COMPARATIVE FINANCIAL ANALYSIS AND RESOURCE USE EFFICIECY OF HIGH YIELDING RICE VARIETIES (HYV's) AND LOCAL RICE VARIETIES OF TRANSPLANT AMAN (T.AMAN) IN SOME SELECTED AREAS OF NARAIL DISTRICT.

PARTHA PROTIM ROY

DEPARTMENT OF AGRICULTURAL ECONOMICS
SHER-E-BANGLA AGRICULTURAL UNIVERSITY
DHAKA-1207

June, 2020

COMPARATIVE FINANCIAL ANALYSIS AND RESOURCE USE EFFICIECY OF HIGH YIELDING RICE VARIETIES (HYV's) AND LOCAL RICE VARIETIES OF TRANSPLANT AMAN (T.AMAN) IN SOME SELECTED AREAS OF NARAIL DISTRICT.

BY

PARTHA PROTIM ROY

REGISTRATION NO. 13-05670

A Thesis

Submitted to the Faculty of Agribusiness Management,

Sher-e-Bangla Agricultural University, Dhaka

in partial fulfillment of the requirements

for the degree of

MASTER OF SCIENCE

IN

AGRICULTURAL ECONOMICS

SEMESTER: JULY-DECEMBER, 2019

Approved by:

(Professor Gazi M. A. Jalil)
Professor
Supervisor

(Dr. B.A.A Mustafi)
Former Director (Admin) BRRI
Co-Supervisor

(Professor Gazi M. A. Jalil)
Chairman
Department of Agricultural Economics

Professor Gazi M. A. Jalil
Professor
Department of Agricultural Economics
Sher-E-Bangla Agricultural University
Dhaka-1207, Bangladesh
Mob: +8801552321883
E-mail: gmajalil@gmail.com

CERTIFICATE

*This is to certify that thesis entitled, "**COMPARATIVE FINANCIAL ANALYSIS AND RESOURCE USE EFFICIECY OF HIGH YIELDING RICE VARIETIES (HYV's) AND LOCAL RICE VARIETIES OF TRANSPLANT AMAN (T.AMAN) IN SOME SELECTED AREAS OF NARAIL DISTRICT."** submitted to the Faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE in AGRICULTURAL ECONOMICS**, embodies the result of a piece of bona fide research work carried out by PARTHA PROTIM ROY, Registration No. 13-05670 under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.

Dated:

Place: Dhaka Bangladesh

Professor Gazi M. A. Jalil
Professor
Supervisor


DEDICATED
TO ALL
CORONA
WARRIORS

ACKNOWLEDGEMENT

At first, I would like to acknowledge the elegance, mercy and profound kindness of "Lord Krishna" for helping me to materialize this thesis paper. Without his intention it was impossible to perform my thesis work.

I am grateful to honorable chairman and supervisor Professor Gazi M. A. Jalil, Department of Agricultural Economics, Sher-e-Bangla Agricultural University, Dhaka, for his scholastic inspection, helpful explanation, valuable suggestions and constant encouragement from the very beginning to the end of this research work. In spite of having heavy academic pressure, he made himself available whenever I needed his help and suggestions.

My heartfelt liability to my Co-supervisor Dr. B.A.A Mustafi, Former Director (Admin) BRRI, for his kind co-operation and bountiful help in completing this study. His constant encouragement and valuable suggestions helped me much for completing this thesis timely.

I would like to express my heartiest thanks to the farmers whose kind co-operation, patience and valuable information helped me so much during the period of data collection.

I am really proud and exultant for my father and mother for their unbiased affections and for numerous sacrifices they have made for my study.

Last but not the least, my heartiest thanks to my beloved sister, wife and friends for their never ending inspiration throughout the research period.

July, 2020 ***The Author***

SAU, Dhaka

ABSTRACT

Rice cultivation is one of the oldest agricultural practices for farmers of Narail district. Transplant and Broadcast both Aman rice are popular for farming here. Some local varieties are so popular that they restrict the popularity of modern Aman rice. By this thesis work we were trying to find out the financial comparison of this two types of Aman rice. This study was conducted during December, 2019. In Narail district there are three upazilas: Narail Sadar upazila, Kalia upazila and Lohagara upazila. The total sample sizes from three upazilas were 60 T. Aman rice cultivators. The number of sample from each upazila was 20 rice cultivators. A simple random sampling procedure was used to select the farmers who cultivate T. Aman rice in this area for collecting the data. In this study, both descriptive and statistical tools were used to analyze the data. The profitability of local and HYV T.Aman cultivation was estimated by using gross margin, net return, and benefit cost analysis. Cob-Douglas production function analysis was used to estimate the significance level of inputs. Then resource use efficiency was calculated in this research. The research found that young energetic farmers were interested in HYV's cultivation. But the experienced farmers were interested in local varieties cultivation. For local T.Aman varieties gross margin was calculated taka 33508.73 per hectare and for HYV T.Aman varieties gross margin was calculated taka 67304.38 per hectare. Gross margin of HYV's was calculated 33795.65 taka more than local T.Aman. On the other hand for local T.Aman net return was calculated taka 18092.77 per hectare and for HYV T.Aman varieties net return was calculated taka 36150.54 per hectare. The net return of HYV's was calculated 18057.77 taka higher than local T.Aman. Benefit cost ratio for local T.Aman full cost and variable cost basis were calculated 1.56 and 2.98 which were greater than the HYV T.Aman 1.49 and 2.59. The thesis found producing local varieties was profitable here. The effect of land preparation cost, seedling cost and TSP cost were significant for local T.Aman rice. Other taken variables had insignificant effect on local T.Aman rice. Human labor cost, seedling cost, manure cost and supplementary irrigation cost had significant effect on gross return of HYV T,Aman rice. It was found from resource use efficiency that human labor, seeds, manure and pesticides were over utilized in local T.Aman. Farmars should reduce use of these inputs. Land preparation, Urea, TSP, DAP, Gypsum, $ZnSO_4$ and Irrigation were underutilized and

farmers should increase use of this inputs to obtain efficiency. On the other hand Seeds, TSP, MOP, Gypsum and $ZnSO_4$ were over utilized in HYV T.Aman. Farmars should reduce use of these inputs. Human labor, Land preparation, Urea, SSP, DAP, Manure, Pesticides and irrigation were underutilized and farmers should increase use of this inputs to obtain efficiency. The problems of cultivating T.Aman were high input price, insufficient credit facilities/ lack of capital, shortage of agricultural labor, high wage rate, poor agronomic practice, lack of scientific knowledge and training, attack by pests and diseases, inadequate and underdeveloped market, lack of storage facilities, natural disaster etc. Government, non-government organizations and other organs of agricultural sectors should take necessary actions to overcome these problems.

CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS (Contd.)

TABLE OF CONTENTS (Contd.)

LIST OF TABLES

LIST OF FIGURE

LIST OF APPENDIX

LIST OF ABBREVIATED TABLE

$	Dollar
%	Percentage
<	Less Than
>	Greater Than
BCR	Benefit Cost Ratio
BBS	Bangladesh Bureau of Statistics
BINA	Bangladesh Institute of Nuclear Agriculture
BRAC	Bangladesh Rural Advancement Committee
BRRI	Bangladesh Rice Research Institute
Cm	Centimeter
Contd.	Continued
EC	Emulsifiable concentrate
et al.	et alia (for others)
etc.	et cetra
EU	European Union
GDP	Gross Domestic Product
MLE	Maximum likelihood estimation
MS	Master of Science
MVP	Marginal Value Product
MFC	Marginal Factor Cost
N/ha	Nitrogen per hectare
NGO	Non-Government Organization
SAU	Sher-e-Bangla Agricultural University
SPSS	Statistical Package for the Social Sciences
Tk	Taka, Bangladeshi currency
USA	United States of America
USG	Urea Super Granule
Π	Profit per hectare

CHAPTER I

INTRODUCTION

CHAPTER I
INTRODUCTION

1.1 Background

Bangladesh is agriculture based country. In this country about 63 percent people are employed in agriculture and 19.6% GDP of the nation comes from agriculture. (Nations Encyclopedia, 2019) The majority of rural poor people depend on agricultural practice. The livelihood of this major portion of population is directly and indirectly engaged and fluctuates with agriculture. Agriculture is the part and parcel of Bangladeshi tradition, culture and customs. The land of Bangladesh is very much congenial and fertile for producing different types of cash and food crops. The rain fed river siltation of the land makes it beneficial for producing crops here. Rice is the major food crop and staple food of about 135 million people of Bangladesh. It provides nearly 48 percent of rural employment, about two-third of total calorie supply and about one half of the total protein intake of an average person in the country. Rice sector contributes one half of the agricultural GDP and one sixth of the national income in Bangladesh. (Bangladesh Rice Knowledge Bank)

Rice is the seed of the grass species *Oryza glaberrima* (African rice) or *Oryza sativa* (Asian rice). As a cereal grain, it is the most widely consumed staple food for a large part of the world's human population, especially in Asia and Africa. Rice is a monocot plant. It is normally grown as an annual plant but in tropical areas it can survive as a perennial and can produce as ratoon crop for up to 30 years. Rice cultivation is well-suited to countries and regions with low labor costs and high rainfall, as it is labor-intensive to cultivate and requires ample water. However, rice can be grown practically anywhere, even on a steep hill or mountain area with the use of water-controlling terrace systems. The climatic condition of Bangladesh is very much helpful for rice production.

There are three main production seasons of rice named – Aus, Aman and Boro. In Bangladesh, summer, monsoon and winter rice are named after this three rice production seasons. Rice sown in summer along with pre monsoonal rains and harvested in autumn are called as Aus rice. They are mainly rice of summer. Rice sown in rainy season (July -

August) and harvested in winter is called Aman rice. There are also two types of Aman depending on cultural operation. They are transplant Aman and broadcast Aman. Transplant Aman is named because its seedlings are grown in seedbed then transplanted to the main land after land preparation. But broadcast Aman is directly sown in the main land. Boro rice is sown in winter and harvested in summer. If we distribute the months of a year in this three season of rice production seasons then they are like: Aus (May to July), Aman (August to November) and Boro (December to April).

Table 1.1 Varieties of Aman cultivated in Narail district.

Hybrid	HYV	Local
Hira	BR-10	Jabra
Dhani Gold	BR-11	Machranga
Tez	BR-22	Gocha
Shonar Bangla	BRRI Dhan-28	Monohar
S L-8	BRRI Dhan-30	Digha
Shathi	BRRI Dhan-33	Dhapo
BADC-2	BRRI Dhan-34	Cini Gura
Agro-12	BRRI Dhan-39	Kalojira
Mukti-01	BRRI Dhan-40	Najir sail
AZ-7006	BRRI Dhan-49	Shishumoti
Shompod	BRRI Dhan-51	Khirkon
Syngenta-1203	BRRI Dhan-52	Gourkajol
ACI-01	BRRI Dhan-56	Irivojon
Jholok	BRRI Dhan-62	Lakshmi Kajol
Chomok	BRRI Dhan-72	
	BINA Dhan-7	
	BINA Dhan-11	
	Horidhan	
	Ronojit	
	Swarna	

Source: Department of Agricultural Extension (2018-2019)

From the table 1.1 we found that different local varieties along with HYV Aman varieties were grown in Narail district. Rice has a wide range of uses all over the world. People use it as main source of calories. Boiled rice is directly consumed with curry in Bangladesh and other Asian countries. Cira, Muri, Khoi are popular food item of rice consumed in Bangladesh.

"Fish and rice make a Bangali", it is a very common maxim for Bangladesh as the people cannot think about their meal without rich. Rice has different food values-

Table 1.2 Nutrient content of Rice per 100 g portion

Nutrient	Amount	Minerals	Amount	Vitamins	Amount
Water (g)	12	Calcium (mg)	28	Vitamin C (mg)	0
Energy (kJ)	1,528	Iron (mg)	0.8	Thiamin (B1) (mg)	0.07
Protein (g)	7.1	Magnesium (mg)	25	Niacin (B3) (mg)	1.6
Fat (g)	0.66	Phosphorus (mg)	115	Vitamin B6 (mg)	0.16
Carbohydrates (g)	80	Potassium (mg)	115	Vitamin A (IU)	0
Fiber (g)	1.3	Sodium (mg)	5	**Fats**	
Sugar (g)	0.12	Zinc (mg)	1.09	Saturated fatty acids (g)	0.18
		Manganese (mg)	1.09	Monounsaturated fatty acids (g)	0.21
		Selenium (µg)	15.1	Polyunsaturated fatty acids (g)	0.18

Source: "Nutrient data laboratory". United States Department of Agriculture. Retrieved August 10, 2016.

For Bangladeshi farmers, producing rice is a very old profession. Farmers associated with rice production needs assistance from other organs of nation like government and non-government organizations. Research organizations like BRRI, BARI, BINA etc. are providing assistance through their improvement of different high yielding varieties of rice day by day. BADC provides direct training and seed support to the farmers. Officers of

Ministry of Agriculture, department of Agricultural Extension (DAE) are providing physical support to farmers for better production of this rice crops. NGO's like Asha, BRAC, proshika ets are also providing support to farmers.

The production of Aman rice is increasing year to year in Bangladesh. The increasing production scenario of Aman rice is given below here.

Table 1.3 Production of Aman Rice in Bangladesh for last few years

Variety	2014-2015 Production (M.tons)	2015-2016 Production (M.tons)	2016-2017 Production (M.tons)	2017-2018 Production (M.tons)
Broadcast Aman	384411	392331	3,96,272	442201
Local Transplant	1917882	1851163	1820241	1340511
High Yielding Variety (HYV)	10887870	11239943	11439541	12210162
Total Aman	13190163	13483437	13656054	13992874

Source: Yearbooks of agricultural statistics

1.2 History of Rice Cultivation in Bangladesh

In the history of rice cultivation, around 10,000-14,000 years ago, Oryza sativa was first grown from the wild grass *Oryza rufipogon*. Indica (prevalent in tropical regions) and japonica (prevalent in the subtropical and temperate regions of East Asia) were considered as two main subspecies of rice. In West Africa, another cultivated species, *O. glaberrima*, was popular much later. Based on recent genetic evidence all forms of Asian rice including indica and japonica come from a single domestication event around 8,200–13,500 years ago in the Pearl River valley region of China. (Ricepedia, 2019)

In China, archeologists point out that the middle Yangtze and upper Huai rivers were the two ensuing places in the country for *O. sativa* cultivation. Evidence proves that Rice and

farming ingredients were found at least 8,000 years back. Over the 2,000 years, cultivation spread down following these rivers. (Ricepedia, 2019)

At first, soil is paddled to turn into mud and then it is broken to prevent too much water percolating away then the seedlings are transplanted. These are the undivided parts of rice farming. This process was firstly practiced in China. Through the evolution of the two process- paddling and transplanting have also popularized and developed.

Rice was the leading crop in Sri-Lanka nearly 1000 B.C. The crop may have been well circulated to Greece and adjacent areas of Mediterranean. It took place around 344-324 B.C by revolving members of Alexander the Great's expedition to India. In all respects rice spread consecutively Southern Europe and to a few positions in Northern Africa from a center in Greece and Sicily. (Ricepedia, 2019)

New lands to the west became available for suction because of Europe's Great Age of Exploration. The early European settlers initiated rice farming to the new world. At first, the Portuguese paddled it to Brazil and the Spanish inaugurated rice cultivation to several places in Central and South America. In 1685 North America firstly records to propagate corn on the costal lowlands and islands named South Carolina at present. It is imagined in the mid-18th century that the transported slaves to the Carolinas from West Africa induced the complicated agricultural technology needed to fructify rice. Then a ascending rice industry was assured by their labor. After that the cultivators revealed rice in California's Sacramento Valley in 20th century. With the timing of the first successful crop in Australia's New South Wales, the introduction into California assembled almost exactly. (Ricepedia, 2019)

Archeological evidence shows that rice was grown first in the region of the Yangtze River valley in China. Based on morphological studies of rice phytoliths from the Diaotonghuan archaeological site it is clearly found that the transmigration of wild rice to the cultivation of domesticated rice. In the history of rice cultivation, about 12,000–

11,000 BP wild rice collection was an important part of their livelihood. By the time from 10000-8000 BP through the morphological transformation of Diaotonghuan phytoliths rice had been domesticated. Then the two major subspecies of rice indica and japonica rice were being cultivated in Central China. Rice farming into mainland of Southeast Asia and Westwards across India and Nepal was quickly spread in the late 3rd millennium BC. (Ricepedia, 2019)

In 2003, Korean archaeologists demanded that they had brought to light the world's ancient rice species. They disagreed with the accepted view that rice cultivation was originated in China about 12,000 years ago. These findings were accepted by academia with potential skepticism. The results and their publicizing has been excerpted as a combination of nationalist and regional interests. In 2011, the Stanford University, New York University, Washington University in St. Louis, and Purdue University claimed that in the Yangtze Valley of China yet that there was only one single origin of cultivated rice. (Ricepedia, 2019)

In 7000-6000 BC, the earliest remnants of the corn in the Indian subcontinent have been found in Indo Gangetic plain. But around 3000-2500 BC the earliest extensively accepted date for cultivated rice is placed with findings in regions associating to the Indus Valley Civilization. In Assam and Nepal, perennial wild subspecies of rice are still cultivated. At first it was grown in the northern parts then it was farmed in southern India around 1400 BC. After that it was spread to all the prolific plains watered by rivers. Southern Europe considered rice as a hearty corn and so the cultivation and cooking methods are quickly expanded to the west by medieval times. (Ricepedia, 2019)

Today, China, India, Indonesia, Pakistan, Bangladesh, Vietnam, Thailand, Myanmar, Philippines, and Japan provided the majority of all rice production. Asian farmers still contribute 92% of the world's total rice production. (FAO, 2019)

1.3 Objectives of the Research work:

i) To investigate the demographic profile of T.aman rice farmers.

ii) To estimate the profitability of HYV T.Aman and local T.Aman rice varieties and compare the results.

iii) To examine the resource use efficiency of HYV T.Aman and local T.Aman rice varieties and compare with one another.

iv) To identify the production problems and constrains associated with production of HYV T.Aman and local T.Aman rice varieties.

1.4 Justification of the Study

The districts of Khulna division have come forward in rice production because of modern rice varieties and modern technology application. Previously people of Narail district were very much dependent on primitive technology for rice production. It has not been fully abolishing in the present time also. Some very poor farmers are practicing the local varieties cultivation using the primitive technologies.

The land of Narail district is very low. In the rainy season most of the lands goes under 2-4 feet of water. The climatic and land condition of this area favor for the local Aman production. That's why farmers are not interested in HYV Aman rice cultivation. This study was conducted to know the economic reasons behind this situation. For this purpose, study was conducted in this area.

There were many local varieties of T.Aman in Narail district. Beside this people are practicing modern varieties cultivation now a day. Main local T.aman varieties cultivated in this area are Dighe, Jabra, Monohor, Ratol, Moiskandi, Dhapo etc. and main modern T.aman varieties were BR-10, BR-11, BR-22, BRRI Dhan-28, BRRI-33, BRRI-39, BRRI-49, BRRI-62, BRRI-72, BINA-7, BINA -11 etc..

The research would add new knowledge in the field of T.Aman rice cultivation in this area and build a foundation for further research. As no such study was conducted in this area previously, the ideas about the profitability level of HYV and local T.Aman rice

varieties and comparison of the results would help farmers to take production decisions in Aman season.

The comparative input use information for both local and HYV T.Aman had generated from the work. This information would help the producers and policy makers to take their decision.

Findings of demographic characteristics of farmers would help to know about the social status of the T.Aman rice cultivators in this selected area. The study might provide valuable information for the policy makers of Government and Non-Government Organizations to formulate policy in order to improve socio-economic position of the T.Aman rice cultivators.

This study might search information about resource use efficiency of local and hybrid T.Aman. That would help farmers to increase production efficiency of Aman rice. Besides this study might provide ideas about the potential factors that effects on Aman rice cultivation.

At last this study might provide ideas about the production problems and constraints associated with production of modern and local T.Aman rice varieties.

CHAPTER II
REVIEW OF LITERATURE

CHAPTER II
REVIEW OF LITERATURE

Review of literature in any research is essential because it provides a scope for reviewing the stock of knowledge and information relevant to the proposed research. But there is little information regarding knowledge and information relevant to the present research. Literature and research of the major past works in connection with the present study were searched because this knowledge and information provide guideline in designing the future research problem and validation of the new findings. Some studies relating to T.Aman rice are reviewed here.

Islam (2001) studied on economic potential of Bina-6 rice production in Mymensingh district with a sample of 55 farmers considering Cobb-Douglas production function and found that BINA-6 rice production was profitable because the total return was much higher than total cost of production.

Anik (2003) studied on economic and financial profitability of aromatic and fine rice production in Dinajpur and Sherpur district with a sample of 100 farmersand found that aromatic rice was more profitable than fine rice as the net return was higher than fine rice.

Shamsuddula (2004) studied on comparative economics of local Boro and Hybrid rice production in terms of profitability and efficiency in Mymensingh district with 160 samples of rice developing farmers and found that net return from Hybrid rice was much higher than local boro rice.

Siddiqui (2008) studied on economic profitability of BRRI Dhan33 and BR-11 rice production in Kurigram district with 60 farmers and found that gross return for BRRI Dhan33 was higher than BR-11.

Ullah (2008) studied on comparative profitability and technical efficiency of aromatic and non-aromatic aman rice production in Dinajpur district with a sample of 60 farmers using stochastic frontier analysis and found that profitability of BRRI Dhan 34 (aromatic) was much higher than BR-11 rice (non-aromatic) as the total return from BRRI Dhan 34 was higher than BR-11.

Hanifa (2009) studied on economic analysis of BR-29 and Hybrid Hira rice production in Netrokona district with a sample of 80 farmers and found that total returns from Hybrid Hira rice per hectare was higher than BR-29

Kana (2011) studied on economic analysis of salt tolerant Binadhan-8 and HYV BRRI Dhan28 rice production in Satkhira district with a sample of 60 respondents and found that total return of Binadhan-8 was greater than total return of BR-28.

Akter (2011) studied on profitability and resource use efficiency of BRRI Dhan29 in old Brahmaputra floodplain area of Tangail district with a sample of 60 farmers using Cobb-Douglas production function and found that total return of BRRI Dhan29 was higher than total cost.

Kamruzzaman (2011) studied on economic potential of BRRI Dhan-51 and BR-11 rice production in Rangpur district with a sample of 60 farmers considering Cobb Douglas production function and found that BRRI Dhan-51 had higher gross return than BR-11.

Banu (2011) studied on economic analysis of BR-28, BR-29 and Hybrid Hira rice production in Kurigram district with a sample of 90 farmers considering Cobb-Douglas production function and found that Hybrid Hira was more profitable than BR-28 and BR-29 rice as the net return was much higher than BR-28 and BR-29.

Shelley et al. (2016) had performed a study on Rice Cultivation in Bangladesh: Present Scenario, Problems, and Prospects. In conclusion they found although Bangladesh is self-sufficient in rice production, yield is low. Bangladesh has the potential to boost rice production and export, which can contribute to the national economy. Targeted breeding

was essential to accommodate the diverse environments of Bangladesh. The development of more high-yielding, early-maturing, drought-resistant, salt-tolerant, disease-resistant, submergence-resistant, cold-tolerant, high-temperature-tolerant, and nutrient-rich varieties would further boost rice production and nutrition. In addition, proper crop management strategies would enhance rice production.

Rafiqul et al. (2017) completed a study on Technical Efficiency of Farm Producing Transplanted Aman Rice in Bangladesh: A Comparative Study Of Aromatic Fine and Coarse Varieties. The variance parameters estimated through maximum likelihood estimation (MLE). The yield gaps observed between the frontier and actual farmer's yield of aromatic, coarse, and fine rice were 5.3%, 16.9%, and 2.6%, respectively. The estimated technical efficiency of each individual farmer varied within the range from 65.5% to 99.88% with a mean technical efficiency of 96.5% for aromatic rice farmers, 85.3% for coarse rice farmers, and 97.6% for fine rice farmers.

Khalique et al. (2019) conduct a study on Economic Analysis Of Rice Production In Bangladesh. They foundgrowth rates of area, production, yield and nominal price of three seasons of rice were estimated by fitting the exponential trend function. Growth rates of an area which were significantly negative for Aus, Aman that were-4.6 percent and-0.3 percent and positive for Boro rice it was 4.5 percent over the whole period. The growth rates of yield for Aus, Aman and Boro were increased significantly at the rate of 2.2, 1.9 and 1.9 percent respectively during the entire time period. There was an upward trend observed in the nominal price for Aus, Aman, and Boro over the period. The short-run and long-run price elasticity of Aus were 0.010 and 0.210 and short-run and long-run elasticity of Aman and Boro rice were 0.091, 0.112 and 0.051 and 0.395 respectively. Policy related to technological advancement, improving varieties, extension services, fertilizer distribution, high yielding variety seeds, and production management research may increase the productivity of food grains in Bangladesh.

Chapter summary

The above reviews indicate that there were different research works on Aman Rice. But none of this research regards with the financial comparison between local T.Aman and HYV T.Aman. None of these researches finds why farmers still culturing Local varieties along with HYV's. That's why in this study we are financially comparing this two Aman rice. So, the present study aims to gather information on profitability and potential factors of Aman rice cultivation in Narail district of Bangladesh.

CHAPTER III

METHODOLOGY

CHAPTER III

METHODOLOGY

Methodology is an indispensable and integral part of any study. The reliability of a specific study finding depends to a greater extent on the appropriate methodology used in the study. Improper methodology very often leads to misleading result. So careful considerations are needed in this area. This chapter describes clearly what sorts of method and procedure had followed in selecting the study area, the source of data and the analysis.

3.1 Selection of the Study Area

Narail district is very well known for rice cultivation. The low land of this district is used for Aman cultivation. Both local and HYV varieties were cultivated here. That's the reason for selecting this district. In Narail district there are three upazilas they are Narail Sadar Upazila, Kalia Upazila and Lohagara Upazila. All upazilas are equally important area for T. Aman rice cultivation. So the three Upazilas under Narail District were selected purposively as study area. Purposive and multi-stage sampling techniques were taken into consideration. Firstly, Narail district of the Southwest region of Bangladesh was deliberately selected. All these three upazillas, were selected purposively. Then villages were purposively selected. Finally, 60 farmers were selected (30 for modern HYV's and 30 for local variety) randomly from farmers list of this upazilas.

3.2 Sample Size and Sampling procedure

The total sample sizes from three upazilas were 60 T. aman rice cultivators. The number of sample from each upazila was 20 rice cultivators. A simple random sampling procedure was used to select the farmer who cultivates T. aman rice in these areas for collecting the data. Names of 20 farmers from each upazila were chosen out by the lottery method (10 for local and 10 for HYV T.Aman). Each of the farmers had assigned a number, after which 20 of those numbers had been chosen at random.

3.3 Data Collection

Primary data were collected through structured interview schedule which were filled up by the researcher. Data was collected July to December 2019. Additionally, secondary data were also collected from various sources like Encyclopedia, Bangladesh Rice knowledge bank of Bangladesh Rice Research Institute (BRRI), Bangladesh Bureau of Statistics (BBS) and Ministry of Agriculture.

3.4 Data Processing and Analysis

In this study, a statistical tool and technique both descriptive and inferential was used to analyze the data. Besides, some descriptive tools and techniques were also used in the study. Primary data were recorded into Microsoft Excel and economic analysis was carried out for determining costs and returns. In this study, cost and return analysis were done on both variable and total cost basis. A profit equation was used to assess the profitability of both HYV and Local T. Aman cultivation.

3.5 Analytical Technique

In this study, descriptive and inferential statistical tools both were used to analyze the data especially for the analysis of Cob-Douglas production function. Both tabular and functional methods of analysis were employed in this study. At first, the collected data were edited and summarized for analysis. The tabular method of analysis involved different descriptive statistics like mean, percentage, ratio, etc. Land use cost was calculated on the basis of five months' lease value of land. The profitability of local and HYV T.Aman cultivation was estimated by using gross margin, net return, and benefit cost analysis.

Cob-Douglas production function analysis was used to estimate the significance level of inputsfor both HYV and Local T. Aman rice cultivation.

To determine the contribution of the most important variables in the production process, the following specification of the model was applied:

$Y=aX_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} X_6^{b6} X_7^{b7} X_8^{b8} X_9^{b9} X_{10}^{b10} X_{11}^{b11} X_{12}^{b12} X_{13}^{b13} e^{ui}$ … … … (i)

The empirical production function was the following:

$\ln Y = a + b_1\ln X_1 + b_2\ln X_2 + b_3\ln X_3 + b_4\ln X_4 + b_5\ln X_5 + b_6\ln X_6 + b_7\ln X_7 + b_8\ln X_8 + b_9\ln X_9 + b_{10}\ln X_{10} + b_{11}\ln X_{11} + b_{12}\ln X_{12} + b_{13}\ln X_{13} + Ui$ .. … … … … … … … … … ..(ii)

Where,

Y = Yield (Mound/ha); X_1 = Human Labor (Man-day/ha); X_2= Land preparation cost (Tk/ha); X_3= Seedling (Tk/ha); X_4 = Urea (kg/ha); X_5 = TSP (kg/ha); X_6 = SSP (kg/ha); X_7 = DAP (kg/ha); X_8 = MOP (kg/ha); X_9 = Gypsum(kg/ha); X_{10} = $ZnSO_4$ (Kg/ha); X_{11} =Manure(md/ha) X_{12} = Insecticide cost (Tk/ha); X_{13} = Irrigation cost (Tk/ha); a = Intercept; b_1, b_2-------- b_{13} coefficients of the respective variables to be estimated. Ui = Error term.

Net value of the produce and cost involved were estimated. Cost of variables inputs such as land preparation, labor, seed, fertilizer, manure, irrigation, and insecticides were calculated. The tabular method of analysis involved different descriptive statistics like mean, percentage, ratio, etc. Land use cost was calculated on the basis of five months lease value of land.

Variable costs

1. Land preparation cost
2. Hired labor cost
3. Seed cost
4. Organic manure cost
5. Chemical fertilizer cost

Fixed costs

1. Interest on operating capital cost
2. Land use cost
3. Family labor cost

Gross Margin

GM = TR - VC … … … … … … … … …… … … … … … … … …… … (iii)

Where,

GM = Gross Margin (The *gross margin* represents the amount of total sales revenue that the farm retains after incurring the direct costs associated with producing)

TR = Total Revenue (*Total revenue* is the full amount of total sales of goods and services. It is calculated by multiplying the total amount of goods and services sold by the price of it)

VC = Variable Cost (*Variable costs* are expenses that vary in proportion to the volume of goods or services that a farm produces.)

Π = Gross return − (Variable cost + Fixed cost)

Here, Π = Profit per hectare

Gross return = Total production × per unit price

Net Return

NR = TR - TC … … … … … … … … …… … … … … … … … …… … (iv)

Whereas,

NR = Net Return

TR = Total Revenue

TC = Total Cost

For estimating net income total cost was subtracted from total revenue. Total cost includes variable cost plus fixed cost.

Benefit Cost Ratio (Undiscounted): The BCR was computed by this method.

BCR = TR/TC … … … … … … … … …… … … … … … … … …… … (v)

Whereas BCR = Benefit Cost Ratio

TR = Total Revenue

TC = Total Cost

Per hectare profitability of local and HYV T. Aman rice cultivation from the view point of individual farmers were measured in terms of gross return, gross margin, net return and benefit cost ratio. Then gross return, gross margin, net return and benefit cost ratio for local and HYV's T.Aman rice compared.

The resource use efficiency of the farmers was judge on neo-classical criteria. Neo-classical theory states that, to achieve the efficient resource use condition, the Marginal Value Product (MVP) should be equal to Marginal Factor Cost (MFC) under perfect competition. The producer used to select the variable input level that maximizes the profit. Marginal Value Product (MVP can be obtained by following formula:

$$MVP = \frac{Y}{x_i} * b_i \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (vi)$$

Where,

b_i = regression co-efficient of input x_i

x_i = mean value (Geometric mean) of x_i variable inputs

y = mean value (Geometric mean) of return.

In the model, Marginal factor Cost of all the inputs are measured in terms of additional taka expensed for using individual inputs.

To measure the efficiency, we would compare and test the ration of Marginal Value Product (MVP) and Marginal Factor Cost (MFC) for them for each of the inputs for its quality to 1(one).

$$\frac{MVP}{MFC} = 1 \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (vii)$$

The resource was thought to be efficiently used and profit would be maximized in Aman rice cultivation when the ratio of Marginal Value Product and Marginal Factor Cost was equal to 1 or MVP is equal to MFC for each input i.e. MVP=MFC.

1. MVP/MFC were greater than 1 or MVP>1, it would imply that the farmer was inefficient on their average in using their resources. In this case inputs are underused compared to the optimum level.
2. If the ratio were equal to 1, that is, MVP =1, it meant the resources were optimally and efficiently used.
3. If the ratio were less than 1, that is, MVP<1, it would mean the resources were not used efficiently but overused. To get the optimal level farmers were required to lessen the use of resources.

CHAPTER IV
DESCRIPTION OF THE STUDY AREA

CHAPTER IV
DESCRIPTION OF THE STUDY AREA

Study area is important element for a study. This chapter focuses on the demography geography, location climate and economy of this area. It indicates the reliability of the study. Climate, land and soil condition are important factors of any study area because the production depends on these.

Khulna Division

History

Khulna Division is one of the seven divisions of Bangladesh and is located in the south-west of the country. The Division was established in 1960. It has an area of 22,285 km^2 and a population of 15,563,000 at the 2011 Census (preliminary returns). Its headquarters is Khulna city in Khulna District. Khulna is the third largest city in Bangladesh.

Geography

The Khulna division borders the Indian state of West Bengal to the west, the Rajshahi Division to the north, the Dhaka and Barisal Divisions to the east, and has a coastline on the Bay of Bengal to the south. It is part of the Ganges River delta or Greater Bengal Delta. Some main rivers of this area include the Madhumati River, the Chitra River, the Bhairob River and the Kopotokkho River. The region also includes several islands in the Bay of Bengal.

Administrative districts are of this division are:

1. Bagerhat District
2. Chuadanga District
3. Jessore District
4. Jhenaidah District
5. Khulna District
6. Kushtia District
7. Magura District
8. Meherpur District
9. Narail District and
10. Satkhira District

Narail District

Narail was a sub-division of former Jessore Zila. It was upgraded to a district in 1984. Nothing is definitely known about the origin of the district name. It is believed that the district was named Narail after the name of the Zamindar family popularly known as Narail family. Narail District has an area of 990.23 square kilometres (382.33 sq mi). It is located to the south of Magura District, north of Khulna District, with the Faridpur District and Gopalganj District on the east, and Jessore District to the west. It lies between 23°02′ and 23°19′ north latitudes and between 89°23′ and 89°48′ east longitudes.

Indigo Revolt was organized in this district during 1859-60; in 1946 Tebhaga movement was held in the district. Narail district was liberated on 10 December 1971.

Total population of this district for both male and female is 7,21,668, male is 3,53,527 and female is 3,68,141. (District Statistics 2011)

Through the district flow the Madhumati, Nabaganga, Bhairab, and Chitra rivers. There are many beels and baors, the most noted of which is Chachuri Beel.

Annual average temperature of this district varies from Maximum 37.1°C to minimum 11.2°C. Annual rainfall is 1467 mm.

Geography

Narail is a district in the southwestern region of Bangladesh. Narail district is bounded on the north by Magura district, on the east by Faridpur and Gapalganj districts, on the south by Khulna and Bagerhat districts and on the westy by Jessore district.

Narail district was established in 1984. The district consists of 3 upazilas, 38 unions, 445 mauzas, 635 villages, 3 paurashavas, 27 wards and 67 mahallas. The upazilas are Narail Sadar, Kalia and Lohagara.

Total Cultivable area of this district is 176,504-acre (714 km^2). Fallow land contains 25,090-acre (102 km^2) of total land. Total forest area of this district is 10 acres. The irrigated land for agriculture is 36,208-acre (147 km^2). And the river system takes 8,562-acre (35 km^2) of land.

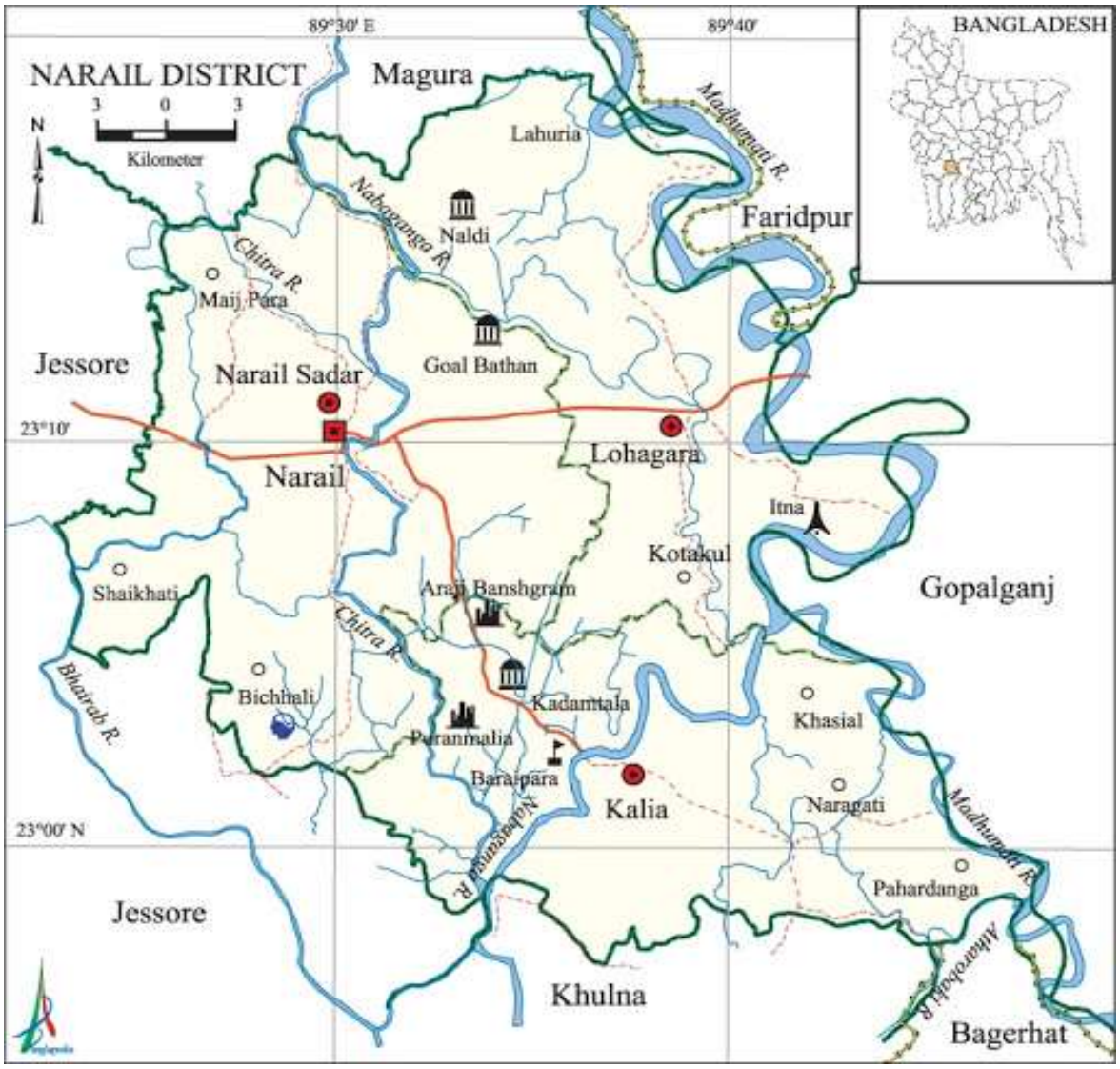

Figure 4.1 Map of Narail district

Source: Internet Search engine Google

Main cereals produced in Narail are rice and then wheat. Other cereals are jab, barley, cheena, maize, kaun, bajra and joar. Main and common pulses are gram, mung, lentil, arhar, gari kalai, khesari and pea.

Farmers of Narail district also produce oil seeds named rape and mustard, sesamum, linseed, groundnut, soybean, sunflower and castor. Farmers grow both summer and winter vegetables. Main vegetables are potato, brinjal, raddish, arum, lady's finger, cauliflower, cabbage, bean, tomato, patal, gourd, cucumber, pumpkin, knollkal-turnip, dhundal, barbati, khirai, chichinga, carrot, kakrol and sak.

Main cash crops produced here are jute, mesta, sunhemp, cotton, sugarcane and tobacco.

Beside this people also produce spices include turmeric, ginger, chillies, onion, garlic, corriander, black cumin and cui jhal.

Dhaincha, jute stick, dry leaf of plants and other smaller plants used as cooking-fuel here.

Demography

Total population of this district is 7,21,668. The population is divided by religion Muslim-586588, Hindu- 134594, Buddhist- 6, Christian- 258 and Other religion 222 people. There are 1572 Mosques, 453 Temples (Mandir), 2 Churches (Girza) and 1 Pagoda in this district. Literacy of this district for both male and female is 61.3%, male is 63.3% and female is 59.3%. The average literacy rate is 61.3%, very low compared to the rest of the world.This district consists of the following three Upazilas.-

Table4.1 Upazilas of Narail district

Upazila	Area in km^2	2011 Census population	Male	Female
Kalia	317.64	220202	80906	84465
Lohagara	381.76	228594	72006	81490
Narail Sadar	290.83	272872	105653	110086
Total	990.23	721668	268078	286588

Source: Yearbook of Agricultural Statistics, (2018-2019)

Climate

Annual average temperature of this district varies from Maximum 37.1°C to minimum 11.2°C. Annual rainfall is 1467 mm.

Archaeological Heritage and Relics:

Mosque at Village Goalbathan (1654), Kadamtala Mosque, Ghazir Dargah at Naldi, Homestead of Raja Keshab Roy at Wazirpur, Radha Govinda Mandir at Jorbangla

(eighteenth century), Kalibari at Lakshmipasha, Math at Baradia of Nihinathtala are remarkable archaeological heritage and relics of this district.

Famous Personalities of the District:

1. Sheikh Mohammed Sultan (1923-1994): heikh Mohammed Sultan better known as SM Sultan, was a Famous Bangladeshi Painter. Sultan was born on 10 August 1923 in Masimdia, Narail district, Bangladesh.
2. Mashrafe Bin Mortaza: He is a Bangladeshi cricketer and former captain of the Bangladesh national cricket team.
3. Bijay Sarkar (1903-1985) He was a Baul Singer, lyricist and composer. He was born in Dumdi in Narail District
4. Suvra Mukherjee: She was the first lady of India, wife of Indian President, Pranab Mukherjee.

Economic Situation:

The economy of Narail is predominantly agricultural. Out of total 151,052 holdings of the district, 72.51% holdings are farms and produce varieties of crops mainly local and HYV paddy, sugarcane, wheat, vegetables, spices, jute, pulses, and other minor cereals. Various fruits like mango, banana, jackfruit, guava, coconut etc. are grown in the district. Almost all kinds of vegetables are cultivated particularly bitter gourd or karala, pumpkin or misti kumra, potato and brinjals are abundantly grown. Pisciculture and rearing of livestock and poultry adds an additional income to rural households. Fish of different varieties are abundant in this district. Moreover, varieties of fish are caught from rivers, tributary channels, even from paddy field during the rainy season. Some valuable timber and forest trees are grown in the district. Non-farm activities are also significant in Narail district. According to the following table-4.2, there are 20,933 establishments in the district of which 41,617 persons are engaged in different types of non-farm activities. Female participation in non-farm activities is very poor. They constitute about11.54% as against 88.46% of the males. Wholesale & retail trade emerges as the single largest

activity (54.58%) with 11,426 establishments and 17,326 persons engaged (41.63%) in the establishments of Narail district.

Table 4.2 Number of Establishments and Population Engaged by Activity

Activity	Establishments			Persons engaged		
	Total	Urban	Rural	Total	Male	Female
Mining and quarrying	0	0	0	0	0	0
Manufacturing	3201	266	2935	8795	6821	1974
Electricity, gas and water supply	11	3	8	151	130	21
Construction	13	12	1	24	24	0
Wholesale & retail trade	11426	2436	8990	17326	16765	561
Hotels and restaurants	903	193	710	1605	1527	78
Transport, storage and communication	520	245	275	848	828	20
Bank, insurance and financial institution	101	36	65	937	724	213
Real estate and renting	127	69	58	204	204	0
Public administration and defense	134	59	75	1203	1123	80
Education	958	78	880	5038	3840	1198
Health and social work	413	85	328	971	790	181
Community, social and personal services	3126	326	2800	4515	4037	478
Narail District	20933	3808	17125	41617	36813	4804

Source: Yearbook of Agricultural Statistics, (2018-2019)

CHAPTER V

SOCIO-ECONOMIC CHARACTERISTICS OF THE T.AMAN RICE FARMERS

CHAPTER V
SOCIO-ECONOMIC CHARACTERISTICS OF THE T.AMAN RICE FARMERS

Socio-economic condition of the sample farmers is very important in use of research planning because there are numerous interrelated and constituent attributes characterizes an individual and profoundly influences development of his/her behaviors and personality. People differ from one another for the variation of socio-economic aspects. However, for the present research a few of the socio-economic characteristics have been taken into consideration for discussion.

5.1 Age and Sex Distribution of the T.Aman Rice Farmers

The age structure of the sample farmers was examined by classifying into three age groups that were Young age (<35 years), Middle age (35-50 years), and Old age (>50 years). The different age groups of the farmer are presented in Figure 5.1. There were three groups because almost all respondent covers these three categories. For local T. Aman, it was found that the highest number of the respondents (60%) belongs to the Old age (>50 years) followed by the Middle age (35-50 years) (33.33%) and only 2% respondents were in the young age (<35 years). On the other hand for HYV T.Aman that the highest number of the respondents (46.67%) belonged to the Middle age (35-50 years) followed by the Old age (>50 years) (30.00%) and 23.33% respondents were in the young age (<35 years years).

Table 5.1 Age Distribution of the Sample T.Aman Farmers

Age Group	Local T. Aman	HYV T. Aman
Young age (<35 years)	2 (6.67%)	7 (23.33%)
Middle age (35-50 years)	10 (33.33%)	14 (46.67%)
Old age (>50 years)	18 (60.00%)	9 (30.00%)

Source: Field survey, 2019

We found that young energetic farmers are interested in HYV's Cultivation. But the experienced farmers are interested in Local varieties cultivation. It is also found that 100 percent T. Aman farmers were male in the study area.

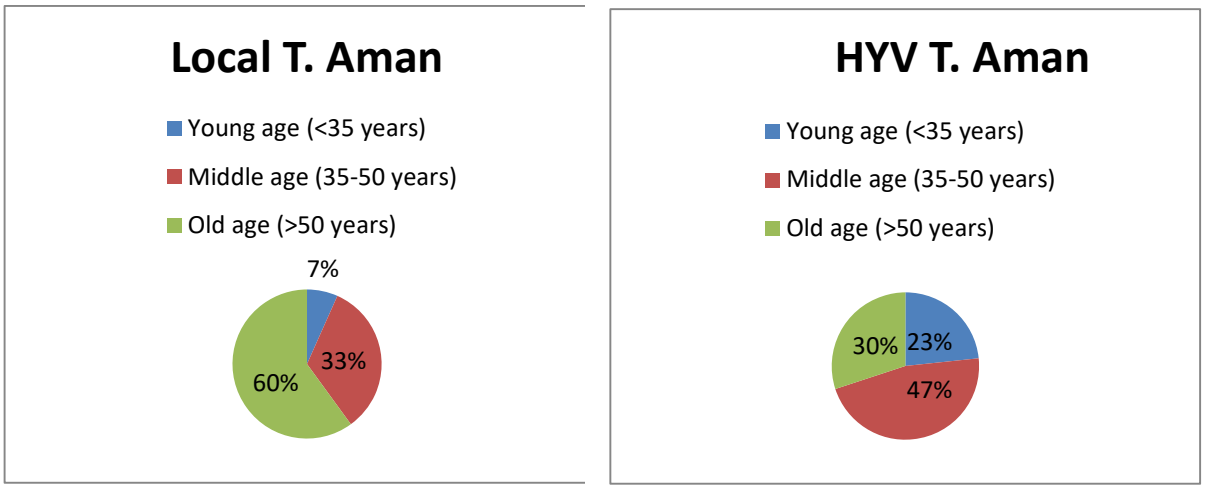

Figure 5.1: Age Distribution of the Sample Local and HYV T.Aman rice Farmers

Source: Field survey, 2019

5.2 Level of Education of the Respondents

On the basis of education, the respondents were classified into six categories as 0= Illiterate, 1=Just literate, 2=Primary level passed, 3=High school passed, 4=Graduate, 5= Post graduate and 6=Child (age<12).

Table 5.2 Level of Education of the Respondents

Education Level	HYV T.Aman	Local T.Aman	HYV T.Aman (%)	Local T.Aman (%)
Illiterate	5	7	16.67	23.33
Just literate	7	11	23.33	36.67
Primary level passed	8	8	26.67	26.67
High school passed	9	3	30	10
Graduate	1	1	3.33	3.33
Post graduate	0	0	0	0
Child (age<12)	0	0	0	0

Source: Field survey, 2019

For local T. Aman, the highest numbers of the respondents (26.67%) were primary level passed. On the other hand, for HYV T. Aman, the majority of the respondents (36.67%) were just literate.

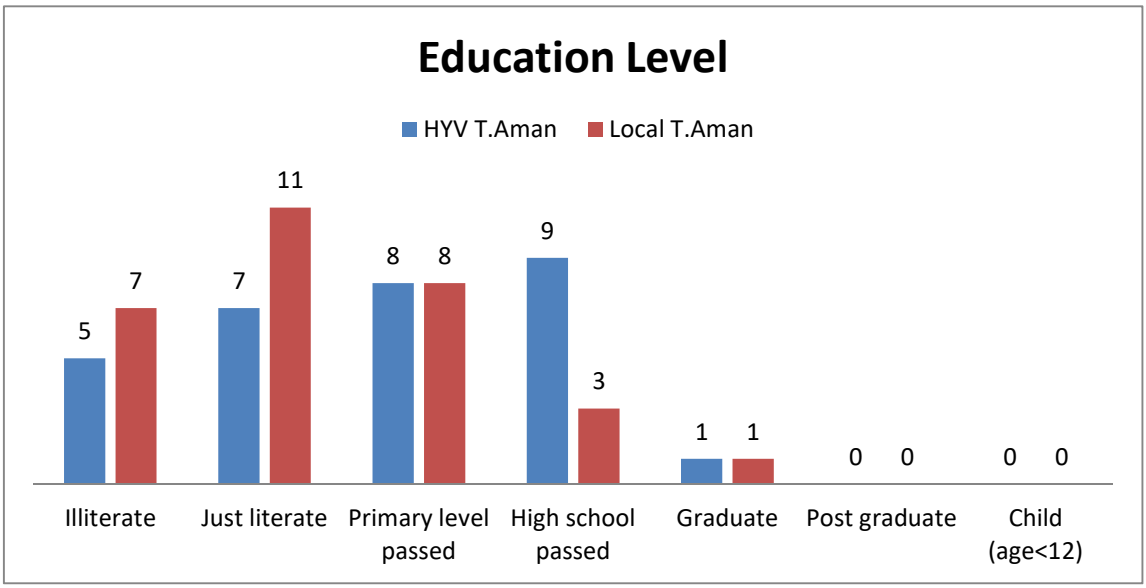

Figure 5.2: Level of Education of the Respondents

Source: Field survey, 2019

5.3 Family Size

Data presented in Table 5.3 indicate that most of the respondent's family (61.67%) belonged to small size family categories. Rest (33.33%) belonged to medium size family. Only 5% of the respondents belonged to large family size category. Average family size of T.Aman farmers is 4.43. On the basis of the report of national household survey (2011) average family size in total was 4.35 where in rural it was 4.36 and urban was 4.29. In this study most of the respondent hold small family belonging to the members of 1to 4. It means farmers were aware of birth control.

Table 5.3 Family Size of the Respondents

Family Size	Number of Family	Frequency (%)
Small Sized Family (1-4 Members)	37	61.67
Medium Sized Family (4-6 Members)	20	33.33
Large Sized Family (>6 Members)	3	5
Total	60	100

Source: Field survey, 2019

5.4 Distribution of Family Member by Literacy and Sex

The literacy levels of the farm family members of the T.Aman cultivators are given in Table 5.4. It appears from the table that 19.17 percent family members were not enrolled of which 8.65 percent were male and 10.53 percent were female. From that table we also find that 29.69 percent family members were just literate, 24.44 percent family members were primary level passed, 19.55 percent family members were high school passed, 3.01 percent family members were graduate and only 0.75 percent family members were post graduate. Rest 3.83 percent family members were child (age<12).

Table 5.4 Distribution of Family Member by Literacy

Education Level	Male % (Number)	Female % (Number)	Total% (Number)
Illiterate	8.65 (23)	10.53 (28)	19.17 (51)
Just literate	11.65 (31)	18.05 (48)	29.69 (79)
Primary level passed	12.41 (33)	12.03 (32)	24.44 (65)
High school passed	11.28 (30)	8.27 (22)	19.55 (52)
Graduate	2.26 (6)	0.75 (2)	3.01 (8)
Post graduate	0.75 (2)	(0)	0.75 (2)
Child (age<12)	1.88 (5)	1.50 (4)	3.38 (9)
Total	48.87 (130)	51.13 (136)	100 (266)

Source: Field survey, 2019

5.5 Occupational Status of T.Aman Rice Farmers

T.Aman farmers of Narail district were not solely dependent on rice cultivation. Beside this they also took part in other occupations also. They practiced fisheries beside T. Aman about 18.33% of the total respondent. The farmers who raised livestock's takes 20% of the total farmers. Respectively 10% and 15% involved in poultry rearing and business. Highest portion (31.67%) acted as day labor during non-agricultural season. And rest 5% migrated for their livelihood

Table 5.5 Farmer's occupation during off-agricultural season

Occupation	Number	Frequency
T.Aman Rice + Fisheries	11	18.33%
T.Aman Rice + Livestock	12	20.00%
T.Aman Rice + Poultry rearing	6	10.00%
T.Aman Rice + Business	9	15.00%
T.Aman Rice + Day Labor	19	31.67%
T.Aman Rice + Migration	3	5.00%

Source: Field survey, 2019

5.6 Amount of Land Ownership of T.Aman Rice Cultivators

On the basis of farm size, the respondents were classified into five categories (according to National Agricultural Extension Policy- NAEP) as shown in Table 5.6. From the table we can get the amount of land ownership of T.Aman Rice cultivators. Here 18.92 percent land occupied by 21 respondents who were marginal sized farmers (0.50-1.49 acres). Majority of the farms were medium sized farms (2.50-7.49 acres) occupied 42.86 percent of total land. Rest 38.23 percent of land occupied by small sized farms (1.50-2.49 acres). There was no large and landless farmer. Average operated land was 1.92 acres. And total operated lands by these 60 farmers were 115.36 acres.

Table 5.6 Amount of Land Ownership of T.Aman Rice Cultivation

Amount of land ownership	Number of Farms	Occupied Area (Acre)	Percentage of total land
Landless (<0.49 acres)	0	0	0.00
Marginal sized farm (0.50-1.49 acres)	21	21.82	18.92
Small sized farm (1.50-2.49 acres)	24	44.10	38.23
Medium sized farm (2.50-7.49 acres)	15	49.44	42.86
Large sized farm (>7.49 acres)	0	0	0.00
Total	60	115.35	100.00

Source: Field survey, 2019, (Scale- National Agricultural Extension Policy- NAEP)

5.7 Sources of Fund

According to this field survey, 5% of the cultivators have their own fund as well as they also take loan. 86% of the cultivators have their own fund. Only 9% cultivators use others fund like friends, kith and kin. No cultivators started their cultivation by only loan. They take loan from local NGOs (BRAC and Grameen Bank).

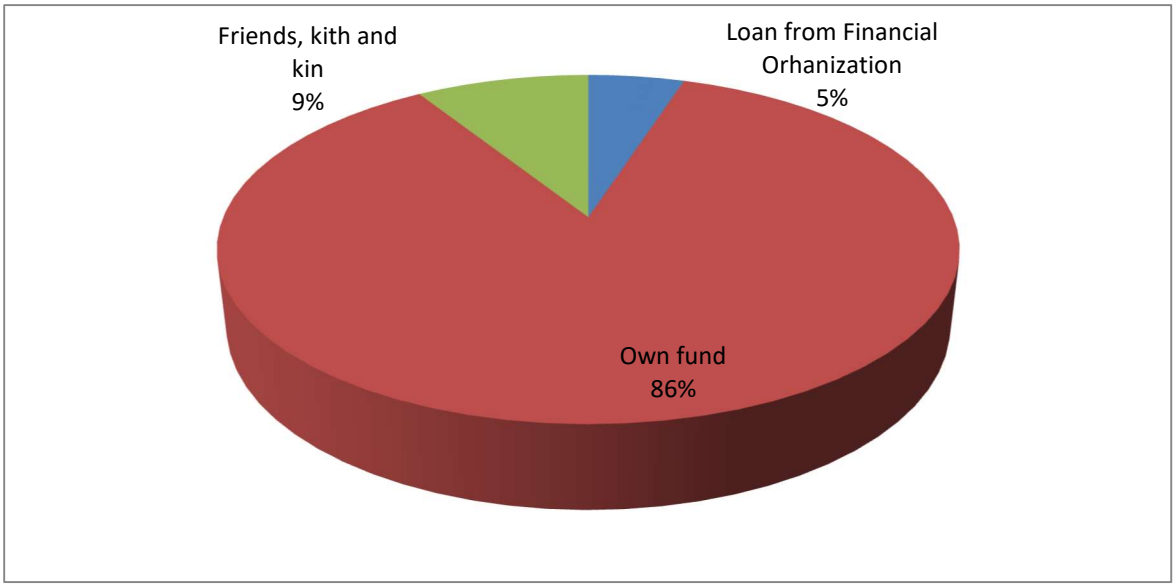

Figure 5.3: Sources of Fund

Source: Field survey, 2019

5.8. Yearly Income of farmers

Average yearly income of HYV aman farmers was tk. 87624.46. And highest income was found tk. 241050. For local T.Aman average yearly income was tk. 83888.00. And highest income was tk.155640.00.

CHAPTER VI

COMPARATIVE PROFITABILITY ANALYSIS OF LOCAL T.AMAN AND HYBRID T.AMAN CULTIVATION

CHAPTER VI
COMPARATIVE PROFITABILITY ANALYSIS AND RESOURCE USE EFFECIENCY OF LOCAL T.AMAN AND HYBRID T.AMAN CULTIVATION

6.1 Comparative Input Use Pattern of local and HYV T.Aman rice

Human labor requirement (Man-days)

Human labor is an important input for T.Aman rice production. The number of labor used in local T.Aman rice production was only 57.68 man-days per hectare. Some local varieties were cultivated with other crops as shathi foshol. That was the reason behind the low number of man-days for local T.Aman than its recommended level. On the other hand for HYV T.Aman the average number of labor was 172.76 man-days per hectare. This was almost three times of local T.Aman rice production.

Land Preparation cost (tk./ha)

The land ploughing cost was same for both T.Aman varieties as it was done by tractor or power tiller. For preparing one decimal of land by the machine operator took Tk.19-Tk.20 at fixed rate for Local T.Aman. And for preparing one decimal of land by the machine operator took Tk.26-Tk.27 at fixed rate for HYV T.Aman. Land preparation cost of local T.Aman is less because of one less number of plowing provided here. For preparing one hectare of land for Local T.Aman it costs tk. 4939.28. On the other hand for HYV T.Aman it costs tk. 6568.32 per hectare.

Machine for (weeding spraying/thrashing) (tk./ha)

For local T.Aman Tk. 850.64 needed for per hectare land weeding, spraying and thrashing machine. For HYV T.Aman Tk. 2064.47 needed for per hectare land weeding, spraying and thrashing machine.

Fretilizer and Manure

For Local T.Aman Urea, TSP, DAP, Gypsum, $ZnSO_4$ and Manure used at the rate of 27.30 kg, 9.69 kg, 10.49 kg, 2.14 kg, 0.54 kg and 2.09 mound per hectare. No SSP and MOP is used here. On the other hand for HYV T.Aman Urea, TSP, SSP, DAP, MOP Gypsum, $ZnSO_4$ and Manure used at the rate of 46.58 kg, 31.37 kg, 4.04 kg, 5.84 kg, 12.30 kg, 1.96 kg, 1.73 kg and 2.62 mound per hectare.

Pesticides and Supplementary Irrigation

For Local T.Aman Pesticides and Supplementary Irrigation cost was tk. 120.23 and tk. 118.92 per hectare. On the other hand for HYV T.Aman Pesticides and Supplementary Irrigation cost was tk. 302.04 and tk. 643.77 per hectare.

Table 6.1 Comparative Input Use Pattern of T.Aman Cultivation in Study Area

Items	Average Amount for local T.aman	Average Amount for HYV T.aman
Human labor requirement (Man-days/ha)	**57.68**	**172.76**
Land Preparation cost (tk./ha)	**4939.28**	**6568.32**
Machine for (weeding spraying/thrashing) (tk./ha)	**850.64**	**2064.47**
Seeds(kg/ha)	**20.25**	**20.65**
Fertilizers		
Urea (kg/ha)	27.30	46.58
TSP(Kg/ha)	9.69	31.37
SSP(Kg/ha)	0	4.04
DAP(Kg/ha)	10.49	5.84
MOP(Kg/ha)	0	12.30
Gypsum(Kg/ha)	2.14	1.96
$ZnSO_4$ (Kg/ha)	0.54	1.73
Manure (md/ha)	**2.09**	**2.62**
Pesticides(tk./ha)	**120.23**	**302.04**
Irrigation/ Supplementary Irrigation (tk/ha)	**118.92**	**643.77**

Source: Field survey, 2019

6.2 Cost and return Comparison of local T.aman and HYV T.aman

All variable cost incurred for human labor, land preparation, seedling, organic manure, fertilizers, insecticides, and irrigation were considered for calculating the cost of T.Aman rice cultivation. The cost of land use calculated on the basis of prevailing local lease value of land.

6.2.1 Variable cost

A variable cost is that expense which changes with proportion to production output. Variable costs increase or decrease depending on a farms production volume. Variable cost is an important part of economic or financial analysis. To compute the profitability, we need to calculate the variable cost. The items included in variable cost is land preparation cost, hired labor cost, seed cost, organic manure, all chemical fertilizer cost (Urea, TSP etc.), irrigation and insecticide cost. From the table 6.2 we found that the total variable cost for local T.aman and HYV T.Aman was respectively Tk. 16921.83 and Tk. 42115.42 per hectare of land.

For local T.Aman it was 52.32 percent of its total cost and for HYV T.Aman variable was 57.48 percent of its total cost. For local T.Aman land preparation cost, hired labor cost, seed cost, organic manure, all chemical fertilizer cost (Urea, TSP etc.) , insecticide and irrigation cost were Tk. 4993.63, Tk. 9989.37, Tk. 777.93,Tk. 99.68, Tk. 1061.22 Tk. 207.45 and Tk. 213.24 which were15.44 percent , 30.98 percent, 2.40 percent, 0.30 percent, 3.28 percent, 0.64 percent and 0.66 percent of the total cost respectively.

For HYV T.Aman land preparation cost, hired labor cost, seed cost, organic manure, all chemical fertilizer cost (Urea, TSP etc.) , insecticide and irrigation cost were Tk. 6568.32, Tk. 30060.06, Tk. 2632.30,Tk. 193.64, Tk. 2661.1 Tk. 1423.29 and Tk. 2845.83 which was 8.96 percent , 41.02 percent, 3.59 percent, 0.26 percent, 3.36 percent, 1.94 percent and 3.88 percent of the total cost respectively.

6.2.2 Fixed cost

Fixed costs are those expenses that are not dependent on the level of output and does not change with an increase or decrease with the level of output change. The producers have to bear the expense even if the production is not undertaken. Total fixed cost for producing Local T.Aman and HYV T.aman was estimated Tk. 15415.96and Tk.

31153.84per hectare. This was 47.67 percent and 42.51 percent of total productin cost. Fixed costs included land use cost and interest on operating capital which is described below.

6.2.2.1 Land use cost

Most of the farmers in the study area had own land for producing T.Aman rice. Land use cost was a fixed cost for the producers. Table 6.1 shows that the land use cost for local T.Aman and HYV T.aman was estimated Tk. 8,333.33 per hectare. The land use cost for loca T.Aman and HYV T.aman was 25.76% and 11.37% of total production cost respectively.

6.2.2.2 Interest on operating capital (IOC)

Interest on operating capital was calculated for 5 months for both local T.Aman and HYV T.aman. Interest rate of 6% per annum for both crop was considered for calculation. Interest on operating capital was calculated based on this formula-

Interest on Operating capital = Operating capital * interest rate * time considered /12.

Interest on operating capital (IOC) for local T.Aman and HYV T.aman is estimated Tk. 423.05and Tk. 1052.88per hectare.

6.2.2.3 Family labor

The family members of farmers also involved in farming business. This labor was considered as the part of fixed cost in economic analysis. Family labor cost for producing Local T.Aman and HYV T.aman was estimated Tk. 6659.58 and Tk. 21767.63 per hectare.

6.2.3 Total cost

Total cost was calculated by combining variable cost and fixed cost. Total cost for producing Local T.Aman and HYV T.aman were estimated Tk. 32337.79and Tk. 73269.26per hectare. The cost for producing HYV T.Aman was 2.26 times of local varieties.

Table 6.2 Comparison of Cost and Return between local T.aman and HYV T.aman in Study Area

Item	Cost of cultivation local T.aman (tk/ha)	Cost of cultivation HYV T.aman (tk/ha)
A. Variable cost	**16921.83 (52.32%)**	**42115.42 (57.48%)**
Land preparation cost	**4993.63 (15.44%)**	**6568.32 (8.96%)**
Hired labor	**9989.37 (30.98%)**	**30060.06 (41.02%)**
Seed cost	**777.93 (2.40%)**	**2632.30 (3.59%)**
Organic manure	**99.68 (0.30%)**	**193.64 (0.26%)**
Chemical fertilizer	**1061.22 (3.28%)**	**2661.1 (3.36%)**
Urea	464.1	791.86
TSP	142.25	784.25
SSP	0	309.25
DAP	272.47	151.84
MOP	0	184.50
Gypsum	64.20	58.8
$ZnSO_4$	118.20	380.60
Insecticides	**207.45 (0.64%)**	**1423.29 (1.94%)**
Irrigation	**213.24 (0.66%)**	**2845.83 (3.88%)**
B. Fixed cost	**15415.96 (47.67%)**	**31153.84 (42.51%)**
Interest on operating cost	423.05 (1.31%)	1052.88 (1.44%)
Family labor	6659.58 (20.59%)	21767.63 (29.70%)
Land use	8333.33 (25.76%)	8333.33 (11.37%)
C. Total cost(A+B)	**32337.79 (100%)**	**73269.26 (100%)**
Grain Yield (Mound/ha))	71.54	152.89
Grain Price (Tk./Mound)	639.33	620.00
By-product (Kaon/plot)	5.08	15.90
By-product price (Tk./Kaon)	923.80	920.00

Item	Cost of cultivation local T.aman (tk/ha)	Cost of cultivation HYV T.aman (tk/ha)
D. Gross return	**50430.56**	**109419.80**
Gross margin (D-A)	**33508.73**	**67304.38**
Net return(D-C)	**18092.77**	**36150.54**
E. Benefit cost ratio		
Full cost basis	**1.56**	**1.49**
Variable cost basis	**2.98**	**2.59**

Source Field survey, 2019

6.2.4 Gross return

Gross return is calculated on the multiplication of grain yield per hectare and price of paddy adding with the by-product yield multiplied by its price. The yield of local T.Aman per hectare was 71.54 Mound/Ha and average price of local T.Aman in local market was 639.33 Tk./Mound. And the straw production for local T.Aman was 5.08 Kaon/Ha and price of this by product was 923.80 Tk./Kaon. So the gross return for Local T.Aman was tk. 50430.56 per hectare (Table 6.2).

The yield of HYV T.Aman per hectare was 152.89 Mound/Ha (2.13 times of local T/Aman) and avarage price of HYV T.Aman in local market was 620.00 Tk./Mound. And the straw production for HYV T.Aman was 15.90 Kaon/Ha (3.13 times of local T/Aman) and price of this by product 920.00 Tk./Kaon. And the gross return for HYV T.Aman was tk. 109419.8per hectare (Table 6.2).

6.2.5 Gross margin

Gross margin is calculated by the subtraction from gross return to variable cost. For Local T.Aman Varieties Gross return was tk. 50430.56 and the variable cost was tk. 16921.83 per hectare. So the gross margin was tk. 33508.73per hectare (Table 6.2). For HYV T.Aman Varieties Gross return was tk. 109419.8 and the variable cost was tk. 42115.42 per hectare. So the gross margin was tk. 67304.38per hectare (Table 6.2). This margin was (67304.38-33508.73) = 33795.65taka more than local T.Aman.

6.2.6 Net return

Net return is calculated by the subtraction from gross return to total cost. For local T.Aman Gross return was tk. 50430.56 and total cost was tk.32337.79. So the net return was tk. 18092.77.

On the other hand for HYV T.Aman Gross return was tk. 109419.8 and total cost was tk.73269.26. So the net return was tk. 36150.54. This return was (36150.54-18092.77) = 18057.77tk. more than local T.Aman.

6.2.7 Benefit cost ratio

Benefit cost ratio is calculated by the division of gross return and total cost on the full cost basis. The benefit cost ratio in full cost basis of Local T.Aman was 1.56 which means that by investing Tk. 1.00, farmers would earn Tk. 1.56 in return. And in variable cost basis benefit cost ratio of Local T.Aman was 2.98 which means that by investing Tk. 1.00, farmers would earn Tk. 2.98 in return.

On the other hand benefit cost ratio in full cost basis of HYV T.Aman was 1.49 which means that by investing Tk. 1.00, farmers would earn Tk. 1.49 in return. And in variable cost basis benefit cost ratio of Local T.Aman was 2.59 which means that by investing Tk. 1.00, farmers would earn Tk. 2.59 in return.

It was clear that production earned higher return in local T.Aman than HYV T.Aman rice per hectare.

6.3 Factors Affecting the Yield of local And HYV T.Aman

Cobb-Douglas production function model had chosen to determine the effects of different inputs on the yield of local T.Aman rice and HYV T.Aman rice production because of its best fit. The significant effects of using various inputs on yield of local T.Aman rice and HYV T.Aman cultivation can be estimated by analyzing the production function of those crops. Thirteen independent variables such as human labor, land preparation cost, seeds/seedling cost, urea, TSP,SSP, DAP,MOP, Gypsum, $ZnSO_4$, manure, pesticides and supplementary irrigation costs were taken into consideration as they were likely to have an impact on gross return of T.Aman rice production. The effects of each of the variables on the yield of local and HYV T.Aman are interpreted below.

6.3.1 Human labor (X_1)

Table 6.3 shows that the regression coefficient of human labor cost for local T.Aman rice is -0.04 which is negative and in-significant. This indicated that human labor cost had no significant effect on the gross return of local T.Aman rice. Table 6.3 also shows that the regression coefficient of human labor cost for HYV T.Aman is 0.93 which is positive and significant at 5% level. It indicated that considering all other factors constant, 1% increase in the cost of human labor would increase gross return by 0.93%.

6.3.2 Land preparation (X_2))

Table 6.3 shows that the regression coefficient of land preparation cost for local T.Aman rice is 2.79 which is positive and significant at 1% level. It indicates that considering all other factors constant, 1% increase in the cost of human labor will increase gross return by 2.79%. Table 6.3 also shows that the regression coefficient of land preparation cost for HYV T.Aman is 0.58 which is positive but in-significant . This indicates that land preparetion cost had no significant effect on the gross return of HYV T.Aman rice.

6.3.3 Seeds/seedling (X_3)

Table 6.3 shows that the regression coefficient of seeds/seedling cost for local T.Aman rice is -710.06 which is negative and significant at 10% level of significance. This indicates that considering all other factors constant, 1% increase in the seeds/seedling cost will decrease gross return by 710.06%. Table 6.3 also shows that the regression coefficient of seeds/seedling cost for HYV T.Aman is -0.24 which is negative and significant at 10% level. It indicates that considering all other factors constant, 1% increase in the cost of human labor would decrease gross return by 0.24%.

6. 3.4 Urea (X_4)

Table 6.3 shows that the regression coefficient of urea cost for both local T.Aman and HYV T.Aman is 0.073 and 0.004 respectively which are positive but insignificant. This indicates that urea cost has no significant effect on the gross return of local T.Aman and HYV T.Aman.

6.3.5 TSP (X_5)

Table 6.3 shows that the regression coefficient of TSP cost for local T.Aman rice is 232.16 which is positive and significant at 5% level. It indicates that considering all other factors constant, 1% increase in the cost of TSP will increase gross return by 232.15%. Table 6.3 also shows that the regression coefficient of TSP cost for HYV T.Aman is -0.175 which is negative but in-significant . This indicates that TSP cost had no significant effect on the gross return of HYV T.Aman rice.

6.3.6 SSP (X_6)

Table 6.3 shows that the regression coefficient of SSP cost for HYV T.Aman is 0.02 (insignificant) . This indicates that SSP cost has no significant effect on the gross return of HYV T.Aman. And local T.Aman farmers do not use any SSP in their field.

6.3.7 DAP (X_7)

Table 6.3 shows that the regression coefficient of DAP cost for both local T.Aman and HYV T.Aman is 0.01 and 0.0024 respectively which is positive but insignificant. This indicates that DAP cost has no significant effect on the gross return of local T.Aman and HYV T.Aman.

6.3.8 MOP (X_8)

Table 6.3 shows that the regression coefficient of MOP cost for HYV T.Aman is -0.0059 (insignificant) . This indicates that MOP cost had no significant effect on the gross return of HYV T.Aman. And local T.Aman farmers did not use any MOP in their field.

6.3.9 Gypsum(X_9)

Table 6.3 shows that the regression coefficient of gypsum cost for both local T.Aman and HYV T.Aman is 0.01 and -0.19 respectively which are positive and negative but both insignificant. This indicates that gypsum cost has no significant effect on the gross return of local T.Aman and HYV T.Aman.

6.3.10 $ZnSO_4$(X_{10})

Table 6.3 shows that the regression coefficient of $ZnSO_4$ cost for both local T.Aman and HYV T.Aman is 0.09 and -0.0076 respectively which are positive and negative but both insignificant. This indicates that $ZnSO_4$ cost has no significant effect on the gross return of local T.Aman and HYV T.Aman.

6.3.11 Manure (X_{11})

Table 6.3 shows that the regression coefficient of manure cost for local T.Aman rice is -0.05 which is negative and in-significant. This indicates that manure cost has no significant effect on the gross return of local T.Aman rice. Table 6.3 also shows that the regression coefficient of manure cost for HYV T.Aman is 0.32 which is positive and significant at 5% level. It indicates that considering all other factors constant, 1% increase in the cost of manure will increase gross return by 0.32 %.

6.3.12 Pesticides (X_{12})

Table 6.3 shows that the regression coefficient of pesticides cost for both local T.Aman and HYV T.Aman is -0.02 and 0.0027 respectively which are negative and positive but insignificant. This indicates that pesticides cost has no significant effect on the gross return of local T.Aman and HYV T.Aman.

6. 3.13 Supplementary Irrigation (X_{13})

Table 6.3 shows that the regression coefficient of supplementary irrigation cost for local T.Aman is 0.06 which is positive but insignificant. This indicates that supplementary irrigation cost has no significant effect on the gross return of local T.Aman . The regression coefficient of supplementary irrigation cost for HYV T.Aman is 0.13 which is positive and significant at 1% level. It indicates that considering all other factors constant, 1% increase in the cost of supplementary irrigation will increase gross return by 0.13 %.

6.3.14 Value of R square

The multiple co-efficient of determination (R^2) is a summary measure which tells how the sample regression line fits with the data (Gujarati, 1995). In this table the value of local T.Aman R^2 was 0.7927 that means the variables considered in the models can explain 79.27 percent of the variation in yield explained by independent variables include in the model.

On the other hand the value of HYV T.Aman R^2 was 0.8556 , that means the variables considered in the models can explain 85.56 percent of the variation in yield explained by independent variables include in the model.

6.3.15 Value of F

In the table for local T.Aman the F value was found 6.26 which is significant at one percent level implying that the variation of yield mainly depends on the explanatory variables include in the model.

For local T.Aman the F value was found 7.29 which is significant at one percent level implying that the variation of yield mainly depends on the explanatory variables include in the model.

Table 6.3 Estimated coefficients and their Related Statistics of Production function of local and HYV T. Aman rice

Explanatory Variables	Co-efficient for local T.Aman	T -valus for local T.Aman	Co-efficient for HYV T.Aman	t-valus for HYV T.Aman
Intercept	10.567363	9.6965789	1.994729	0.496516
Human labor(X_1)	-0.0420353	0.1657175	0.934667**	2.539304
Land Preparation ($X_{2)}$)	2.79423***	3.528521	0.576009	1.142201
Seeds/seedling (X_3)	-710.062*	-2.00766	-0.23687*	-1.78947
Urea (X_4)	0.0731567	0.4434572	0.004492	0.020942
TSP (X_5)	232.1593**	2.14074	-0.17586	-0.82282
SSP (X_6)			0.02285	0.242221
DAP (X_7)	0.0127559	0.1210093	0.002404	0.041768
MOP (X_8)			-0.00594	-0.07445
Gypsum(X_9)	0.0139556	0.2417615	-0.18872	-1.81287
$ZnSO_4$ (X_{10})	0.0883477	0.3891566	-0.00766	-0.06508
Manure (X_{11})	-0.0528595	-0.9939059	0.323483**	2.813376
Pesticides (X_{12})	-0.0192293	-0.7345336	0.002702	0.064588
Supplementary Irrigation (X_{13})	0.0599746	0.8830869	0.1273***	4.575796
R^2	0.7927		0.8556	
F value	6.26***		7.29***	

*** means significant at 1% , ** means significant at 5% ,* means significant at 10%

Source: Field survey, 2019

6.4 Comments for Resource use efficiency

6.4.1 Human labor

Human labor were overutilized for both local and HYV T.Aman. Farmers required to reduce using human labor to increase efficiency.

6.4.2 Land preparation

Land preparation cost were underutilized for both local and HYV T.Aman. Farmers required investing more in land preparation to increase efficiency.

6.4.3 Seeds

Seeds were overutilized for both local and HYV T.Aman. Farmers required to reduce using seeds to increase efficiency.

6.4.4 Urea

Urea was underutilized for both local and HYV T.Aman. Farmers required use more in urea to increase efficiency.

6.4.5 TSP

TSP was underutilized for local T.Aman. Local T.Aman farmers should increase using TSP to increase efficiency. On the other hand TSP was overutilized for HYV T.Aman. HYV T.Aman farmers should reduce using TSP to increase efficiency.

6.4.6 SSP

SSP was underutilized for HYV T.Aman. Farmers required to increase use of SSP to increase efficiency. For local T.Aman no farmer used SSP.

6.4.7 DAP

DAP was underutilized for both local and HYV T.Aman. Farmers required to use more DAP to increase efficiency.

6.4.8 MOP

MOP was overutilized for HYV T.Aman. HYV farmers required to reduce use of MOP to increase efficiency For local T.Aman no farmers used MOP.

6.4.9 Gypsum

Gypsum was underutilized for local T.Aman. Local T.Aman farmers should increase using gypsum to increase efficiency. On the other hand Gypsum was overutilized for

HYV T.Aman. HYV T.Aman farmers should reduce using Gypsum to increase efficiency.

6.4.10 $ZnSO_4$

$ZnSO_4$ was underutilized for local T.Aman. Local T.Aman farmers should increase using $ZnSO_4$ to increase efficiency. On the other hand $ZnSO_4$ was overutilized for HYV T.Aman. HYV T.Aman farmers should reduce using $ZnSO_4$ to increase efficiency.

6.4.11 Manure

Manure was overutilized for local T.Aman. Local T.Aman farmers should reduce using manure to increase efficiency. On the other hand manure was underutilized for HYV T.Aman. HYV T.Aman farmers should increase using manure to increase efficiency.

6.4.12 Pesticides

Pesticides were overutilized for local T.Aman. Local T.Aman farmers should reduce using pesticides to increase efficiency. On the other hand Pesticides were underutilized for HYV T.Aman. HYV T.Aman farmers should increase using pesticides to increase efficiency.

6.4.13 Supplementary Irrigation

Supplementary Irrigation was underutilized for both local and HYV T.Aman. Farmers required to invest more in supplementary irrigation to increase efficiency.

Table 6.4: Resource use efficiency of Local and HYV T.Aman

Variables	GM for local T.Aman	MVP/MFC for local T.Aman	Comments for local T.Aman	GM for HYV T.Aman	MVP/MFC HYV T.Aman	Comments for HYV T.Aman
Human labor	54.57	-36.02	Over utilized	168.38	593.11	Under utilized
Land preparation	1367.09	2.71	Under utilized	6504.35	9.46	Under utilized
Seeds	14.87	-568.31	Over utilized	13.56	-1866.17	Over utilized
Urea	21.86	156.52	Under utilized	27.93	17.18	Under utilized
TSP	2.43	968.85	Under utilized	19.30	-973.60	Over utilized
SSP				2.11	1151.87	Under utilized
DAP	2.21	269.07	Under utilized	2.36	108.50	Under utilized

MOP				6.85	-92.49	Over utilized
Gypsum	1.47	441.98	Under utilized	1.26	-15880.8	Over utilized
$ZnSO_4$	1.16	3539.05	Under utilized	1.18	-688.06	Over utilized
Manure	1.41	-1750.38	Over utilized	1.82	18975.58	Under utilized
Pesticides	8.41	-106.92	Over utilized	91.46	3.15	Under utilized
Supplementary Irrigation	1.59	1761.12	Under utilized	227.89	59.70	Under utilized

Source: Field survey, 2019

CHAPTER VII

MAJOR PROBLEMS AND CONSTRAINS OF T.AMAN RICE CULTIVATION IN NARAIL DISTRICT

CHAPTER VII

MAJOR PROBLEMS AND CONSTRAINS OF T.AMAN RICE CULTIVATION IN NARAIL AREA

T.Aman rice farmers of Narail district face different type of problems. This problems can be categorized as economic, technical, marketing, social and others . Some of the major problems faced by the T.Aman farmers of this selected area has identified in this research work. Now we are going to discuss these problems-

7.1 Economic Problems

In the time survey, farmers were asked to identify some economic problems related to growing T.Aman Rice. The problems that were identified and faced by them are discussed below.

7.1.1 High Input Price

The production of T.Aman depends much on the price of production inputs. The seed used by local T.Aman farmers were mainly from their own previous production. That's why they can save some costing of production. On the other hand HYV rice seed price of renowned seed company was very high. Farmers faced economic problem when buying HYV seeds. Sometimes they bought low quality seed from local market and faced severe problem for yield loss. When surveying in the market and farmers we got the subsidized price of the fertilizer at this range-urea 17 tk./kg, TSP 25 tk./kg, MOP 15 tk./kg, Gypsum 30 tk./kg Zinc 180-220 tk./kg, DAP 26 tk./Kg. Farmers accused that pesticide cost were getting high day by day.

7.1.2 Insufficient Credit Facilities/ Lack of capital

Insufficient credit is a big problem for farmers. Most of the farmers in this area were running their farming business by their own fund. But on the other hand the credit organizations were available in the rural area also. Farmers were not interested in loan and bearing the interest of it. Due to low profitability of rice growing business they were not taking risk of getting loan from the credit organizations and NGO's.

7.1.3 Low Selling Price / Low price of output

The biggest problem of rice cultivation at this time is the low price of paddy. Though government has taken initiatives to buy paddy directly from farmers, some corrupted middleman still controlling the system. They were buying rice from some selected farmers and rests of the farmers had to sell their products at local hat at low price.

7.1.4 Shortage of agricultural labor

At the time of rice seedling uprooting and plantation and the time of harvesting paddy much number of labors was needed. But at this time farmers faced the shortage of labor. Loss of yield happens due to late plantation and late harvesting for the scarcity of agricultural labor at that time.

7.1.5 High wage rate

As the scarcity of agricultural labor the wage rate became high at the time of seedling uprooting, plantation and the time of harvesting paddy.

7.2 Technical Problems

7.2.1 Poor agronomic practice

Poor agronomic practice are related to production techniques and technology such as lack of scientific knowledge, lack of quality seeds or plants, attack by pest and diseases, and lack of extension work in T.Aman production.

7.2.2 Lack of Scientific Knowledge and Training

Most of the farmers kept a little knowledge about modem technology of growing rice. Scientific Knowledge and Training is needed for trained manpower and to handle commercial agricultural activities. But the farmers were deprived of scientific knowledge and proper training. That’s why they faced problem at the time of post harvest handling and selling time.

7.2.3 Attack by Pests and Diseases

Stem-borer, gall midge, thrips, root-knot nematode, root nematode and white tip nematode, gall midge, green leafhopper, hispa, leaf folder, mealy bug, ear-cutting caterpillar/ cut worm and gundhi bug are major pests that crates problem for T.Aman rice farmers. And leaf blast, neck blast, sheath blight, brown spot, false smut, bacterial blight etc. are main diseases that hamper the production.

7.2.4 Lack of Extension Services

Farmers needed to introduce new information and technologies about T.Aman rice cultivation because of new practice of commercial rice farming. More research needed on our local rice varieties.

7.3 Marketing Problems

T.Aman rice farmers face different types of marketing problem. These problems are discussed bellow-

7.3.1 Inadequate and Underdeveloped Market

Though rice market is a very big market of our economy this market is very much unstable. The local farmers of rice at the very root level of marketing rice faces the problem of price gap. Miller regulates the price gap of paddy and rice. It creates a very big problem for these marginal producers.

7.3.2 Lack of storage facilities

Rice is a bulky product and needed proper storage facility. After harvesting and threshing the moister content of rice decreased by drying in the sun. Then this paddy needed to be stored in a moisture and pest free room. But it becomes very hard for farmers to manage such storage facility at monsoon. It causes post harvest yield loss.

7.3.3 Transportation and Communication Problems / High transportation cost

Farmers need to carry their paddy from field to home. As paddy is a bulky product usually they use horse or bullock drawn cart for carrying it. This is a costly process. And

this cost affect on the gross and net margin of T.Aman rice. Then this rice after threshing, winnowing and drying this rice needed to send to market. Due to bad road communication system and long distance of market farmers cost of carrying becomes very high.

7.3.4 Lack of Market Information

Rice market is very much unstable and unpredictable. Proper market information is essential. T.Aman farmers are deprived of information.

7.4 Social and Other Problems

7.4.1 Loss of Production Due to Walking or Boating inside paddy field

At the rainy season all paddy fields of Narail district goes under water. People use boat for transportation. They usually use shortcut through the paddy field. It hampers the production of Aman.

7.4.2 Damage by Animals

Domesticated animals like cows, goats, duck and birds can consume leaves and paddy as their food. It is a social problem for rice grower of Narail district.

7.4.3 Spoilage

Spoilage of paddy affect negatively to the rice cultivators.

7.5 Others

7.5.1 Natural disaster

Every year natural disaster like heavy rainfall, heavy wind, salinity in the water, water logging occurs in the district. This hampers T.Aman rice production much.

CHAPTER VIII

SUMMARY, CONCLUTION AND RECOMMENDATION

CHAPTER VII

SUMMARY, CONCLUTION AND RECOMMENDATION

In this chapter, major findings, conclusion and policy recommendations are highlighted. The findings and observations of both Local and HYV T.Aman rice growers on various issues related to the production like costs, returns and profitability along with the socio-economic condition of farmers are presented briefly in this chapter.

Summary

The land of Bangladesh is very much congenial and fertile for producing different types of cash and food crops. The rain fed river siltation of the land makes it beneficial for producing crops here. Rice is the major food crop and staple food of about 135 million people of Bangladesh. Rice sector contributes one half of the agricultural GDP and one sixth of the national income in Bangladesh. (Bangladesh Rice Knowledge Bank)

Narail district is very well known for rice cultivation. As most of the land here is low land in the Aman season (rainy season) most of the land goes under water. In this time some local rice takes the place as main crop in the field besides HYV T.Aman are grown in slightly high areas. In Narail district there are three upazilas: Narail Sadar Upazila, Kalia Upazila and Lohagara Upazila. Among these upazillas, all three upazillas was selected purposively. Then villages were purposively selected among 651 villages of this upazillas. Finally, 60 farmers were selected (30 for modern HYV's and 30 for local variety) randomly from farmers list of this upazilas.

The total sample sizes from three upazilas were 60 T. aman rice cultivators. The number of sample from each upazila was 20 rice cultivators. A simple random sampling procedure was used to select the farmers who cultivate T. aman rice in these area for collecting the data. Data was collected July to December 2019. Additionally, secondary data were also collected from various sources like Encyclopedia, Bangladesh Rice knowledge bank of Bangladesh Rice Research Institute (BRRI), Bangladesh Bureau of Statistics (BBS) and Ministry of Agriculture. Then all the collected data was stored and scrutinized. The Cobb-Douglas production function was used to analyze the effects of the independent variable on the dependent variable.

Firstly, the socio-economic condition of farmer was analyzed. Different characteristics of farmer like- age, gender, marital status, education, family size, occupation, farming experience and farm size of holdings were taken under consideration during analyzing the socio-economic condition of farmers.For local T. Aman, it was found that the highest number of the respondents (60%) belongs to the Old age (>50 years).On the other hand for HYV T.Aman that the highest number of the respondents (46.67%) belongs to the Middle age (35-50 years). The research found that young energetic farmers are interested in HYV's Cultivation. But the experienced farmers are interested in Local varieties cultivation. It is also found that hundred percent T. Aman farmers were male in the study area.

For local T. Aman, the highest number of the respondents (26.67%) were primary level passed. On the other hand, for HYV T. Aman, the majority of the respondents (36.67%) were just literate.

It was found that 19.17 percent family members were not enrolled of which 8.65 percent were male and 10.53 percent were female. From the data we also found that 29.69 percent family members were just literate, 24.44 percent family members were primary level passed, 19.55 percent family members were high school passed, 3.01 percent family members were graduate and only 0.75 percent family members were post graduate. Rest 3.83 percent family members were child (age<12).

T.Aman farmers of Narail district are not solely dependent on rice cultivation. Beside this they also take part in other occupations also. They practiced fisheries beside T. Aman about 18.33% of the total respondent. The farmers who raised livestock's takes 20% of the total farmers. Respectively 10% and 15% involved in poultry rearing and business. Highest portion (31.67%) acted as day labor during non-agricultural season. And rest 5% migrate for their livelihood.

Here 18.92 percent land occupied by 21 respondents who were marginal sized farmers (0.50-1.49 acres). Majority of the farms were medium sized farms (2.50-7.49 acres) occupied 42.86 percent of total land. Rest 38.23 percent of land occupied by small sized farms (1.50-2.49 acres). There was no large and landless farmer. Average operated land was 1.92 acres. And total operated lands by these 60 farmers were 115.36 acres.

The paper found that for HYV T.Aman the average number of labor is 172.76 man-days per hectare. This was almost three times of local T.Aman rice production. For preparing one hectare of land for Local T.Aman rice it costs 4939.28 tk. On the other hand for HYV T.Aman it costs 6568.32 tk. Per hectare. Machine for weeding, spraying and thrashing cost for local and HYV T.Aman was Tk. 850.64 and Tk. 2064.47 respectively. From the this paper we found that the total variable cost for local T.aman and HYV T.Aman was respectively Tk. 16921.83 and Tk. 42115.42 tk. per hectare of land. Total fixed cost for producing Local T.Aman and HYV T.aman was estimated Tk. 15415.96 and Tk. 31153.84 per hectare. Total cost was calculated by combining variable cost and fixed cost. Total cost for producing Local T.Aman and HYV T.aman was estimated Tk. 32337.79 and Tk. 73269.26 per hectare. The gross return was found for Local T.Aman was tk. 50430.56 per hectare and the gross return for HYV T.Aman was tk. 109419.8 per hectare. For Local T.Aman varieties gross return was tk. 33508.73 per hectare. And for HYV T.Aman varieties gross margin was tk. 67304.38 per hectare. This margin was 33,795.65 taka more than local T.Aman. For local T.Aman net return was tk. 18092.77. On the other hand, for HYV's net return was only tk. 36150.54. This net return for HYV was 18,057.77 tk. more than local T.Aman. Benefit cost ratio for local T.Aman full cost and variable cost basis is 1.56 and 2.98 which is greater than the HYV T.Aman 1.49 and 2.59. That means producing local varieties is much profitable here.

Cobb-Douglas production function model had chosen to determine the effects of different inputs on the yield of local T.Aman rice and HYV T.Aman production because of its best fit. Thirteen independent variables such as human labor, land preparation cost, seeds/seedling cost, urea, TSP, SSP, DAP, MOP, Gypsum, $ZnSO_4$, manure, pesticides and supplementary irrigation costs were taken into consideration as they are likely to have an impact on gross return of T.Aman rice production. The value of local T.Aman R^2 was 0.7927 , that means the variables considered in the models can explain 79.27 percent of the variation in yield explained by independent variables include in the model. On the other hand the value of HYV T.Aman R^2 was 0.8556, which means the variables considered in the models can explain 85.56 percent of the variation in yield explained by independent variables include in the model. The effect of land preparation cost, seedling cost and TSP cost were significant for local T.Aman rice. Other taken variables had

insignificant effect on local T.Aman rice. Human labor cost, seedling cost, manure cost and supplementary irrigation cost had significant effect on gross return of HYV T,Aman rice.

By resource use efficiency analysis it was found that human labor, seeds, manure and pesticides were over utilized in local T.Aman. Farmers should reduce use of this inputs. Land preparation, Urea, TSP, DAP, Gypsum, $ZnSO_4$ and Irrigation were underutilized and farmers should increase use of this inputs to obtain efficiency. On the other hand Seeds, TSP, MOP, Gypsum and $ZnSO_4$ were over utilized in HYV T.Aman. Farmers should reduce use of these inputs. human labor, land preparation, urea, SSP, DAP, manure, pesticides and irrigation were underutilized and farmers should increase use of this inputs to obtain efficiency.

The present study identified some problems faced by the farmers in the study area. The problems were high input price, insufficient credit facilities/ lack of capital, shortage of agricultural labor, high wage rate, poor agronomic practice, lack of scientific knowledge and training, attack by pests and diseases, inadequate and underdeveloped market, lack of storage facilities, natural disaster etc.

Conclusion

The present study was conducted to compare the profitability of the local and HYV T.Aman rice growers. The thesis found that young energetic farmers were interested in HYV's Cultivation. But the experienced farmers were interested in Local varieties cultivation. For local T. Aman, the highest number of the respondents (26.67%) were primary level passed. On the other hand, for HYV T. Aman, the majority of the respondents (36.67%) were just literate. Most of the respondent's family (80%) belonged to small size family categories. Additionally, it was also found in the study that for Local T.Aman varieties gross margin is tk. 33508.73 per hectare and for HYV T.Aman varieties gross margin was tk. 67304.38 per hectare. This gross margin was 33795.65 taka more than local T.Aman. For local T.Aman net return was tk. 18092.77. On the other hand net return was tk. 36150.54 for HYV T.Aman. The net return for HYV T.Aman was 18057.77 tk. more than local T.Aman. Benefit cost ratio for local T.Aman full cost and

variable cost basis is 1.56 and 2.98 which is greater than the HYV T.Aman 1.49 and 2.59. That means producing local varieties is much profitable in Narail district.

Recommendations

The following recommendations can be suggested to overcome the constraints of local and HYV T.Aman rice cultivation faced by the farmers.

1. Most of the farmers found illiterate, just literae and completed primary level of education. Higher education and technical knowledge needed for their well-being and much productivity. Most of the farmers keep a little knowledge about modem technology of growing rice. Scientific Knowledge and Trainings needed for trained manpower and to handle commercial agricultural activities. Government should take necessary training program for farmers of this study area.

2. Majority of the respondents reported that costs of inputs for producing of local and HYV T.Aman rice were high. For this reason, they could not provide the recommended dose of inputs during plantation of local and HYV T.Aman rice. Government should provide all possible help to supply required amount of inputs and capital to the farmers. Inputs like seed, fertilizer and insecticides should be provided at subsidized rate.

3. A large portion of farmers said that labor was scarce in the rural area. As a result, the wage rate was high which made the cultivation cost high. Government can take initiatives to make the rural sector more attractive to reduce the migration of labor. If the availability of labor in rural area becomes high, the wage rate will automatically reduce.

4. The biggest problem of rice cultivation at this time is the low price of paddy. Though government has taken initiatives to buy paddy directly from farmers, some corrupted middleman still controlling the system. All farmers reported that they did not receive fair price of the output. To ensure the fair price and control fluctuation of price of local and HYV T.Aman rice the government should intervene in the procurement and marketing process of local and HYV T.Aman rice. Government should take action against stock keepers.

5. Farmers had to sell their produce at low price to middleman because they had no storage facilities. Government can make storehouse in rural areas near farmers field which may help them to store their produce during off season and sell it when they get

reasonable price. Loss of yield happens due to late plantation and late harvesting for the scarcity of agricultural labor at that time.

6. Insufficient credit was a big problem for farmers. Most of the farmers are running their farming business by their own fund. Many farmers faced the problem of lack of capital. For this reason, they could not provide the recommended dose of inputs during plantation of local and HYV T.Aman rice. Government can encourage private banks to provide loan at low interest rate to farmers.

7. Government can give subsidy on the electricity and fuel cost on the agricultural sector by reducing the cost.

8. Many farmers also faced the problem of high transportation cost. Unfavorable roads and transportation system was the reason for this high cost. More infrastructure development like building new and construction of poor road and culvert can reduce the problem.

REFERENCES

REFERENCES

Akhter, S. (2011). Profitability and resource use efficiency of BRRI Dhan 29 in old Brahmaputra floodplain areas. M.S. thesis, Department of Agricultural Economics, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur.

Anik, A.R. (2003). Ecomomic and financial profitability of aromatic and fine rice production in Banglagesh, M.S. thesis, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh.

Banu, B. (2011). A comparative economic analysis of Br-28, BR-29 and Hybrid Hira rice production in a selected area of Kurigram district.M.S. thesis, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh.

Bangladesh Economic Review, (2019), Finance Division, Ministry of Finance, Government of the people's republic of Bangladesh.

Bangladesh Economic Review, (2018), Finance Division, Ministry of Finance, Government of the people's republic of Bangladesh.

Bangladesh Economic Review, (2017), Finance Division, Ministry of Finance, Government of the people's republic of Bangladesh.

BBS, (2019). Yearbook of Agricultural Statistics, Bangladesh Bureau of Statistics and Information Division, Ministry of Planning, Government of People's Republic of Bangladesh.

BBS, (2018). Yearbook of Agricultural Statistics, Bangladesh Bureau of Statistics and Information Division, Ministry of Planning, Government of People's Republic of Bangladesh.

BBS, (2017). Yearbook of Agricultural Statistics, Bangladesh Bureau of Statistics and Information Division, Ministry of Planning, Government of People's Republic of Bangladesh.

Chowdhury, K.N. (2012). A study on the economic potential of BR-28 and BR-29 in a selected area in Rangpur District, M.S. thesis, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh.

DAM (2018), Department of Agricultural marketing, Ministry of Agricultural, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.

Hasan, K. (2015). A comparative economic analysis of Aus rice and jute production in some selected areas of Netrokona district. M.S. thesis, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh.

Hanifa, A. (2009). A comparative economic analysis of BR-29 and Hybrid Hira rice production in some selected areas of Netrokona district. M.S. thesis, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh.

Hoque, M.Z. and Haque, M.E. (2014). Economic profitability of boro rice production in a selected area of Bangladesh. The Agriculturists, 12(1): 33-40.

Islam, S. (2001). A study on economic potential of Bina-6 rice production in a selected area of Mymensingh district. M.S. thesis, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh.

Kamruzzaman, S.A. (2011). A comparative study on economic potential of BRRI Dhan-51 and BR-11 rice production in a selected area of Rangpur district, M.S. thesis, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh.

Kana, K.A. (2011). A comparative economic analysis of salt tolerant Binadhan-8 and HYV BRRI Dhan 28 rice production in Satkhira district of Bangladesh. M.S. thesis, Department of Agricultural Economics, Bangladesh Agricultural University,Mymensingh.

Khan, A.R., Saha, K.M., Ghosh, B.K. and Uddin, F.T. (2011). Resource use efficiency and profitability of boro rice production in Mymensingh district of Bangladesh. Field Crops Researsch. 151: 72-81.

Rahman, A. and Nargis, K. (2015). A study on economic potential of BRRI Dhan -29 production in a selected area of Mymensingh district. Field Crops Research, 140 (2): 38- 47.

Islam, M. Rafiqul & Hossain, Mahabub & Jaim, W. M. H., (2004). Technical Efficiency Of Farm Producing Transplanted Aman Rice in Bangladesh: A Comparative Study of Aromatic Fine and Coarse Varieties, Bangladesh Journal of Agricultural Economics, Bangladesh Agricultural University, vol. 27(2), pages 1-24, December.

Khalique, M.F.B., Sarker, M.T., Islam, S., Murmu, H. & Rasel, M. (2019) . Economic Analysis of Rice Production in Bangladesh. United International Journal for Research & Technology;1: 8-17

Shamsuddula, A.M. (2004). Comparative economics of Local Boro and Hybrid rice production in terms of profitability and efficiency in Mymensingh. M.S. thesis, Department of Agricultural Economics, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur.

Shelley, I.J., Takahashi-Nosaka,M., Kano-Nakata,M., Mohammad,S.H. and Yoshiaki, I. (2016). Rice Cultivation in Bangladesh: Present Scenario, Problems, and Prospects. Journal of International Cooperation for Agricultural Development, 14: 20–29

Siddiqui, M.J. (2008). A comparative economic study on profitability of BRRI Dhan33 and BR-11 rice production in Ulipur upazilla of Kurigram district. M.S. thesis, Department of Agricultural Economics, Bangladesh AgriculturalUniversity, Mymensingh.

Ullah, A.M. (2008). Comparative profitability and technical efficiency of aromatic and non-aromatic Aman rice production in Dinajpur district. M.S. thesis, Department of Agricultural Economics, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur.

Appendix I

Department of Agricultural Economics

Sher-e-Bangla Agricultural University, Dhaka-1207

INTERVIEW SCHEDULE ON

COMPARATIVE FINANCIAL ANALYSIS AND RESOURCE USE EFFICIECY OF HIGH YIELDING RICE VARIETIES (HYV's) AND LOCAL RICE VARIETIES OF TRANSPLANT AMAN (T.AMAN) IN SOME SELECTED AREAS OF NARAIL DISTRICT.

Sample No. _____

Objective (s):

i) To investigate socio-economic profile of T.Aman Rice farmers.
ii) To estimate the profitability level of modern T. Aman rice and local T. Aman variety.
iii) To know the resource use efficiency of modern T. Aman rice and local T. Aman variety.
iv) To identify the problems of modern T. Aman rice and local T. Aman variety cultivation in Narail area and
v) To provide policy recommendations from the above.

1. IDENTIFICATION OF RESPONDENT

Name: Union: Mobile:

Village: Upazila:

2. Family Composition:

Sl. no	Relation to HH	Sex	Age	Education	Farming Experience (year)	Occupation	Training	Annual income from off-farm/ non-farm
1								
2								
3								
4								
5								
6								

Education code: 0= Illiterate, 1=Just literate, 2=Primary level passed, 3=High school passed, 4=Graduate, 5= Post graduate, 6=Child (age<12)
Sex code: 1= Male, 2= Female
Training: 1=Yes, 2=No
Occupation: 1=Agriculture, 2=Agricultural labor, 3=Service, 4=Non-agricultural Labor, 5= Rickshaw/Van pulling

3. Land Holding and tenancy

Area in Bigha (1 bigha= 0.33 decimal)

(1kani=.35 dec; 1 bigha= 3.00 kani)

Category	Own cultivated land	Leased-in	Leased-out	Rented in	Rented out	Mortgage in	Mortgage out	Total operated land(2+3+5+7-4-6-8)
1	2	3	4	5	6	7	8	9
Cultivable land								
Homestead								

4. Information about annualfamily source ofincome:

Agriculture	Total amount	Present value (Tk)	Family consumption		Amount of remainder (tk)
			Amount (kg)	Value (tk)	
Farm income					
Rice (mound)					
Fisheries: i. Capture					
ii. Cultivation					
Livestock: i.Milk					
ii. No of Animal: a. Cow					
b. Goat/Sheep					
Poultry					
Other					
Non-farm income					
Service					

Day labor on others farm					
Business/Trade					
Foreign source					
Shops					
Handicraft					
Boat sailing					
Other:					

Farmer's occupation during off-agricultural season

Occupation	Yes/No
Fisheries	
Livestock	
Poultry rearing	
Business	
Day Labor	
Migration	

5. Primary utilization pattern of T. Aman rice:

Total production of Aman (mound)	Paid as kind (Harvesting and threshing) (mound)	Used for family consumption (mound)	Used as seed(mound)	Sold (mound)

Pattern of T. Aman rice sold by farm households

Items	Sale before harvest	Sale within 0-1 month of harvest	Sale within 2-5 month of harvest	Stored for sale after 5 months
Amount (mound)				
Price Tk/md				

To whom rice crop is sold?

Item:

Directly to millers: ……..

Middleman ……..

Govt. procurement centre ……..

Directly to nearby market ……..

Directly to neighbor ……..

Farmers to farmers exchange ……

Do you usually store Aman rice to sale after 5 months (yes/no), if yes why?

If no, Why don't you store Aman rice to sale after 5 months?

6. Availability of cash capital for farming

Yes	No

operation

7. Sources of seed: Owned (%)……. Purchased (%)……..

8. If loan is needed, institutional loan is

Yes	No

available or if

ifnot why,

9. Plot wise information about variety grown in last season:

Sl no	Name of variety	Plot area (dec)	Plot yield (mound)	Yield (t/ha)
1				
2				
3				
4				
5				

10. Varieties grown during last 5 years in Aman season

Name of the previously grown variety		Name of currently grown variety	
Modern	Local	Modern	Local

11. Local or Deshi varieties grown during last 5 years

Name of the previously grown variety	Name of currently grown variety

12. Reasons for cultivating existing 5 major varieties including deshi/local, if any

Sl no	Variety	Positives traits	Negative traits

13. COST AND RETURN OF RICE PRODUCTION AT FARMER'S FIELD

i. Variable cost
ii. Fixed cost
iii. Total cost (a+b)

i. Variable cost calculation

Input use pattern of Aman rice crops

Items	
Name of variety	
Size of plot (decimal)	

i.a. Human labor requirement (Man-days)

Practices	Own labor (tk)	Hired labor (tk)		Contract payment (tk)(if any)
		With meal	Without meal	
Seed bed preparation and sowing				

Mainland preparation (Ploughing and laddering)				
Uprooting and transplanting				
Fertilizer and top dressing				
Manuing				
Weeding				
Pest management				
Irrigation				
Harvesting				
Carrying & Threshing				
Winnowing, Sunning, drying and storing				

Wage Rate with meal (tk/day):
Wage Rate without meal (tk/day):
i.b. Animal/ mechanical power used

Operation	Machine (tk)		Animal (tk)	
	Own /Family	Hired	Own/Family	Hired
Ploughing/Laddering				
Weeding				
Spraying				
Threshing				

i.c. Material input used

Inputs	Quantity used	Price (tk/kg)	Cost (tk)
Seeds/seedling (kg)			
Urea: Basal (kg)			
1st dose (Kg/plot)			
2nd dose (Kg/plot)			
3rd dose (Kg/plot)			
TSP(Kg)			
SSP(Kg)			
DAP(Kg)			
MOP(Kg)			
Gypsum(Kg)			
$ZnSO_4$ (Kg)			
Manure (md) : a. Home			
b. Bought			
Ashes (md)			

Pesticides:			
1st dose (ml/plot)or (Kg/plot)			
2nd dose (ml/plot)or (Kg/plot)			
3rddose (ml/plot)or (Kg/plot)			
4th dose (ml/plot)or (Kg/plot)			
Other			
Irrigation/ Supplementary Irrigation			
Other			

Fertilizer price (tk./50 kg): Urea…….., TSP……..,
MOP……,
Gypsum……., Zinc…….. Sulphate……,
DAP……,
Farmyard manure…… Ashes…….

14. Credit information

a. Have you borrowed any capital for this crop cultivation?
Yes…….. No……

If yes, please mention the source and amount of credit received

Source	Cash	Kind	Amount received	Interest rate
Local Farmer				
Friends and relatives				
Bank				
NGO				
Money Lender				
Other				

Please mention the purpose the credit was spent

Purpose	Amount (tk)
Buying fertilizer	
Buying seed/seedling	
Buying Insecticides	
Paying Lobor wage	

Paying irrigation cost	
Paying Bullock	
Others	

15. Grain and by-product yield

Item	Plot size	Good seasonal weather	Normal seasonal weather	Bad seasonal weather
Grain Yield (Mound/plot)				
By-product (mound/plot)				

16. Grain and By-product price

Item	within 1 month of harvest	within 2-5 months of harvest	After 5 months of harvest
Paddy price (Tk/mound)			
Rice price (Tk/mound)			
By product value (tk/plot)			

17. What are the major constraints of T.Aman rice cultivation in Narail area:

	Rank

18. What is your opinion about the cultivation of T. Aman for higher yield

Sl no	
1	
2	
3	
4	

5	

Name of Enumerator:

Date……

Appendix II

Cobb-Douglas production function output for Local T.Aman-

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.890346
R Square	0.792716
Adjusted R Square	0.666042
Standard Error	0.247324
Observations	30

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	11	3.62E+09	3.29E+08	6.257931	0.000341
Residual	18	9.45E+08	52523707		
Total	29	4.56E+09			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	10.567363	1.0898033	9.6965789	1.432E-08	8.2777715	12.856955	8.2777715	12.85695488
man days/ha	-0.0420353	0.2536562	0.1657175	0.8702264	-0.5749472	0.4908766	0.5749472	0.490876643
land preparation (tk/ha)	2.79423	0.791899	3.528521	0.0024	1.130513	4.457947	1.130513	4.457947
Seeds/seedling (kg/ha)	-710.062	353.677	-2.00766	0.059932	-1453.11	32.98637	-1453.11	32.98637
Urea: Basal (kg/ha)	0.0731567	0.1649691	0.4434572	0.6627193	-0.2734305	0.419744	0.2734305	0.419743958
TSP(Kg/ha)	232.1593	108.4482	2.14074	0.046235	4.318161	460.0005	4.318161	460.0005
DAP(Kg/ha)	0.0127559	0.1054129	0.1210093	0.9050242	-0.2087083	0.2342202	0.2087083	0.234220169
Gypsum(Kg/ha)	0.0139556	0.0577248	0.2417615	0.8116978	-0.1073197	0.135231	0.1073197	0.135230981
ZnSO4 (Kg/ha)	0.0883477	0.2270236	0.3891566	0.7017257	-0.3886112	0.5653067	0.3886112	0.565306662
Manure (md/ha) : a. Home	-0.0528595	0.0531836	-0.9939059	0.3334428	-0.1645942	0.0588751	0.1645942	0.058875122
Pesticides(taka/ha)	-0.0192293	0.0261789	-0.7345336	0.4720851	-0.0742292	0.0357706	0.0742292	0.035770578
Irrigation/ Supplementary Irrigation(tk/ha)	0.0599746	0.0679147	0.8830869	0.3888315	-0.0827089	0.2026581	0.0827089	0.202658114

Appendix III

Cobb-Douglas production function output for HYV T.Aman-

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.92499
R Square	0.8556065
Adjusted R Square	0.7382868
Standard Error	0.2838958
Observations	30

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	13	7.641252	0.5877886	7.2929481	0.0001772
Residual	16	1.2895495	0.0805968		
Total	29	8.9308016			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1.9947286	4.0174519	0.4965159	0.6262827	-6.5218888	10.511346	-6.5218888	10.511346
X Variable 1	0.9346673	0.3680801	2.5393043	0.0218709	0.1543724	1.7149621	0.1543724	1.7149621
X Variable 2	0.5760092	0.5042974	1.1422014	0.2701758	-0.4930535	1.645072	-0.4930535	1.645072
X Variable 3	-0.2368725	0.1323703	-1.7894689	0.0924832	-0.517485	0.04374	-0.517485	0.04374
X Variable 4	0.0044923	0.2145116	0.0209418	0.983551	-0.4502519	0.4592364	-0.4502519	0.4592364
X Variable 5	-0.1758621	0.2137309	-0.8228203	0.4227046	-0.6289514	0.2772271	-0.6289514	0.2772271
X Variable 6	0.0228503	0.0943365	0.2422207	0.8116866	-0.1771342	0.2228348	-0.1771342	0.2228348
X Variable 7	0.0024037	0.057548	0.0417684	0.9672001	-0.1195925	0.1243999	-0.1195925	0.1243999
X Variable 8	-0.005938	0.0797561	-0.0744525	0.9415732	-0.1750135	0.1631374	-0.1750135	0.1631374
X Variable 9	-0.1887165	0.1040984	-1.8128667	0.0886565	-0.4093952	0.0319622	-0.4093952	0.0319622
X Variable 10	-0.007662	0.1177249	-0.0650838	0.9489136	-0.2572275	0.2419036	-0.2572275	0.2419036
X Variable 11	0.3234832	0.1149804	2.8133761	0.0124917	0.0797356	0.5672309	0.0797356	0.5672309
X Variable 12	0.0027015	0.0418272	0.0645876	0.9493025	-0.0859682	0.0913712	-0.0859682	0.0913712
X Variable 13	0.1273343	0.0278278	4.5757957	0.0003109	0.068342	0.1863266	0.068342	0.1863266