conditions and agro-ecologies, from sea level to 2100m and it can withstand minor dry spells, although it grows best in areas where the annual rainfall is between 750-2500 mm. Today it is widely grown in tropical and sub-tropical regions of the world, for use pre dominantly as animal fodder. Napier grass can be more commonly distributed by vegetative cuttings and tillers, since the grass cannot produce many seeds and through that are produced are normally very small, light, of poor quality and the spikelet's are prone to shattering. Consequently, the seeds are considered inappropriate for propagation as they produce week seedlings are also highly heterozygous. Therefore, propagation by stem cuttings is currently the dominant practice for the distribution of Napier grass propagates.

A range of grass species are used as fodder crops by farmers in Africa, Asia and other tropical/sub tropical regions of the world. Napier grass is mainly used as fodder to feed livestock in cut and carrying systems. It is a multipurpose forage crop that can be grazed directly or made into silage or hay and there have also been reports of using Napier grass, as fish feed and young shoots as Vegetable and many other uses.

Napier grass, with its perennial nature and fast growing characteristics, has been reported to produce a dry matter (DM) yield up to 78 tons/ha/annum (average 34-41 tons/ha). Napier grass cultivars have been reported to yield around 60 tonnes dry matter/ha/year, with some studies indicating significantly higher yields. The yield of Napier grass mainly depends on the type of cultivars used which in turn is influenced by both the environment and management practices employed.

It has low water and nutrient requirements and therefore can make use of otherwise uncultivated or marginal lands. The grass grows tall and forms large clumps like bamboo. Napier grass is ready for harvesting 3-4 months after planting / sowing and harvesting can continue at an interval of 6-8 weeks for 3-5 years or more. The current recommendation to feed Napier grass to cows at a highest from 60 to 100 cm (age, 6-10 weeks) does not take into account factors such as amount of rainfall which many influence yield and quality of grass. It has a very high productivity, both as a forage grass for livestock and as a bio-fuel crop. It is most susceptible to forest. Its deep root system allows it to survive in drought time. It provides good hay of cut at early stage. It is usually made into silage of high quality without additives.

Napier grass has been cultivating as a fodder crop for livestock in small scale by the farmers in the country for long time. Currently, Napier grass has been cultivating by the motivated farmers as commercial fodder crop for livestock all over the country to meet-up the livestock feed demand along with the commercial development of cattle farming. Similarly motivated farmers in

Satkhira Sadar Upazila has been cultivating Napier grass on commercial basis for more than a decade as a high value crop without any risk with the available market for the harvested grass throughout the year. Dissemination and scale-up of Napier grass as a profitable crop in Sadar Upazila of Satkhira District are taking place through farmers knowledge based and their own initiative during last two decades.

Purpose

High value Napier grass is grown in Sadar Upazila of Satkhira District by motivated progressive farmers, the latest information from progressive farmers on production, cost and return of Napier grass should be available for the benefit of extension personnel, specialist, project staff, policy makers, cattle farmers and relevant other users. Accordingly, Dr. Harun-Ar-Rashid, Executive Director, AAS undertook an initiative to collect the relevant primary data for cost and return analysis of Napier grass in Sadar Upazila of Satkhira District on 9 November 2019.

Study Location

The study conducted at Indira village under Agordari union in Sadar Upazila of Satkhira District on 9 November 2019. The primary field data was collected from Sheikh Muzaffor Rahman, a progressive farmer of Indira village at a focus group discussion (FGD) through validation with 10 farmers at a tea stall including a progressive farmer Md. Nazrul Islam, who first cultivated Napier grass in 2000 at Indira village. The study location (Satkhira District) is illustrated in Figure 1.

Data Collection, Analysis and Report Preparation

Primary data for cost and return analysis for Napier grass was collected by Dr. Harun-Ar-Rashid, Executive Director, AAS in collaboration with Mr. Firoz Ahmed, Junior Officer, Lal Teer Seed Ltd. and Mr. Rezaul Karim, ITO, AAS from the progressive farmer Sheikh Muzaffor Rahman using one page structure questionnaire developed by AAS. Thus, the relevant cost and return data were collected from a selected farmer along with 10 other farmers at a FGD. Collected data were finalized through validation with the rest 10 Napier growers (farmers) at the FGD. Collected data were cleaned for analysis and entered in MS Excel spread sheet and analysis was done using MS Excel and SPSS. Cleaned data were presented in Appendix.I.

Report summarizing cost and returns analysis for Napier grass interviewed a selected farmer (Sheikh Muzaffor Rahman) at a FGD with 10 other farmers through using the following data categories and definitions:

(a) Cost of production (Tk./ha) for Napier grass for first year of planting includes cost for land preparation, Labor, planting material, fertilizer (Organic & Chemical fertilizers), irrigation, land rent and interest on working capital. Total cost is calculated on full cost basis (FCB) and Cash cost basis (CCB) in taka per hectare. (I) Full cost includes: 1. Land Preparation 2. Labor (100 %), 3. Planting materials, 4. Organic fertilizer, 5. Chemical fertilizer, 6.Irrigation, 7. Land rent, 8. Interest on working capital. (II) Cash cost includes: 1. Land Preparation, 2. Labor (50 %), 3. Planting materials, 4. Chemical fertilizer , 5. Irrigation, 6. Interest on working capital.

(b) Gross return (Tk./ha) is calculated by valuing harvested Napier grass at the local market sale price.

(c) Net-return (Tk./ha) is calculated through subtracting the cost from the gross return on full cost and cash cost basis.

(d) Cost-benefit ratios are calculated through dividing the gross return by the total cost on full cost and cash cost basis.

(e) Crop production total cost (Tk./ha) is calculated from the respondent farmer on full cost basis and cash cost basis.

(f) Crop production total sale price (Tk./ha) is calculated as gross return from the respondent farmer.

Findings

I. Cost and Return of Napier grass

Table 1 presents the summary cost and return of Napier grass cultivation during 2019 cropping season as first year crop and Annex I provides item-wise summary cost and return of Napier grass cultivation as first year crop during 2019 cropping season in Sadar Upazila of Satkhira District. Average gross-return was calculated Tk. 711,061/ha counter to the average total cost of Tk. 635,959/ha and Tk.294,319/ha on full cost basis and cash cost basis, respectively, for Napier grass cultivation. The average net-returns were calculated Tk.75,103/ha and Tk.416,741/ha on full cost basis and cash cost basis, respectively for Napier grass cultivation. The higher benefit-cost ratio was calculated on cash cost basis (1:2.42) than full cost basis (1:1:12). About 116% higher average total cost was calculated for full cost basis (Tk.635,959/ha) than cash cost basis (Tk.294,319/ha) for Napier grass cultivation as a first year crop harvest. In contrast, about 455% higher average net-return was calculated for cash cost basis (Tk.416,741/ha) than full cost basis (Tk. 75,103/ha) for Napier grass cultivation as a first year crop harvest. Similarly, about 116% higher benefit-cost ratio was calculated on cash cost basis (1:2:42) than full cost basis (1:1:12) for Napier grass cultivation as a first year crop harvest.

Table.1: Summary cost and returns analysis of Napier Grass cultivation during 2019 cropping season as first year crop in Satkhira District

Item	**Average Cost / Return (Tk/ha)**
Gross / Return (Tk/ha)	711,061
Total Cost (Tk/ha)	
(i) Full cost basis	635,959
(ii) Cash cost basis	294,319
Net- Return (Tk/ha)	
(i) Full cost basis	75,103
(ii) Cash cost basis	416,741
Benefit-Cost Ratio	
(i) Full cost basis	1.12
(ii) Cash cost basis	2.42

A. Cash cost basis: 1. Land Preparation, 2. Labor (50 %), 3. Planting materials, 4. Chemical fertilizer 4. Irrigation, 5. Interest on working capital

B. Full cost basis: 1. Land Preparation 2. Labor (100 %), 3.Planting materials, 4. Organic fertilizer, 5. Chemical fertilizer, 6.Irrigation, 7. Land rent, 8. Interest on working capital

II. Proportion of cost item

Table 2 presents item-wise cost proportion of the total cost (Tk.635,959/ha) on full cost basis for Napier grass cultivation as first year crop in Sadar Upazila of Satkhira District during 2019 cropping season. Among the involved eight cost items for Napier grass cultivation as first year crop, the highest proportion of cost of the total cost (Tk.635,959/ha) was calculated for labor used (49.14%) followed in order by organic and chemical fertilizers used (18.89%), land rent in for one year (17.65%), interest on working capital used (8.26%) at the 9% interest rate per annum, irrigation used (3.77%), land preparation cost (1.42%) and planting material used (0.88%). Total of 18.89% fertilizers cost calculated on the total cost (Tk.635,959/ha) for Napier grass cultivation as first year crop, of which higher proportion of cost calculated for chemical fertilizer (11.83%) than organic fertilizer (7.06%) used from his own available source.

Table.2: Item-wise cost proportion of the total cost on full cost basis for Napier Grass cultivation as first year crop in Satkhira District during 2019 cropping season.

SL #	Cost Items	Amount (Tk./ha)[1/]	%
1	Land Preparation	8,982	1.42
2	Labor use (all)	312,492	49.14
3	Planting material	5,614	0.88
4	Organic fertilizer	44,909	7.06
5	Chemical fertilizer	75,223	11.83
* Fertilizer cost sub- total (4 +5)		120,132	18.89
6	Irrigation	23,952	3.77
7	Land rent	112,273	17.65
8	Interest on working capital ((FCB)	52,514	8.26
Total Cost		635,959	100

[1/] = First year cultivation cost

III. Agricultural advice for Napier grass

Table 3 provides sources of agricultural advice, type of advices and their ranking for introduction, production practices and marketing of Napier grass in Sadar Upazila of Satkhira District. Of the total five sources of agricultural advices, of which the highest number of items for advice claimed for own or individual farmer (7) followed by other farmers (6), public extension workers mainly livestock hospital, Department of Livestock Services (DLS) (3), agri-inputs dealers (2) and private extension workers (1) for Napier grass introduction in Indira village, its production and marketing.

Among the seven items for advices with five sources of agricultural advices, the highest ranking of score was observed for introduction of Napier grass/planting material management (10) followed by fertilizer management/irrigation management/intercultural operation/marketing (7) and plant health management for Napier grass (5).

In introduction of Napier grass in Indira village in Sadar Upazila of Satkhira District, participants of the FGD unanimously claimed for public extension, mainly Livestock Hospital, Department of Livestock Services (DLS) with rank 5 and own or individual farmer with rank 5. Participants of the FGD unanimously claimed for public extension, mainly livestock hospital, Department of Livestock Resource with rank 5, other farmers with rank 5 and own or individual farmer with ranks 5 for planting material management of Napier grass cultivation. Respondents of the FGD unanimously claimed for agri-inputs dealers with rank 1, other farmers with rank 1 and own or individual farmer with rank 5 for fertilizer management of Napier grass cultivation. Participants of the FGD unanimously claimed for public extension workers from DAE (Department of Agricultural Extension) with rank 1, private extension worker with rank 1, agri-inputs dealers with rank 1, other farmers with rank 1 and own or individual farmer with rank 1 for plant health management of Napier grass cultivation. Respondents of the FGD unanimously claimed for other farmers with rank 2 and own or individual farmer with rank 1 for irrigation management for Napier grass cultivation. Participants of the FGD unanimously claimed for other farmers with rank 2 and own or individual farmer with rank 5 for intercultural operation for Napier grass cultivation. Respondents of the FGD unanimously claimed for other farmers with rank 2 and own or individual farmer with rank 5 for marketing of harvested Napier grass.

Table.3: Sources of agricultural advices, type of advices and their ranking (0-5 scale) for Napier grass

SL #	Item for advice	Sources of agricultural advices and Ranking[1/]					
		Public Extension workers	Private Extension workers	Agri-Inputs dealers	Other farmers	Own	Total
1	Introduction of Napier grass	5[2/]	0	0	0	5[3/]	10
2	Planting material management	5[2/]	0	0	5	5	10
3	Fertilizer management	0	0	1	1	5	7
4	Plant health management	1	1	1	1	1	5
5	Irrigation management	0	0	0	2	5	7
6	Intercultural operation	0	0	0	2	5	7
7	Marketing	0	0	0	2	5	7
Total of item for advice		**3**	**1**	**2**	**6**	**7**	**-**
%		**43**	**14**	**29**	**86**	**100**	**-**

[1/] Ranking (0-5 scale): 0 = No service, 1 = Very low service, 2 = Low service, 3 = Medium service, 4 = High service, 5 = Very high service

[2/] Livestock Hospital, Department of Livestock Services (DLS)

[3/] Md. Nazrul Islam, a progressive farmer at Indira village

Conclusion and Recommendation

Conclusion

1. When a farmer uses own family labor, own organic fertilizer and own land and expending for all other costs (Tk. 166,285 /ha) for Napier grass cultivation and then the farmer can earn Tk. 547,776/ha (Tk.72,00/Bigha) net profit from the achieved Gross return (Tk.711,061/ha/annum).

2. When a farmer uses own land, own organic fertilizer and 50% family labor along with expending for all other costs (Tk.322,531/ha) for Napier grass cultivation and then the farmer can earn Tk.388,530/ha (Tk.52,000/Bigha) net profit from the calculated gross return (Tk.711,061/ha/annum).

3. When a farmer hired all labor, rented land and purchased organic fertilizer along with expending for all other costs (Tk.635,959/ha) for Napier grass cultivation and then the farmer can earn Tk.75,000/ha (Tk.10,000/Bigha) net profit from the achieved gross return (Tk.711,061/ha/annum).

Accordingly, Napier grass cultivations found as a high value fodder crop through year around harvesting without any risk, particularly on cash cost basis.

Recommendation

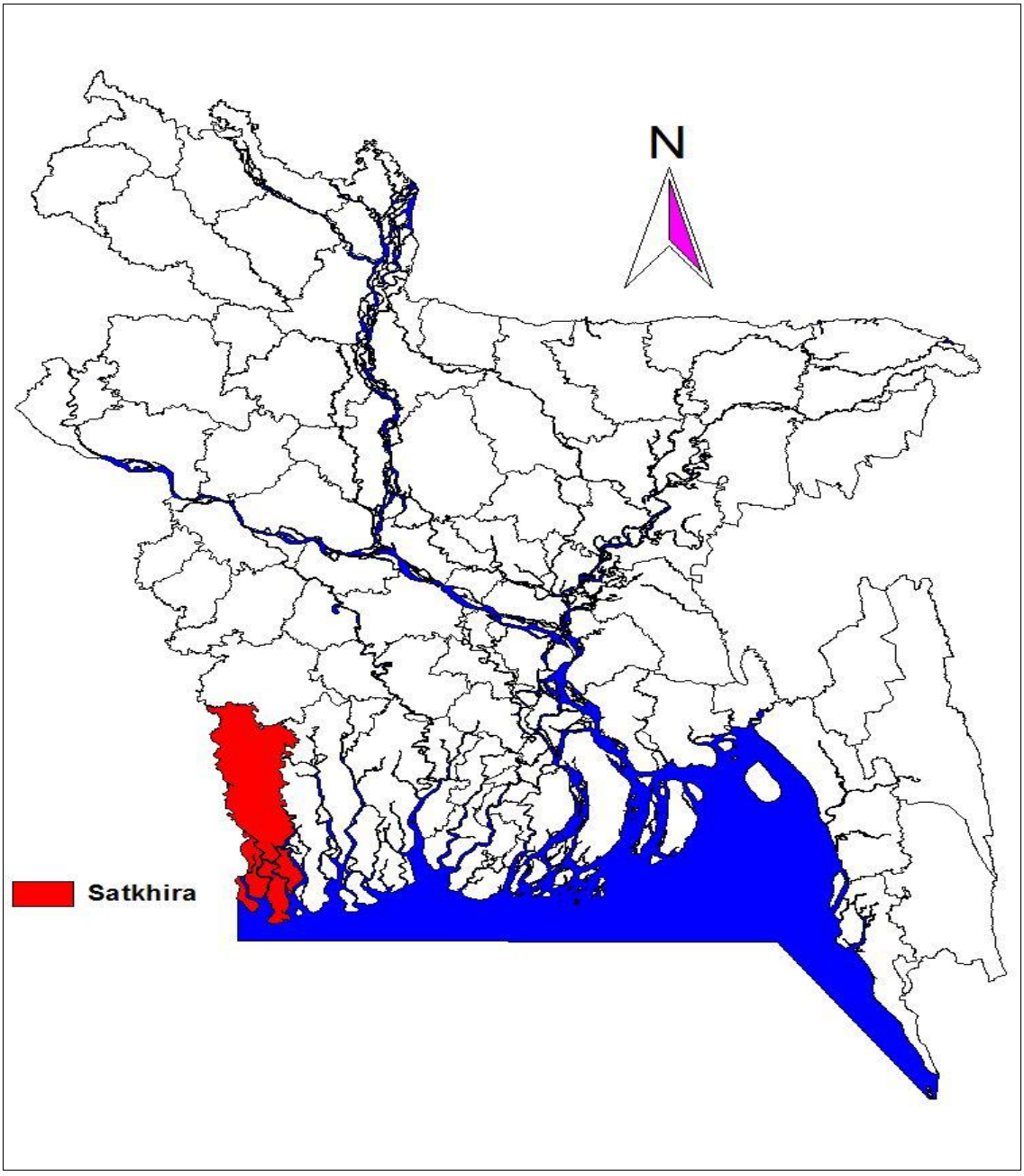
1. Napier grass as a high value fodder crop need to be disseminated in large scale on commercial basis along with commercial cattle farming in the flood free areas all over the country.

2. To achieve the higher yield per unit area, high yielding Napier grass varieties need to be introduced among the motivated farmers all over the country.

3. Innovative cultural practices on Napier grass cultivation from the progressive Napier grass farmers need to be documented for their large scale dissemination among the motivated farmers for Napier grass cultivation across the country.

4. Farmers' need to train on modern technologies and motivate on how to make small scale silage from surplus Napier grass harvest from the production fields.

Figure.1: Location Map of Satkhira District



Annex.I: Item-wise summary cost and return analysis of Napier Grass cultivation as first year crop during 2019 cropping season in Satkhira District

SL #	Item	Average Cost-return (Tk/ha)
A. Cost		
1	Land Preparation	8,982
2	Labor use	312,492
3	Planting material	5,614
4	Fertilizer	120,132
5	Irrigation	23,952
6	Land rent	112,273
7	Cost	
	a) Full cost basis (1-6)	583,444
	b) Cash cost basis (1,2,4,5)	270,106
8	Interest on working capital	
	a) Full cost basis (9%)	52,514
	b) Cash cost basis (9%)	24,303
9	Total Cost (7+8)	
	a) Full cost basis	635,959
	b) Cash cost basis	294,319
B. Gross return & net return		
	Gross return	
	a) Main product (Grass)	711,061
	Net-return	
	a) Full cost basis	75,103
	b) Cash cost basis	416,741
C. Benefit-Cost Ratio		
	a) Full cost basis	1.12
	b) Cash cost basis	2.42

A. Cash cost basis: 1. Land Preparation, 2. Labor (50 %), 3. Planting materials, 4. Chemical fertilizer 4. Irrigation, 5. Interest on working capital

B. Full cost basis: 1. Land Preparation 2. Labor (100 %), 3.Planting materials, 4. Organic fertilizer, 5. Chemical fertilizer, 6.Irrigation, 7. Land rent, 8. Interest on working capital

Appendix I: Cost and Return for Napier Grass cultivation

Farmer Name: Sheikh Muzaffor Rahman Father Name: Sheikh Abdul Motaleb Village: Indira

Union: Agordari Upazila: Sadar District: Satkhira Crop: Napier Grass: Cell: 01785021358

SL #	Item	Quantity/ Bigha	Price (Tk.)	Cost-Income (Tk./Bigha)	Cost-Income (Tk./ha)
A. Cost					
1	Land Preparation (1st year)	4 Plowings	-	1,200	8,982
2	Labor use (all) (No.) (1st year)	167	250[1/]	41,750	312,492
3	Planting materials use (1st year)	-	-	750	5,614
4	Fertilizer use				
	(i) Organic fertilizer:				
	(a) Cowdung / Compost	10 Trolleys	600	6,000	44,909
	(ii) Chemical fertilizer				
	(b) Urea (kg)	210	16	3,360	25,149
	(c) TSP (kg)	210	26	5,460	40,867
	(d) MOP (kg)	50	15	750	5,614
	(e) Gypsum (kg)	80	6	480	3,593
	Total Chemical fertilizer cost (b-e)			10,050	75,223
	Total fertilizer cost (i+ii)			16,050	120,132
5	Irrigation	8 times	400	3,200	23,952
6	Land Rent (1 Yr.)			15,000	112,273
7	Total Cost				
	(a) Full cost basis (1-6)			77,950	583,444
	(b) Cash cost basis (1,2,4,5)			36,075	270,106
8	Interest on working capital				
	(a) Full cost basis (9%)			7,016	52,514
	(b) Cash cost basis (9%)			3,247	24,303
9	Total Cost (7+8)				
	(a) Full cost basis			84,966	635,959
	(b) Cash cost basis			39,322	294,319
B. Gross return & net return					
	Gross return				
	(a) Main product (Grass)			95,000	711,061
	Net return				
	(a) Full cost basis			10,034	75,103
	(b) Cash cost basis			55,678	416,741
C. Benefit-Cost Ratio					
	(a) Full cost basis			1.12	1.12
	(b) Cash cost basis			2.42	2.42

[1/] **1 Man day = 5 hrs**

A. Cash cost basis: 1. Land Preparation, 2. Labor (50 %), 3. Planting materials, 4. Chemical fertilizer 5. Irrigation, 6. Interest on working capital

B. Full cost basis: 1. Land Preparation 2. Labor (100 %), 3.Planting materials, 4. Organic fertilizer, 5. Chemical fertilizer, 6.Irrigation, 7. Land rent, 8. Interest on working capital