

Doctoral Dissertation

**Agricultural Production According to Land Tenure Arrangements in
Bangladesh: A Case Study of Basail Upazila**

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**Graduate School for International Development and Cooperation
Hiroshima University**

September 2015

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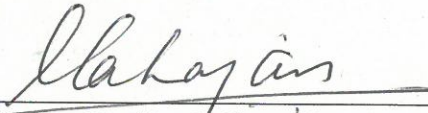
ISLAM MD. AMINUL

**A Dissertation Submitted to
the Graduate School for International Development and Cooperation
of Hiroshima University in Partial Fulfillment
of the Requirement for the Degree of
Doctor of Philosophy**

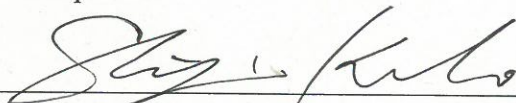
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We hereby recommend that the dissertation by Mr. ISLAM MD. AMINUL entitled "Agricultural Production According to Land Tenure Arrangements in Bangladesh: A Case Study of Basail Upazila" be accepted in partial fulfillment of the requirements for the degree of DOCTOR OF PHILOSOPHY.


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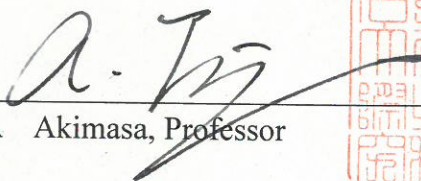
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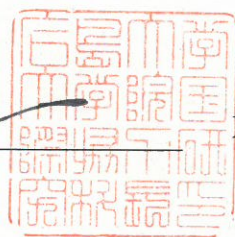
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Graduate School for International Development and Cooperation
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Dedication

Dedicated to my beloved family members

This study is also dedicated to the tenant farmers those who are not getting their legal right in share cropping cultivation but contributing for the betterment of economy of Bangladesh.

Summary

Land is a very important factor of production in an agricultural developing country like Bangladesh. Land reform ordinance 1984 was formulated and declared by the government of Bangladesh in due respect for the improvement of agricultural production as well as the proper utilization of agricultural lands in the country by properly addressing the tenancy issue of share cropped land. The academic contribution of this thesis lies in evaluation of implementation and agricultural production aspect of this land reform ordinance 1984, which is a very important issue in the national perspective of Bangladesh. The aim of this thesis is to analyze the various aspects of land tenure arrangements on agricultural production based on with and without implementation of land reform ordinance 1984. The study area was selected at Basail Upzila (sub- district) of Tangail district in Bangladesh, as the farmers of this Upazila have location advantages in farming those can represent the various regional characteristics of land tenure arrangements in the country, including cropping patterns and other concerned issues in farming. Other related aspects those affect on land tenure and agricultural production were also assessed. Data were collected from 150 respondents of equally 50 from each category of owner, owner cum tenant and tenant farmers. This data were collected from January to March, 2013 by stratified random sampling technique based on the cultivated crops in a cropping year. Then the collected data were analyzed by statistical analytical software Stata 13. There are two core chapters (Chapter 5 and 6) have been incorporated in this thesis. These include analyses of various aspects of agricultural production, according to land tenure arrangements. This Thesis has attempted to locate the most relevant theoretical models to explain the econometric outcomes in the relevant chapters. The first core chapter (chapter 5) attempts to analyze the agricultural production in the different land tenure arrangements of Basail Upazila of Tangail district in Bangladesh. This study shows that output sharing is conducted according to this legal provision of land reform ordinance 1984 but input cost sharing are not practiced accordingly in share cropped land. Those lead the tenant farmers (share croppers) in lack of proper incentive. That is revealed in benefit cost ratio and analysis of variance of net revenue of the farmers. From this analysis of variance, it is found that there is a statistically significant difference from zero among the net revenue of owner, owner cum tenant and tenant farmers. Again, this benefit cost ratio in owner cum tenant mortgaged land is higher than that of both the owner cum tenant or tenant share cropped lands. This indicates the potentiality to transform share cropped land into mortgaged land for the cultivators. The second core chapter (chapter 6) identifies the technical efficiency of different categories of

farmers. From this study it is found that there is a statistically significant difference from zero among the technical efficiency of various categories of cultivated land of the farmers. This technical efficiency becomes higher in share cropped lands if input cost is shared by the land owner according to the legal provision of land reform ordinance 1984. It is also found significantly positive influence of credit on this technical efficiency.

From the above mentioned various analysis, it can be holistically detected that, proper implementation of land reform ordinance 1984 is needed for achieving the proper incentive in cultivation of share cropped land, enhancement of technical efficiency, Profitability in crop cultivation for the cultivators as well as for the better outcome of agricultural production in Bangladesh.

Preface

This Thesis aims to study various aspects of land tenure in the utilization of agricultural lands in the country. This study was conducted based on household level survey data collected in January - March, 2013. In doing so, this study starts with a general background of the study chapter, which introduces research problem and its objectives. Chapter 2 illustrates literature review, including agricultural land issues in Bangladesh. The review depicts the land issues scenario in Bangladesh over time. Chapter 3 is on analytical flow and methodology. This chapter includes an analytical flow, study area, linking stochastic frontier model in the flow, source of data, sampling technique and data analysis those were used in this study. Chapter 5 is on agricultural production in the different land tenure arrangements of Basail Upazila of Tangail district in Bangladesh. This chapter also presents a detailed study on profitability of different crop cultivation in farming aspect. The result of this chapter has been published in the Bangladesh journal of agricultural research as an article. Chapter 6 is on Technical efficiency of different categories of farmers. The outcome of this chapter has been accepted as an article in the journal of Bangladesh agricultural research. The finding of this chapter also has been presented in the 8th Asian Society of Agricultural Economists (ASAE) conference. The outcome of eco-friendly aspect of the study has been submitted to the Journal of Bangladesh Development Studies (BIDS) to publish as an article. Lastly, chapter 7 consists of a summary conclusion and recommendation. This study will be helpful for the government of Bangladesh to take appropriate measures for the better utilization of agricultural lands as well as agricultural production in Bangladesh.

Lastly, I want to pay my heartiest thanks to my main academic advisor Professor Maharjan K.L., academic advisor Professor Kaneko S., Academic advisor Associate Professor Seki Koki, academic advisor Associate Professor Kawamura K., other concerned professors of IDEC, Hiroshima University and colleagues.

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Abbreviation and Terminology

BARI	Bangladesh Agricultural Research Institute
BBS	Bangladesh Bureau of Statistics
BDT	Bangladesh Taka
BLM	Binary Logistic Model
BPM	Binary Probit Model
Bigha	Local land measurement unit (0.133 ha equivalent to 1 Bigha)
Barga	Share cropping
Bargader	Share cropper
GDP	Gross Domestic Product
Ha	Hectare
HHH	House Hold Head
IC	Irrigation Cost
Lease	Fixed renting
LFU	Labor Force Unit
LSU	Livestock Standard Unit
MLE	Maximum likelihood Estimation
ME	Marginal Effect
OLS	Ordinary Least Square
SSA	Security in Share Cropping Arrangements
TK	Taka
Tebhaga	Three share
TE	Technical Efficiency

Chapter1. General Background of the Study

1.1 Introduction

Bangladesh is an agricultural developing country. In which 52% of the people derive their livelihood from agriculture. Agriculture is the major dominating sector and this sector contributes 23.50% of the gross domestic product (GDP) of the country. Again, the contribution of the crop sub sector to GDP is 13.44% in the country (BBS, 2011). Rice and fish compost of main diet of Bangladeshi people and fish is the major source of animal protein for the majority of the common people of the country. This fishery sub-sector contributes 75 % of the daily per capita animal protein intake, 8 % of agricultural GDP, 4% of total GDP and 9% of foreign exchange earnings (Chowdhury and Maharjan, 2001).

Land tenure refers to the arrangements (rules, institution and process) through which people gain legitimate access to land. Proper land tenure arrangements are perceived an important strategy for input use and agricultural production in the utilization of land resources. The policies those are related to the land tenure for the improvement of agricultural production as well as proper use of agricultural lands in the country are termed as land tenure policies and land tenure arrangements are administered by these land tenure policies. Agriculture plays a vital role in contributing these dietary issues from prevailing different land tenure arrangements in the country as well as contributing in the national economy. In Bangladesh, 41% of the total people are living below the poverty line and 80% of the total people are living in the rural area where the incidence of poverty is noticeable (Ahmed, 2012). Poverty is concentrated mostly in households, which do not have assets in Bangladesh. Like many other developing countries - land is the single most important asset for the livelihood of people in Bangladesh and tenancy arrangements are commonly used in order to improve access of land for the poor. This thesis explores agricultural production in the different land tenure arrangements based on these various tenancy arrangements among different categories of farmers.

The current agricultural policies are focused on economic restructuring for attaining proper agricultural development. This provides the rationale for this research to study land and livelihood based on the agricultural production according to different land tenure arrangements. It is important to highlight that livelihood strategies among the farmers in the rural Bangladesh are influenced by land tenure rules which are informal and based on customary rules. That is why, how formal rules and policies interact and their impacts are

important to identify the drawbacks as well as taking proper measures for attaining the potential agricultural production having proper agricultural development in Bangladesh.

1.2 Farming Categories in the Study Area

There are three farming categories prevailing in Bangladesh

- a. Owner farming
- b. Owner cum Tenant farming
- c. Tenant farming

Tenancy Arrangements in the Country

Among these farming categories the following tenancy arrangements are observed in the country:

- i. Share cropping
- ii. Leasing (Fixed renting)
- iii. Mortgaging

1.3 Present Land Tenure Scenario in Bangladesh

According to the national census, presently the percentages of owner, owner cum tenant and tenant farmers in Bangladesh are 65%, 22% and 13% respectively (BBS, 2011). But these percentages in the study area are 48%, 28% and 24% respectively (DAE, 2013). Again among these tenancy arrangements crop sharing is practiced only in the case of share cropping arrangements.

1.4 Cultivated Crops in the Study Area

Rice is the staple food in the Bangladeshi diet. In getting this staple source of cereal; High Yielding Variety Boro (HYV Boro), Transplanting Aman (T. Aman), Broadcasting Aman (B. Aman) and other varieties of rice are cultivated by the farmers. But HYV Boro, T. Aman and B. Aman are cultivated by the majority of the farmers. Besides this, mustard, jute, pulses, wheat and vegetables are cultivated by the minor groups of the farmers.

1.5 Paddy cum Fish Farming

Paddy cum fish farming is one of the most recent ideas of the farmers. Farmers are practicing this paddy cum fish farming in utilizing highest and best use of scarce land resource in their crop cultivation. Incorporating this innovative pattern of paddy cum fish farming with their major cultivated crops, farmers are getting extra income from this entrepreneurship as well as

this is helpful for the improvement of the paddy yield also. That is supported by conducted study that paddy cum fish farming systems can improve paddy yields by as much as 10- 20 per cent in Bangladesh, possibly due to better mulching, fertilization of soils through fish waste, and better weed control (Dey et al., 2012). Farmers are practicing this paddy cum fish farming in the study area in the following three distinct patterns to maximize their net revenue and best utilization of their resources:

1.5.1 Paddy cum Fish Farming with T. Aman

This form of paddy cum fish farming is practiced during T. Aman season in cultivating T. Aman along with fish in the T. Aman paddy field. There is a positive externality in this type of paddy cum fish farming. Mulching and fish waste provided by the fish is helpful for the improvement of paddy yield again; generated feed supplied from the T. Aman cultivation is helpful to increase fish production also.

1.5.2 Paddy cum Fish Farming with B. Aman

B. Aman is flood tolerant Local Variety paddy (LV paddy), this B. Aman can be cultivated even in deep water. In cultivation of fish along with B. Aman in the B. Aman paddy field, both B. Aman and fish are mutually benefitted from each other like above mentioned paddy cum fish farming with T. Aman also.

1.5.3 Paddy cum Fish Farming in the HYV Boro Field

Paddy cum fish farming in the HYV Boro field is different than those both paddy cum fish farming with T. Aman or, paddy cum fish farming with B. Aman. In this paddy cum fish farming system, HYV Boro is cultivated in dry season and fish is cultivated in the wet season to make proper use of land. In this paddy cum fish farming in the HYV Boro field, fish waste is beneficial for soil nutrient; again produced fish meal from used chemical fertilizer in HYV Boro cultivation is helpful for fish production. Both HYV Boro as well as fish is getting benefit of positive externalities from this practice also. All of these forms of paddy cum fish farming are practiced by the farmers according their geo- physical viabilities.

1.6 The Economy of Bangladesh

Bangladesh is a low- lying country located in South Asia. This country is formed by a deltaic plain area having surrounded by Ganges (Padma), Brahmaputra (Jamuna) Meghna River and lots of their tributaries. This country has highly fertile soil, but vulnerable to flood, drought

and other natural calamities. This country has a sub-tropical monsoon climate constitutes of seasonal rainfall, moderately warm temperature and high humidity which is very favorable for agricultural production. Bangladesh is the seventh largest country in the world in terms of population; and its population density is more than 1,229 people per square kilometer (Ahmed, 2012).

1.7 Land and Population Scenario in South Asia

There are eight countries in South Asian Association for Regional Co-operation (SAARC). This SAARC was formed in 1980 for the regional co-operation in attaining the economic development among these countries of Bangladesh, India, Bhutan, Pakistan, Sri-Lanka, Maldives and Nepal. Later, Afghanistan also joined the association.

It is found based on the study (Ahmed, 2012) that agriculture sector contributes for the 4th highest (52%) for the employment opportunity in Bangladesh, though the per capita land is lowest (0.12 ha) among these SAARC countries. This study indicates the necessity of proper land use arrangements in Bangladesh.

1.8 Statement of Problem

There are various land use pattern prevailing in the country. This land use pattern affects gross revenue per hectare by using the efficient use of inputs under different land tenure arrangements. Considering the tenancy status of farm lands in Bangladesh, 58% of the land is operated by owner, 40% by owner cum tenant and 2% by tenant farmers. Moreover, about one-fifth of the total operated area is under some kind of tenancy arrangements with share cropping covering about one-half of the land (Tenaw et al., 2009). Owned land, mortgaged land, leased land and share cropped land are cultivated by these farming categories in different patterns. Cultivators get rationality in cultivation of their land having proper incentive in cultivating all of these types of land except this share cropped land. Because, only in the share cropped land cultivators need to provide half of the produced crop to the land owner according to the legal provision of land reform ordinance 1984 but input cost is not shared accordingly. That leads them lack of proper incentive. Land reform ordinance 1984 was undertaken to ascertain this incentive for the share cropped land in sharing 50:50 input cost between land owner and tenant farmers for all the input except labor.

1.9 Rationale

Favorable cultivation process is a pre-requisite for adopting proper varieties and input use. In cultivation of high yielding varieties, if this input cost is shared by the land owner then the adaptation rate becomes higher. But if this input cost is not shared by the land owner then this adaptation rate becomes lower in case of share cropping arrangements. But this adaptation rate becomes highest in case of fixed rental arrangements. Again, there is a potentiality of technological transformation in Bangladesh agriculture, but in share cropping rental arrangements if this input cost is not shared properly by the land owner, then that share cropping arrangements work as a drawback of this potential technological transformation (Hossain, 1991).

1.10 Objectives of the Study

The overall objective is to study agriculture production under different land tenure arrangements in Bangladesh. The specific objectives are as follows;

- i. To explain different land tenure arrangements in Bangladesh.
- ii. To analyze revenue from agriculture production, according to land tenure arrangements in Basail Upazila.
- iii. To assess technical efficiency of agriculture production, according to land tenure arrangements in Basail Upazila.

Chapter2. Literature Review

2.1 Land reform measures in Bangladesh

2.1.1 Introduction

Bangladesh became independent in 16 December, 1971. The depiction of distribution of land ownership in 1979 was 2% households owned 25% of land, 10% households owned 53% of land and the rest 88% households owned only 22% of land in the country. There was absolutely unequal distribution. As a result 80% households enjoyed 20% of income and rest of 20% households enjoyed 80% income in 1980. In the end of nineteenth century tenure complexity reached its highest, 10-15 layers occupy the intermediary interest who all shared the peasant surplus. In this scenario, poorest and upper richer group increase and middle income group decreases (Ullah, 1996).

2.1.2 Ceiling of upper limit of land holding in the different land reform measures

After independence, proper measures were taken for the improvement of agricultural production as well as proper use of agricultural lands in the country. These measures were taken by adapting necessary strategies to establish security and incentive measures by materializing the claim of Tebhaga (Three shares) movement in tenancy system. In addition deregulation of input supply policy and introducing agricultural credit programs were taken by the government of Bangladesh (Fujita, 2010). In this background, Land reform measures were taken in Bangladesh determining the ceiling of upper limit 13.36 hectare (100 *Bigha*) in land reform measure in 1972 and 8.016 hectare (60 *Bigha*) in land reform ordinance 1984. This land reform ordinance was formulated and declared in 1984 for the security and incentive in tenancy system as well as better utilization of agricultural lands in the country. Before this land reform ordinance 1984 tenancy right was not addressed properly, measures were taken to improve this tenancy right as well as betterment of agricultural production for the better utilization of agricultural lands in the country by this land reform ordinance 1984.

Before introducing this land reform ordinance 1984, though there was an upper limit of ceiling in land holding but this restriction was not implemented properly due to the malpractice of owner farmers. They registered their land in the disguise name of their relatives, actually they were the real owner and they were holding land violating this upper limit by adapting this malpractice.

As a result, this initiative was not effective. In this respect, integrated proper measures were taken by the land reform ordinance 1984 in proper utilization of agricultural lands in the country (LRB, 1982).

2.1.3 Land reform ordinance 1984

2.1.3.1 Background of land reform ordinance 1984

2.1.3.1.1 British regime (Before 1947):

Permanent settlement act was enacted during this period in 1793 for collecting tax as well as for the vested interest of the British government in the name of land administration and land management. Zamindary (Big land lord) system was introduced by this act. Before this act, farmers were the owner of the land but after the formation of Zamindary system, Zaminders were the owner of the land and cultivators were tenant. In this zamindary system, Zaminders were authorized to collect the tax and they were also authorized to increase the tax according to their desire (Islam, 1985).

They provided the collected tax to government after deducting the certain percentage for them to maintain the tax collection as well as administrative expenses. As a result, zaminders were used to increase this percentage of tax frequently for their own interest without considering the interest for tenants (Islam, 1985).

Moreover, Zaminders were not interested to take any initiative for the improvement of land. Due to this tenants were exploited, suppressed and deprived from even their legal right during this Zamindary system.

2.1.3.1.2 Pakistan regime (1947- 1971):

Zamindary system was abolished in 1950 by East Bengal state acquisition and tenancy act after the recommendation of Floud commission report. After the dissolve of Zamindary system peasant became direct tenant under government and got property right of their land. Though these initiatives were taken but the outcome was little. Centralization of capital was an obstacle in agriculture. That leads the small scale peasant farmers in secondary occupation. Land ownership pattern changed gradually in a capitalistic trend.

2.1.3.1.3 Bangladesh regime (After 1971):

Bangladesh became independent in 16 December, 1971. After independence, proper measures were taken for the improvement of agricultural production by adapting the required measures to establish security and incentive strategy in materializing the claim of Tebhaga movement in tenancy system by land reform ordinance 1984 in consideration of drawbacks in required land use, but proper implementation is needed.

2.1.3.2 Objectives of land reform ordinance 1984

The objectives of this ordinance were to introduce the reform of the law related to land tenure, land holding and land transfer with the view to maximize production and ensuring better relationship between land owner and tenant farmers.

2.1.3.3 Features of land reform ordinance 1984

The main features of land reform ordinance 1984 are as follows:

- (i) The upper ceiling of land holding is 8.016 hectare;
- (ii) Tenancy right of rented land must be at least for 5 years;
- (iii) The upper ceiling of rented land is 2.004 hectare;
- (iv) Tenant will get the collateral right for the rented land;
- (v) Tenant will get Preference right to buy the land;
- (vi) Ensuring Inherited right in tenancy;
- (vii) Tebaga system in output sharing;

2.1.3.4 Necessity of restriction in the upper ceiling of land holding:

After dissolve the zamindary system, exploitation strategy was changed by the richer group. They start to buy huge amount of land and rent out these land in share cropping arrangement in taking half of the produced crop without sharing any parts of the cost. That leads the share cropping tenant farmers lack of incentive in cultivation of share cropped land rationally.

As a result, restriction was needed successively to maintain the upper ceiling of the land holding (LRB, 1982). In this trend, Tebhaga movement was gradually becoming stronger by the share cropping tenant farmers in the support of rational civil society.

2.1.3.5 Legal provision of land reform ordinance 1984

In this ordinance the division of the produce and duration of share cropping contract aspects are stated as follows:

The produce of any share cropped land shall be divided in the following manner, namely:

- (i) One-third shall be received by the land owner for land;
- (ii) One-third shall be received by the tenant for the labor;
- (iii) One-third shall be received by the land owner or the tenant or by both in proportion to the cost of cultivation, other than the cost of labor, borne by them;

About the duration aspect of the share cropping contract, it is stated that the contract shall be valid for a period of five years commencing from such date as may be specified in the contract.

2.1.3.6 Specification and implication of land reform ordinance 1984

According to this ordinance “Owner” refers in relation to share cropping arrangement the person from whom tenant gets the land for cultivation under a share cropping contract. “Tenant” refers the person who under the system generally cultivates the land of another person on condition of delivering a share of the produce of such land to that person. The main specification and distinct features of this ordinance are as follows:

1. No farmer acquire more than 8.016 hectare of land ...under section 4 (1); Implication of this section is to prevent exploitation of the share croppers from rich farmers.

2. Every Bargader (Share cropper) shall be construed under the specific contract as notified by the government from the 14 April, 1984. If this procedure is not followed by the Bargader will be null & void and government will acquire all such product. Once a Barga (Share cropping) contract is made it shall be valid for next 5 years from the date it is made ...under section 8; the implication of this section is to ensure security in share cropping arrangement.

3. Product grown by Barga system will divided into 3 parts: (1) one- third one will get by the land owner (2) one - third another will get by the Bargader (3) the rest another will get the person who bear the cost of cultivation other than the labor borne by them ...under section 12. The implication of this section is to enhance net revenue (Incentive) in the share cropping arrangement for the tenant.

4. Where the extends to sell the Barga land shall ask the Bargader in writing if he is willing to purchase the land from 15 days from the date of received the offer Bargader has to communicate in writing to the land owner whether Bargader is agree or not to

purchase...under section13; the implication of this section is Bargader will get preference to buy the land. If this is not followed by the land owner then Bargader can complain even in the judicial court.

5. One Bargader can cultivate only 2.004 hectare of land, excess of it is prohibited by law... under section15; the implication of this section is to ensure the intensive use of Barga land.

6. All disputes between Bargader and land owner shall be settled by the authority as may be prescribed by the government ...under section 16; the implication of this section is to make the judgment procedure affordable for the tenant.

7. Accused will be penalized with Taka of two thousand if he violates this ordinance...under section 21; the implication of this section is to make aware the land owner in obeying this legal provision.

8. Suit can be filed in village court for compensation ...under section 6; the implication of this section is to bring the judicial procedure closer to the tenant to make access easy for them.

9. This ordinance came into force on 14 April 1984 as land reform ordinance 1984...under section 1(1); the implication of this section is to enact the ordinance from a fixed date to make the ordinance effective and f fruitful.

2.1.3.7 Problem associated with share cropping arrangement and land reform ordinance 1984

According to Todaro and Smith (2014) giving share croppers a larger share of the produce and security of tenure on the land, the result can be not only higher income of the tenant but also greater overall efficiency. The higher product share gives higher work effort incentives, and greater security of tenure gives greater investment incentives.

Initiative has been taken in this respect in introducing produce and input cost sharing provision (Section 12) of land reform ordinance 1984. This will lead to attain higher share of the produce (Net revenue) for the share cropper. Again, initiative of security has been ensured by determining the minimum duration of rented land (Section 8).

Tenant farmers are poor; they have low income and low employment opportunity outside farming. According to Scott (1976) safety first logic works among farmers in this very low income, little land, large families, vulnerable yields and few outside employment opportunities except farming. This safety first logic is the drawback to increase the average return of the farmers.

Four categories of land namely, owned land, mortgaged land, leased land and share cropped land are cultivated by the farming categories. Cultivators get proper rationality due to proper

incentive in cultivation of their land in cultivating owned land, mortgaged land as well as leased land, but they do not get this rationality in cultivating share cropped land. Because, only in the share cropped land cultivators (tenant farmers) need to provide half of the produced crop to the land owner according to the legal provision of land reform ordinance 1984, but input cost is not shared accordingly, though input cost sharing is also incorporated in this legal provision. That leads to lack of proper incentive to the tenant farmers. Land reform ordinance 1984 was undertaken to ascertain this incentive for the share cropped land.

2.1.3.8 Result in implication of land reform ordinance 1984

Output sharing is conducted according to this land reform ordinance 1984 but input cost sharing is not practiced properly between owner and tenant farmers (Ullah, 1996). This depiction is also found from a conducted study in Bangladesh in 50:50 system of share cropping, the total produce was shared between owner and tenant farmers in 50:50 ratio. In that case the owner shared around 20 percent of the input cost. The rest 80 percent of the production cost was borne by the tenant (CIRDAP, 2009).

2.1.3.9 Limitation of land reform ordinance 1984

According to the provision of this ordinance accused will be penalized Taka two thousand if he violates this ordinance and the matter will be settled in the village court (... Under section 21); there is no provision of imprisonment or, matter to be settled in judicial court for the accused. Due to this limitation owner farmers do not implement this ordinance properly.

2.1.3.10 Land reform ordinance 1984 and agricultural production

Land ownership pattern affects per hectare gross revenue by using the efficient use of inputs under different land tenure arrangements. In Bangladesh, about one-fifth of the total operated area is under some kind of tenancy arrangements with share cropping covering about one-half of the lands (Tenaw et al., 2009).

There are studies (Ahmed, 2012; Asadullah, 2005) about land tenure and tenancy system in Bangladesh refuting the claim about the significance of land leasing in and consequence enhancements in the viability of small farms, it is cited evidence that the terms of tenancy in Bangladesh were very oppressive. In large portion of the cases, the share of land owner was 50 per cent of the produced crops as rent without sharing any parts of the cost and at least 5 per cent of the cases the share of rent was more than 50 per cent.

Thus, when full cost accounting is applied the share croppers incurred a negative return. It is also argued that share croppers were more dependent on family labor than owner farmers and they survived through self-exploitation and tremendous deprivation in the form of under consumption (Ullah, 1996).

2.2 Agricultural land issues, contractual arrangements and efficiency of agricultural production in Bangladesh

2.2.1 Introduction

Access to land refers to the ability to use the land and other natural resources to control the resources and to transfer the rights to the land and take advantage of other opportunities in the rural economy. In getting this advantage different contractual arrangements are prevailed in using agricultural land. Bangladesh is a highly densely populated country. The total area of Bangladesh is 144,000 sq.km and population is 150 million (BBS, 2011). Due to this the distribution of farm holdings has been changed over time and different contractual arrangements are prevailing in agricultural production.

2.2.2 Percentages distribution of agricultural land among households in 1977 and 1979 in Bangladesh

In 1977, 9.67% households enjoyed 50.68% of agricultural land, but 77.67% households was the owner of 25.17% of agricultural land only. The rest 12.66% households got the ownership of 24.15% of agricultural land in the country (LRB, 1982). In this trend, the depiction of distribution in land ownership was 2% households owned 25% of agricultural land, 10% households owned 53% of agricultural land and the rest 88% households owned only 22% of agricultural land in 1979. This depicts the reality of absolutely unequal distribution (Ullah, 1996).

2.2.3 Distribution of farm holdings and area in Bangladesh

Table 2.2.3.1 presents the distribution of farm holdings and area in Bangladesh. From the table it is found that, the percentage of owner farmers was 61.66 in 1996 and this percentage reached in 69.76 in 2008. The percentage of owner cum tenant farmers was 34.86 in 1996 which became 23.73 in 2008. Again the percentage of tenant farmers was 3.48 in 1996 which became 6.51 in 2008. In case of tenant farmers the percentage has been changed merely during this time period. As a result, the average farm size of all tenure categories was 0.61 ha in 1996 and this average farm size reduced in 0.54 ha in 2008. In this turn, per farm household operated area was 0.70 ha in 1996 and this operated area reduced in 0.65 ha in 2008.

Table 2.2.3.1 Percentage distribution of farm holdings and area by type of tenure in Bangladesh

Type of tenure	1996			2008		
	% of farm holdings	% of area	Average farm size (ha)	% of farm holdings	% of area	Average farm size (ha)
Owner	61.66	58.51	0.66	69.76	73.32	0.69
Owner cum tenant	34.86	39.59	0.79	23.73	24.08	0.66
Tenant	3.48	1.90	0.39	6.51	2.60	0.26
ALL	100.00 (11.80 million)	100.00 (8.29 million ha)	0.61	100.00 (14.53 million)	100.00 (9.49 million ha)	0.54

Source: Tenaw et al., 2009 Note: Average farm size indicates average farm size of owner, owner cum tenant and tenant farmers Figures in the parentheses indicate total

2.2.4 Distribution of farm holdings and area in Basail Upazila

The Table 2.2.4.1 depicts the distribution of farm holdings and area by type of tenure in Basail Upazila. From the table it is found that the percentage of owner farmer increased, but the percentages of both owner cum tenant and tenant farmer decreased during this time period. This was because of advantage of owner farmers as well as dis-advantage of owner cum tenant and tenant farmers in their farming. As a result, the average farm size of all tenure categories was 0.48 ha in Basail upazila in 1996. This average farm size reduced to 0.43 ha in Basail upazila in 2008. During this time period the cultivated area in Basail upazila was increased. This was because of newly cultivated area came under cultivation in Basail upazila by covering the low lying riverine area under cultivation. The operated area per farm household in Basail upzila was 0.54 ha in 1996. Again the operated area per farm household in Basail upzila was reduced in 0.47 ha in 2008.

Table 2.2.4.1 Percentage distribution of farm holdings and area by type of tenure in Basail Upazila

Type of tenure	Basail/ 1996			Basail/ 2008		
	% of farm holdings	% of area	Average farm size (ha)	% of farm holdings	% of area	Average farm size (ha)
Owner	64.70	55.87	0.46	68.38	55.67	0.38
Owner cum tenant	29.38	41.79	0.77	27.84	42.59	0.71
Tenant	5.92	2.34	0.21	3.78	1.74	0.21
ALL	100.00 (19,956)	100.00 (10,745 ha)	0.48	100.00 (23,546)	100.00 (10,962 ha)	0.43

Source: Bangladesh Bureau of statistics, 2011 (District series) Note: Average farm size indicates average farm size of owner, owner cum tenant and tenant farmers Figures in the parentheses indicate total

2.2.5 Contractual arrangements on agricultural land

The following contractual arrangements on agricultural land are practiced in Bangladesh:

(i) Share cropping: A fixed share of produced output is needed to provide to the land owner by the tenant as rent for the cultivated land;

(ii) Fixed rate tenancy: A fixed amount of money is needed to pay annually as rent to the land owner by the tenant;

(iii) Mortgaging : A certain amount of money is needed to pay to the land owner as mortgaged money and the duration of this mortgaged land persist until this mortgaged money can be repaid by the mortgagor;

According to Herbon (1994, cited by CIRDAP, 2009), the dynamics of tenancy market in Bangladesh is based on two principles:

(i) The choice of the tenant on the basis of efficiency criteria;

(ii) Reduction in the supply of rentable land, because self- management is both profitable and necessary;

2.2.6 Necessities of share cropping arrangement

According to Todaro and Smith (2014) Share cropping arrangement results into exchange of land with agricultural produce as rent. The phenomenon of risk aversion among small scale farmers in presence of high land holding inequality is the reason for prevalence of share cropping arrangement in Bangladesh. It occurs when peasant farmer uses the land owner's farm land in exchange for a share of produced output. This share may vary from less than one third to more than two thirds of output, which is determined by the local labor availability and other inputs that the land lord provides. Over several decades theories are put forward to explain the existence and increasing trend of share cropping around the world including

Bangladesh (Ahmed, 2012).The popularity in existence of share cropping in the many economies can be justified in the following way:

Firstly, if we do not observe share cropping where theory tells us there should be none, then there is something difference in reality. The theory needs to be argued by a complete depiction of reality. Secondly, at a more ground reality level, share cropping may still exist for compensating aspects, if these aspects can be corrected by appropriate policy measures, share cropping will decrease. Thirdly, these contractual relationships may have implications for other kinds of agreement issues of landlord and tenant. These issues may be the provision of credit to the tenant, contracting parties risk preferences, the tendency to evict the tenants and incentives to make long run improvement in cultivation (Ray, 2008,cited by Ahmed, 2012).

2.2.7 Percentage distribution of area under various pattern of land use arrangements in Bangladesh

Table 2.2.7.1 shows the changes in area under various pattern of land use arrangements during 1983 and 1997. Share cropping remains the dominant form of tenancy arrangement, accounting for about 12.40 percent of area in 1983 and 13.40 percent in 1997.Share cropping is the most common form of tenure arrangement for the poor to gain access to land.

The proportion of share cropping has not changed much despite the fact that there has been a substantial increase in landlessness over time, as a result the percentage of total operated land under owner cultivation was 82.70% in 1983 but this percentage reduced 78.40 in 1997 (CIRDAP, 2009).

Table 2.2.7.1 The percentage of area under various patterns of land use arrangements (as percentage of total land operated), 1983 and 1997 in Bangladesh

Pattern of land use	1983	1997
Share cropping	12.40	13.40
Owner cultivation	82.70	78.40
Total other (Fixed rate, Lease, Mortgage and Others)	4.9	8.2

Source: CIRDAP, 2009

2.2.8 Terms of contractual arrangements:

The landlord sets following four contractual terms in different contractual arrangements (Braverman & Srinivasan, 1979):

- i. Crop share;
- ii. Tenancy size;
- iii. Rate of interest to be charged;
- iv. Necessity of credit that the tenant borrows;

In such condition, policies like tenancy reform or provision of credit to the tenant lower than the market rate cannot improve the tenant's utility level. Hence, only the land re-distribution, intervention in several markets, or rising alternative wage levels can improve tenant welfare. Hence, it is recommended that the planner will have to re-distribute land to the tenant in order to overcome their inability to buy land. This will improve the efficiency in a decentralized economy. Hence, share cropping tenancy remains a second best option as long as the underlying constraints on information or land transfer remain in place (Braverman & Srinivasan, 1979).

2.2.9 Advantages of share cropping arrangement:

(i) Absentee ownership: There are some people those who are not living in the rural areas but they have some agricultural lands. These lands of absentee ownership can be cultivated in this share cropping arrangement. That reduces the rural- urban migration also (Haque & Rahman, 1988);

(ii) Farmers of large farm holding: There are some farmers who have large farm holding and they are unable to cultivate all of their land. These lands can be cultivated in share cropping arrangement (Haque & Rahman, 1988);

(iii) Utilization of agricultural resources (e.g. human labor, draft power etc.) of the tenant farmers: Tenant farmers do not have land but they have some agricultural resources those can be used as inputs in agricultural production. These inputs can be utilized in this share cropping arrangement (Herbon, 1994);

(iv) Advantage over fixed rent: In fixed rent arrangement risk is not shared but in case of share cropping arrangement risk is shared between land owner and tenant farmers;

2.2.10 Dis-advantages of share cropping arrangement:

- (i) Less production: In share cropping arrangement, production become less due to lack of incentive (Shaban, 1987);
- (ii) In share cropping arrangement, cultivators do not get right to cultivate their land permanently, as a result tenant farmers do not get incentive for the improvement of the land quality (Haque & Rahman, 1988);
- (iii) Tenant farmers cannot cultivate the share cropped land in a rational way of cultivation as they need to provide half of the produced crop to the land owner (Haque & Rahman, 1988);

2.2.11 Marshallian model of inefficiency in share cropping arrangement: A comparison of share cropping and fixed rate contract

Alfred Marshall (1890) formalized these efficiency implications of share cropping versus fixed rate contracts (Cited by Todaro and Smith,2014). Marshall assumes that there is a perfect labor market based on output variable in this model. Later on, this model was identified valid and supported by Shaban (1987) .This Marshallian model can be explained geometrically in the following figure 2.2.11.1.

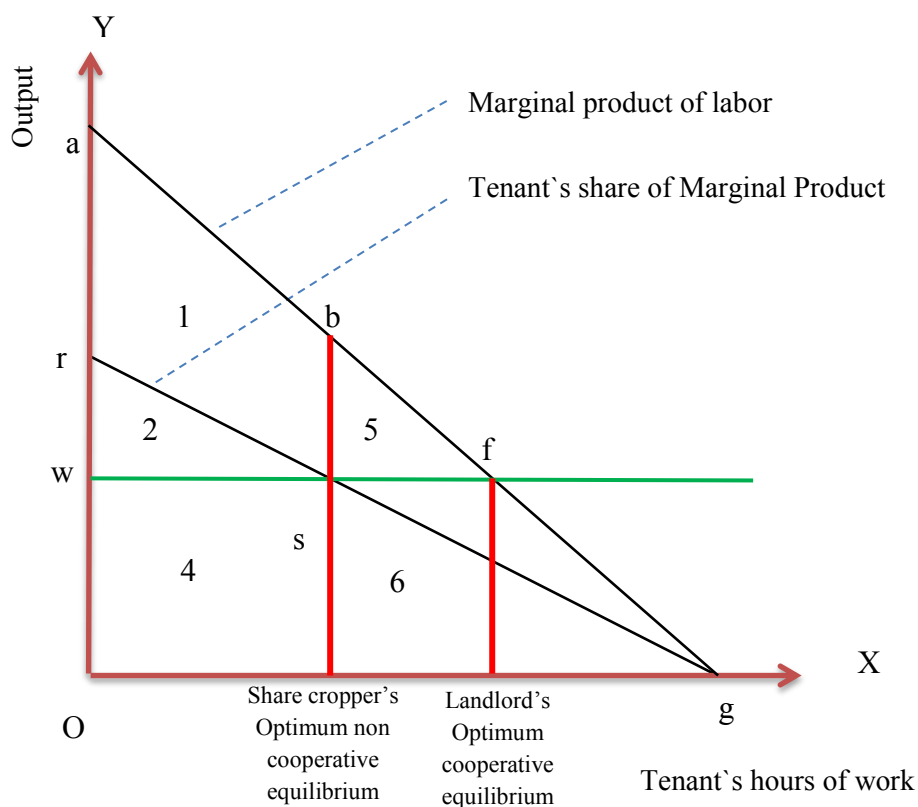


Figure 2.2.11.1 Marshallian inefficiency in comparison of rent under fixed rate and share cropping contracts (Source: Ahmed,S.,2012)

Share cropping and risk:

Share cropping can be defined as a contract where the land lord supplies the land, the tenant supplies the labor and non- labor inputs and produced output is shared by them. In real world, there are similar contracts like share cropping is very common (Ahmed, 2012). Risk and risk aversion also play an important role in determining share cropping tenancy (Cheung, 1968, 1969).

The puzzle of share cropping starts when output sharing is conducted according to legal provision but input cost is not shared accordingly. The classical view of share cropping was first introduced by Adam Smith (1776) in the first volume of Wealth of Nations. Smith discussed the issues surrounding incentives inherent in the share cropping arrangement. Later on in line with Adam Smith, Alfred Marshall (1890) depicted the efficiency implications between share cropping and fixed rate contracts.

In general there will be no equilibrium share that clears the market of land. The Marshallian model assumes that there is a perfect labor market with exogenous wage w per unit of time worked and no risk in crop cultivation.

Geometrically from the figure 2.2.11.1, land lord's rent under fixed rate contract= area 1+2+5 (▲awf); in a rational way of cultivation, where area 5 (▲bsf) is dead weight loss (allocative inefficiency) area. The land lord's rent under share cropping contract= area 1 (▲aws).Hence, the land lord loses area 2+5 (▲rws + ▲bsf); area 2 is loss to the tenant and area 5 is a dead weight loss. This is due to allocative inefficiency. From the figure (2.2.11.1), it is found that in fixed rental arrangement allocative efficiency is obtained but in share cropping arrangement this allocative efficiency cannot be achieved. The result is an excess supply of tenants. However, the land lord would do better by offering a fixed rate contract, thus eliminating the deadweight loss. Mashall argued that share cropping contract should never been observed under the first best condition. This implies there are some other reasons for prevailing share cropping contract. Therefore, the wide prevalence of the share cropping has remained a puzzle based on the socioeconomic condition of owner and tenant farmers.

2.2.12 Moral economy of the peasant in the perspective of share cropping arrangement

Chayanov has shown in his classical study on Russian small holder peasant in respect of various aspects of moral economy (Scott, 1976). If cultivation is practiced in a way only by increasing the extra amount of labor in a fixed plot of land due to abundant supply of labor then marginal productivity of labor becomes very low, nearly zero. Then labor will not get their proper equity, Chayanov called this self-exploitation. If this self-exploitation remains in whole agricultural system, then that is called agricultural involution. Such an economic scenario peasant will adopt "safety first" logic in their cultivation process. Peasant in this safety first logic, minimize the probability of disaster risk rather maximizing average return. It is claimed that if peasant can overcome this safety first logic that might be helpful for them to increase their average return significantly. This safety first logic works in very low income, little land, large families, vulnerable yields and few outside employment opportunities except farming.

Share cropping has existed in various times and places in various forms, due to different types of socioeconomic background of owner and tenant farmers. "Sometimes the tenant's share is one-half, sometimes it is not. Sometimes the output share equals the cost share, sometimes it does not. Sometimes productivity is higher on share cropped land than on other types of tenancy or with self-cultivation, sometimes it is not. Sometimes share croppers are poor, sometimes they are prosperous. Sometimes, share croppers produce risky cash crops, sometimes they produce for subsistence"(Otsuka and Murakami, 2007).

Marshallian tradition is based on one variable, this Marshallian tradition was built on the implicit assumption that the share cropping contract refers to only one variable- share of output. However, as pointed out by Cheung (1968) and other authors, a contract needs not to contain only one variable. Cheung (1968) begins his analysis by arguing that many real world contracts (he draws support for his argument from Taiwan) specify through a set of items such as the amount of land to be cultivated, non-labor inputs to be supplied, etc., in addition to the rental share (Cited by Todaro and Smith, 2014). By incorporating these features in his model, Cheung is able to show the Pareto efficiency in share cropping contract. However, unlike traditional analysis, he views the problem from the landlord's side.

Bardhan and Srinivasan (1971) extended the conventional unilateral maximization approach to a general equilibrium approach using same set of transaction items as Cheung did (1968). They allow both the influence of landlord and tenant in determination of the share cropping arrangement retaining perfectly competitive labor market of Cheung and Marshall. The share tenant in the Bardhan-Srinivasan model has the option of leasing in land to cultivate with his own labor or working as wage labor in some alternative employment.

The tenant is assumed to maximize his utility defined in terms of income and leisure. However, Bardhan and Srinivasan meticulously explain the utility of land issue but do not provide any proof of existence in equilibrium, while they claimed that the price of land is not zero because additional land would provide additional utility.

Perhaps the most common answer for the existence of share cropping is existence of agricultural risk. The terms of tenancy contracts are built upon the magnitude of these predicted and unpredicted risks. The share cropping has been a device to share such risk between landlord and tenant. A number of scholars have attempted to provide a rigorous formulation of this and related problems (Stiglitz, 1974; Holmstrom, 1979; Holmstrom and Milgrom, 1987).

The analysis of share cropping under uncertainty thus provides one with the following rationale for the existence of the institution: firstly, as risk sharing device; secondly, as providing incentives to the tenant; thirdly, as economizing on information or moral hazard problem; fourthly, as a means of screening workers of different capabilities and finally, as a tool for threat of eviction.

In 1979 Newbery and Stiglitz emphasized uncertainty in agricultural production issues and looked more closely at the question of prevalence of share cropping and enriched the environment where there are uncertainties in agricultural production. They assumed both output and product price may be risky. In share cropping arrangement, this risk is shared

between landlord and tenant; thus, the share cropping contract may be better than a fixed rate contract for the risk adverse tenant as well as risk adverse landlord.

Cheung (1960) argued that profit maximizing landlords would establish contract requiring adequate work effort from the tenant as well as stipulate each party's share of output. In such case, if one tenant failed to live up to his part of the bargain, he would be replaced by another tenant who will be willing to work harder. Thus share cropping would be as efficient as any other contractual form.

The overall greater efficiency can be achieved through well designed and enforced land tenancy reform. Costly supervision of labor is also recognized as the cause to allow tenant and landlord to engage in share cropping (Stiglitz, 1974; Braverman & Srinivasan, 1979). Risk and risk aversion also play an important role in determining share tenancy (Cheung 1968; 1969).

Again it is also detected that the negative incentive of crop sharing and difficulty in monitoring effort (transaction cost) are further two reasons to go for share tenancy (Jaynes, 1979, cited by Ahmed,S.,2012).

Moreover, wage rate risk in labor market can also lead to the share cropping contracts to be a superior to mixture of wage and fixed rate contract (Newbery and Stiglitz, 1979, cited by Ahmed,S.,2012).

2.2.13 The economics of share cropping

The phenomenon of risk aversion among peasant farmers in the presence of high land inequality is basically responsible for the prevalence of share cropping arrangement. Although different types of relationship may arise between land owner and tenant farmers who engaged in share cropping contract.

In share cropping contract landlord's share varies place to place time to time. In this contract, the landlord's share may vary from less than a third to more than two-thirds of output, depending on the local labor availability and other inputs (such as credit, seeds and tools) that the landlord provides. Alfred Marshall observed that the tenant farmer was, in effect, paid only part, rather than his entire marginal product and would rationally reduce work effort accordingly. This effect can be seen graphically in the following figure 2.2.13.1. Labor input is found along the x-axis, which may be interpreted as number of hours of work or of total effort; value of output per unit of labor is found along the y-axis. A farmer who owned his own farm land would work until his value of marginal product of labor (MVP_L) was equal

to his alternative wage, or opportunity cost of labor w^A , and so would put in an efficient amount of labor L^F . However a share cropper receives only a fraction Y , of his effort; for example, under 50-50 share cropping, the share cropper's share would be $Y=0.5$. Thus the share cropper would receive only Y of his value of marginal product, or, $YVMP_L$.

As a result, the share cropper would have an incentive to put in an inefficiently low level effort, L^S as seen in figure 2.2.13.1. This view was challenged in the 1960s by Steven Cheung, who argued that profit maximizing landlord establish contracts requiring adequate work effort from the tenant as well as stipulating each party's share of the output. If as Cheung argued, effort is not too difficult to monitor, then if one tenant failed to live up his part of the bargain, he would be replaced by another tenant who was willing to work harder. As a result share cropping would be as efficient as any other contractual form.

Cheung's theory is known as monitoring approach, in contrast to the Marshallian approach to the analysis of share cropping illustrated in figure 2.2.13.1. Cheung argued that labor effort, L^F , would also obtain under share cropping (Klitgaard, 1991, cited by Todaro and Smith, 2014).

In fact, some scholars believe that land lord may offer to the tenant an option of either share cropping or fixed rate rental contract.

Because higher ability farmers more often choose fixed rate contract arrangement to get the full value of their marginal product, while this is not as attractive to the lower ability farmers. If landlord is not sure about the ability of the farmers, then they may find out by observing which ones choose the fixed rate contract.

The motivation may be to enable landlord to squeeze more profits, charging higher effective rents for fixed rate contract than share cropping contract. Again, not too high or even high ability farmers would choose share cropping. This approach is known as screening hypothesis of share cropping contract (World Bank, 1997).

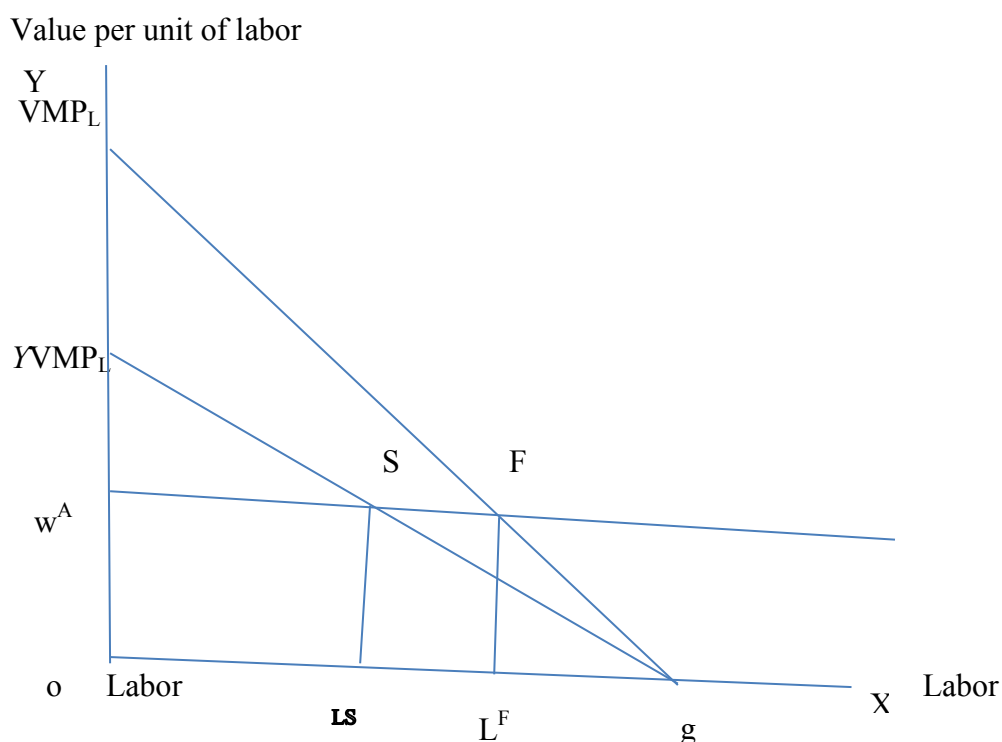


Figure 2.2.13.1 Marshallian incentive under owner and share cropping cultivation (Source: Todaro and Smith, 2014)

Later on in the line of Marshall, Shaban (1987) supported Marshallian inefficiency approach of share cropping and identified comparing the same farmer's behavior under different contractual arrangements using the farm level data from India (Cited by Todaro and Smith, 2014). He compared average per acre value of output produced and different input used across owned land and share cropped land of the same household and found that farmers used fewer input and produced less output on share cropped land than their owned land. These results provide the evidence that share cropping is less efficient than farming in one's owned land.

A final approach suggests that share cropping is relatively efficient after all, in that it makes the best out of an inherently uncertain and risky situation for both the parties according to their requirements. Thus, share cropping represents a compromise between the risk to the landlord that the tenant will not do much work and the risk to the tenant that a fixed rate tenancy will in some years leave him no income.

So, even though share cropping with its poor work incentives is needed in the real world of inequality in land ownership as well as uncertainty by adopting proper measures.

Attempts at re- distributive reform through the establishment of upper ceiling have been a feature both Pakistan and Bangladesh periods, but these were not effective due to the mal-practice of wealthy and powerful people (CARE, 2003).

Beside this, it is found based on the study that re- distributive land reform measure was not suggested because even the landless was found to purchase land using their non-farm incomes and loans from NGOs (Akanda and Shoichi, 2008).

Moreover, it is found from a conducted study in Bangladesh that, in one-half tenancy system of share cropping- the total produce was shared between owner and tenant farmers in a 50:50 ratio. In that case the owner shared around 20 percent of the input cost, mostly the cost of seed and part of the land preparation cost. The rest 80 percent of the production cost - irrigation, fertilizer, pesticide, harvesting was borne by the tenant. Financially solvent tenant never took land under one –half tenancy system (CIRDAP, 2009).

On the other hand, in two- thirds system of share cropping arrangement- tenant farmers got two-thirds of the total produce; in that case, owner farmers did not contribute in any input cost.

The higher share for the tenant, result into higher investment and consequently leads to attain higher land productivity in this two- thirds system of share cropping. As a result it is found that two- thirds system of share cropping was at least 5-20% more productive than one- half system (CIRDAP, 2009).

2.2.14 Farming system and efficiency in agricultural production

The adaptation of proper variety and other socioeconomic factors have significant impact on technical efficiency in rice production of different farming system in Bangladesh (Barmon, 2013). In this study it is found that farmers producing modern variety of rice were more technically efficient than farmers producing rice in prawn gher (Area used for prawn cultivation) farming in the coastal region of Bangladesh.

The noted literatures clearly demonstrate that the stochastic frontier approach is widely used in agricultural economics studies. In case of Bangladesh, it is observed that fragmentation of land generates production inefficiency in agriculture sector (Wadud, 2003). In this study it is also found that farmers could increase their rice production by 9 to 39 per cent if they could operate at full technical efficiency level with their existing resources and technology. The mean technical efficiency of Nigerian agriculture is 77 percent (Idiong, 2007).

The mean technical efficiency of Nepalese rice seed growers is 81 percent and it is found that there was a wide variation in technical efficiency due to education level and experience of the farmers in seed production (Khanal and Maharjan, 2013).

In case of Bangladesh, it is found that adaptation of proper variety has significant impact on technical efficiency (Barmon, 2013). But it is also found based on the study (Hossain, 1991) that in case of share cropping arrangement if input is shared by the land owner then adaptation rate becomes higher in cultivation of high yielding varieties (HYV) but if this input cost is not shared by land owner then adaptation rate becomes lower and this adaptation rate becomes highest in case of fixed rental arrangement. This indicates, in share cropping arrangements if input cost is not shared properly by the land owner then that share cropping arrangement works as a drawback of adaptation of HYV as well as enhancement of technical efficiency.

Moreover, Todaro and Smith (2014) emphasized that security in land tenure is needed to be ensured based on the duration, protection and robustness characteristics of security in land tenure aspect for attaining better outcome. In addition, these incentives and security aspects are also emphasized by Scott (1976) arguing that balance of peasant and elite is needed in consideration of moral and welfare aspects of peasant. This balance should be based on subsistence and security. Cultivators prefer to minimize the probability of disasters rather than maximizing average return in safety first logic. Again vulnerability among peasant starts in the subsistence agriculture from the early childhood of the peasant. That leads to self-exploitation in the long run. Incentive on subsistence and security based preventive measures are needed as protective means of this self-exploitation. Additionally, in share cropping arrangement it is emphasized that giving share croppers a larger share of the produce and security of tenure on the land is needed for the better outcome. This better result can be not only higher income of the tenant but also greater overall efficiency. The higher product share gives higher work effort incentives, and greater security of tenure gives greater investment incentives (Todaro and Smith, 2014). These issues of share cropping arrangement as well as other aspects of agricultural production have been addressed properly in Land reform ordinance 1984 (Unnayan Onneshan, 2009).

Chapter3. Analytical flow and Methodology

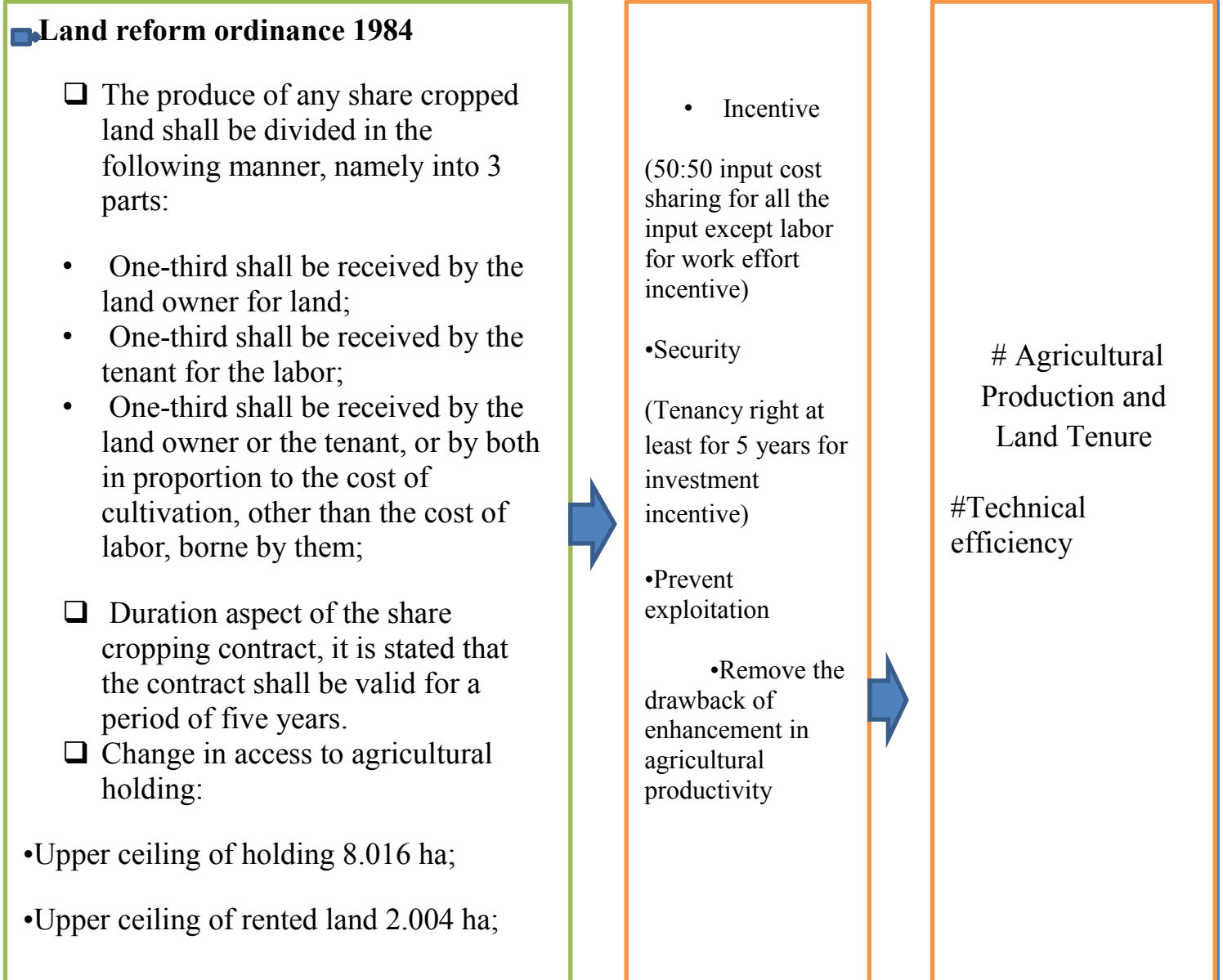


Figure 3.1 Analytical flow of the study

3.1 Interaction of the components within the framework

Focal issue of land reform ordinance 1984 is to maintain the equity aspect of share cropping arrangement. This ordinance was declared to maintain this equity issue for the improvement of agricultural production including agricultural production in share cropped land.

Maintaining the ceiling of upper holding limit was needed to prevent exploitation of the richer farmers to the poorer tenant farmers as share cropping arrangement cannot be practiced as profit oriented commercial business. This ceiling for the upper limit of land holding was introduced by this land reform ordinance 1984. A study on agricultural production in the different land tenure arrangements has been incorporated in chapter 5 based on benefit cost ratio (BCR) and analysis of variance (ANOVA). Technical efficiency in stochastic frontier model has been arranged in chapter 6 to detect the technical efficiency of owner, owner cum tenant and tenant farmers. This technical efficiency in the different land tenure arrangements has been incorporated to enrich the research arena of agricultural production according to land tenure arrangements of Basail Upazila in Bangladesh.



Figure 3.2 Map of study area in Bangladesh

Source: (Alauddin & Sharma, 2013)

3.2 Study Area:

The geographical location of Bangladesh is $20^{\circ}34'$ and $26^{\circ}38'$ north latitude and between $88^{\circ}01'$ and $92^{\circ}41'$ east longitude. The north and west side of this country is surrounded India, east side is surrounded by India and Myanmar and south side is surrounded by Bay of Bengal.

There are 64 districts and 509 Upazilas in the country. This study was carried out at Basail upazila of Tangail district in Bangladesh. The area of Basail upazila is 158 sq. km and population is 176,002.

This study area was selected as this Upazila has some location advantages in farming those can represent the agricultural production according to land tenure arrangements in the different categories of farming.

3.3 Sources of data

Primary sources of data

Data were collected from January, 2013 to March, 2013 by household survey questionnaire method according to the design of the study.

Secondary sources of data

Secondary sources of data are based on literature review on concerned related issues right from the conception is the sources of secondary data. This secondary data were used to enlarge arena of this research.

3.4 Sampling design

This study was conducted based on 150 respondents equally 50 for each category by stratified random sampling technique to trace out the agricultural production in the different land tenure arrangements based on the cultivated crops in a cropping year.

3.5 Data analysis

This study is based on quantitative data collected from field survey, government publication and data bases. These quantitative analyses were supplemented by information generated through group discussions and meeting with the government officials, public representative and civil society in the study area. The results of the collected data were analyzed in relation to the policy and programs undertaken by the government over the periods. For this quantitative analysis, data were collected through field surveys according to the requirement and compiled from government documents were coded and entered into computer for proper processing of the data. Data entry and analysis were conducted using computer packages such as Microsoft excels spread sheets and analytical software STATA 13 according to the requirement of analyzes those data. To find out the general overview of data the initial was done based on simple descriptive analysis, frequencies, percentage and cross tabulations. The other statistical tools used for analysis were analysis of variance, ordinary least square regression, Tobit regression analysis including stochastic production frontier model. All of

these statistical econometric tools were used with theoretical understanding in relation to agricultural production and land tenure arrangements discussed in more detail in the relevant chapters. Gross revenue was calculated produced quantity of crops multiplying by per unit obtained price of the farmers from that concerned crops. In calculating total cost of the farmers all the labor and non- labor cost were taken into account. Benefit ratio (BCR) was used to get the benefit cost ratio based on gross revenue and total cost of cultivated different types of crops in crop wise as well as land category wise in the cultivated various categories of land of the farmers. Net revenue was calculated gross revenue subtracting the total production cost. This net revenue provides the net margin of the farmers. Again analysis of variance (ANOVA) was used to get the mean difference of net revenue of the different categories of land of the farmers. This ANOVA was needed to be assessed based on net revenue, because tenant farmers need to provide half of the produced crop to land owner as rental cost of land. Measuring technical efficiency is one of the approaches for understanding how farmers could maximize the benefits from the proper utilization of existing resources and technologies. This approach can be conducted using production, cost or profit function. This production based approach is called technical efficiency (Battese and Coelli, 1995). This technical efficiency measurement was needed to detect the existing technical efficiency of the different categories of farmers as well as to identify the potentiality for enhancing this technical efficiency. Thus, technical efficiency has been measured to identify this existing efficiency level as well as to detect the maximum attainable technical efficiency level of the farmers in utilizing their existing resources and technologies in crop cultivation in the different categories of cultivated land.

3.6 Linking stochastic frontier model and technical efficiency in agricultural production:

Empirical model for production

$$\ln Y_i = a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + \mu_i \dots (1)$$

Where,

Y = Gross revenue of output (Taka ha⁻¹) of different types of cultivated land in different types of farming

a, b₁, b₂, b₃, b₄, b₅, b₆ = Parameters to be estimated

X₁ = Human labor cost (Taka ha⁻¹) in different types of cultivated land

X₂ = Power tiller cost (Taka ha⁻¹) in different types of cultivated land

X₃ = Seed cost (Taka ha⁻¹) in different types of cultivated land

X₄ = Material cost (Taka ha⁻¹) in different types of cultivated land

X_5 =Irrigation cost (Taka ha⁻¹) in different types of cultivated land
 X_6 = Land use cost (Taka ha⁻¹) in different types of cultivated land

μ_i = Error term

3.7 Empirical model for TE

The TE of the farmers in the context of stochastic frontier model can be expressed as:

$$TE_i = \frac{Y_i}{Y_i^*} = f(x_i; \beta) \exp(v_i - u_i) / f(x_i; \beta) \exp(v_i) = \exp(-u_i) \dots (2)$$

Where, Y_i^* is the maximum possible gross revenue of output ha⁻¹ in different types of cultivated land, Y_i is the gross revenue of output ha⁻¹ in different types of cultivated land, β is the vector of parameters to be estimated, x_i presents inputs and v_i , u_i are error term. TE_i measures the gross revenue of output ha⁻¹ in different types of cultivated land of the farmers relative to the maximum possible gross revenue of output ha⁻¹ in the different types of cultivated land that can be produced using the same cost of input vectors. This value of TE_i is 0 to 1.

If $TE_i=1$, Y_i achieves the maximum value of $f(x_i; \beta) \exp(v_i)$. If TE_i is less than 1, that indicates the shortfall of gross revenue of output from the maximum possible level. This situation is characterized by stochastic elements, which vary among the farmers.

Chapter 4. Description of Basail Upazila

4.1 Socio-economic background

4.1.1 Introduction

This depiction presents a brief description of the study area to know the salient features of the study area. Knowledge of the study area is quite essential to understand the location, physical features, topography, soil, climate, temperature, rainfall, agriculture, communication and marketing facilities. These affect their production pattern and technology use. These aspects are also important as these have impact on their level of living standard, socioeconomic environment in which they live and the nature of the extent of their participation in the national development programs. An effort has therefore, been made to focus briefly on some of the socioeconomic aspects of the study area.

4.1.2 Physical features

Basail Upazila of Tangail district was selected as the study area for this study. This area is a new flood plain of Langulia river with flat topography and high density of population. North and south sides are surrounded by Kalihati and Mirzapur Upazila, Sakhipur and Tangail sadar are surrounded in the eastern and western side of the Upazila. This study area is located 14 K.m north- east from district head quarter and connected by Basail- Tangail high way.

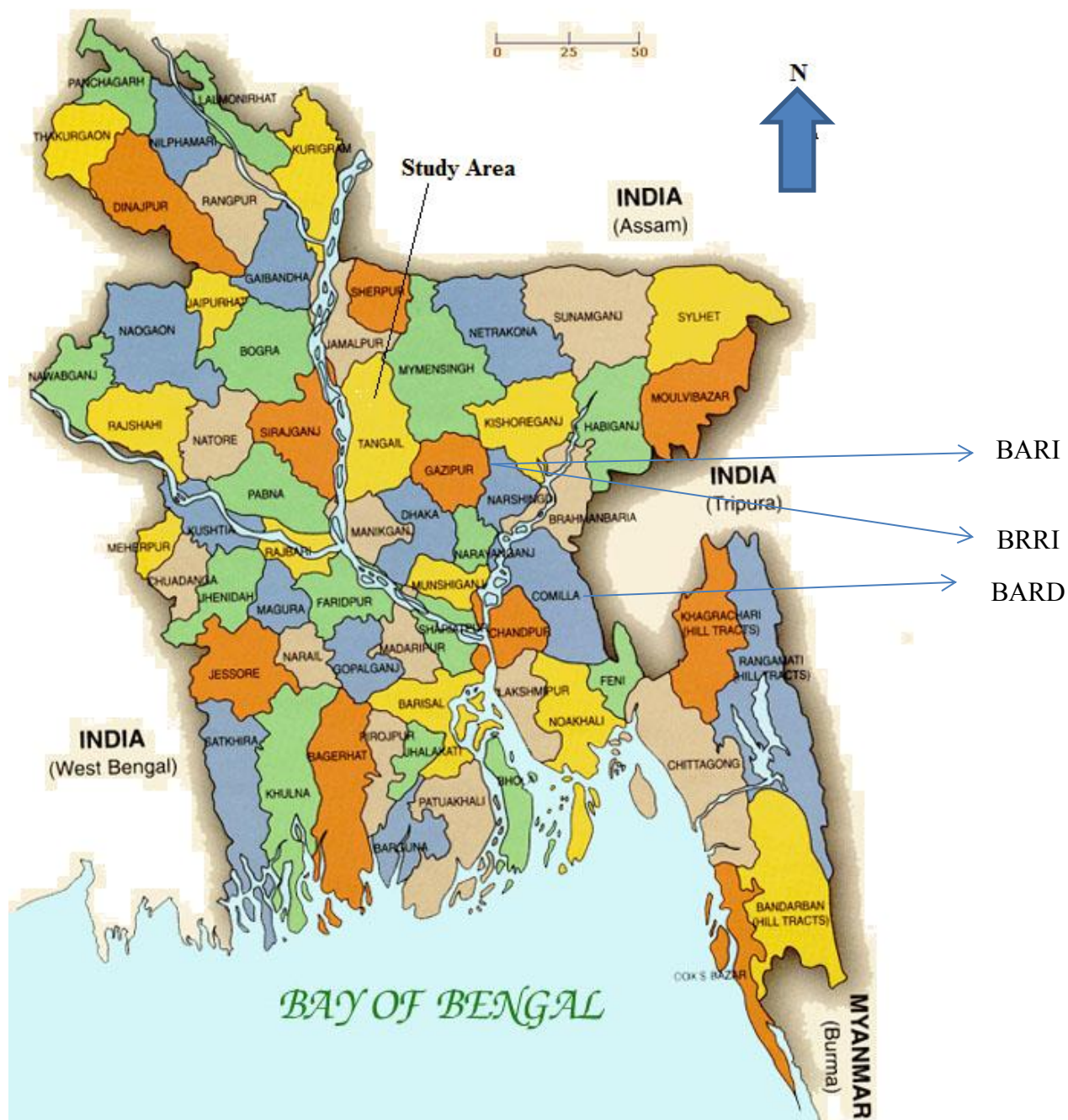


Figure 4.1.1: Map of study area in Bangladesh showing the location of agricultural research institutes

Source: Alauddin & Sharma, 2013

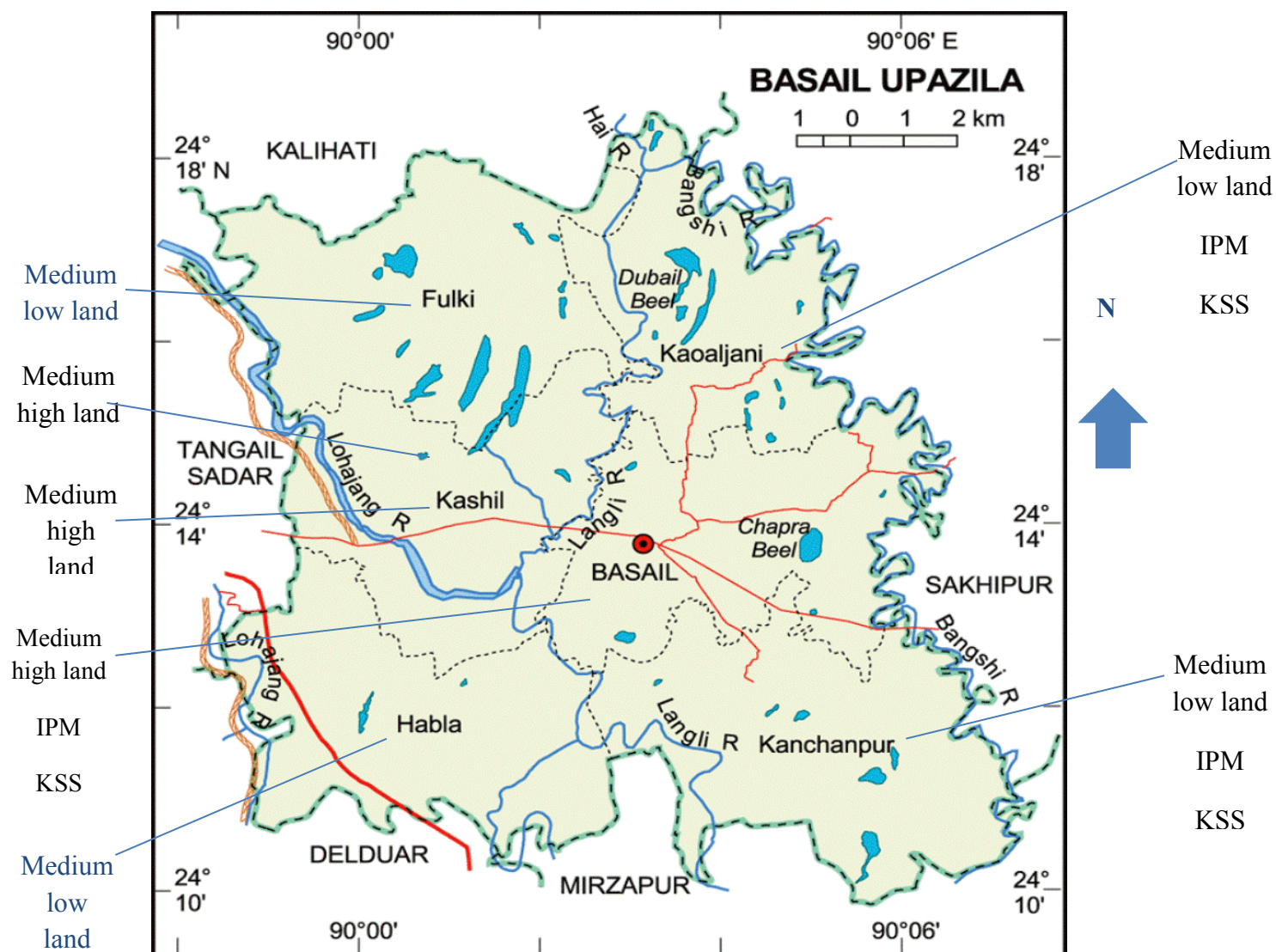


Figure 4.1.2: Map of Basail Upazila

Source: <https://www.google.co.jp>

Note: IPM indicates integrated pest management (IPM) club

KSS indicates Krishak samaby samity (Farmers co-operative association)

4.1.3 Soil and Topography

The study area is dominated by medium and high land and dominant soil type is sandy loam. One part of the land is high and other part of the land is medium high. Sometimes the medium part of the area gets affected by over flow of the river. The favorable water table, flat topography and loamy soil have encouraged rapid expansion of ground water irrigation technology such as shallow tube wells (STW) on a somewhat competitive basis and achieved irrigated acreage and yield well above the national averages. So, the irrigation potentiality of this area is very good.

4.1.4 Climate, temperature and rainfall

There is no meteorological center in the study area. As a result exact climatic data are not available. The neighboring meteorological center is located at Tangail town which is about 14 Km from the study area. It is however believed that the climatic condition of the study area does not differ much than that of Tangail town. The temperature of the study area varies from 10-36⁰c. Cold weather persists from November to February and hot weather prevails during March to September with average temperatures of 17.50⁰c and 32.80⁰c respectively. The highest temperature is in April (34.71⁰c). The coldest month is in January when average temperature becomes 11.60⁰c. Heavy rainfall occurs in the area from the end of April and cold continues even up to month of December. The average rainfall is about 1,530 mm with the lowest in the month of January and highest in the month of July.

4.1.5 Area and population

The total area of the Upazila is 158 sq. Km and population is 176,002. That depicts the population density 481/sq.Km

4.1.6 Roads, communication and marketing facilities

The communication system in the study area is good. There is a Basail- Tangail high way linked by kuccha (earthen) roads which allows transportation by rickshaw and vans mainly. The internal communication among the villages is also good. Therefore, the marketing facilities in the study area are reasonably developed.

The local markets are located within a short distance. Basail hat (Big market arranged in a specific day of the week) and Korotia hat are two well accommodated hat for buying and selling commodities according to the requirement of the people.

4.1.7 Agriculture

Majority of the households in the study area are dependent on agriculture directly or indirectly for their livelihood. Due to the expansion of irrigation facilities, the agricultural practices are relatively intensive in this area. A brief description of crops, labor use, modern technology and agricultural wages of the study area are given below:

4.1.7.1 Crops and cropping seasons:

The major cultivated crops in the study area are high yielding variety (HYV) Boro and T. Aman. B. Aman, mustard, jute, wheat and pulses are cultivated as minor crops in the study area. Normally two or three crops are cultivated in each plot of land among these crops in a year based on the flood situation and other favorable condition of the farmers. However HYV Boro is the most important crop in the study area and this HYV Boro is cultivated to meet up the demand of staple food rice. There are 4 cropping seasons, like Rabi I, Rabi II, Kharif I and Kharif II. Mustard and wheat are cultivated in Rabi I and HYV Boro is cultivated in Rabi II. B. Aman and jute are cultivated in Kharif I and T. Aman is grown in Kharif II.

Mustard is grown between first October to January last and wheat is grown between November to March. HYV Boro is grown between January to mid- May. B. Aman is grown between mid-February to November but T. Aman is grown September to December.

4.1.7.2 Use of modern technology

Modern technology namely STW irrigation, modern varieties of seeds, chemical fertilizers and insecticides are widely used in the study area.

STW are mainly used for watering HYV Boro in the study area. Major cropping patterns are dominated by HYV of Boro and local variety (LV) of T. Aman paddy.

4.1.7.3 Labor use and wage rate

Different crops require different amount of labor and growing season varies from crop to crop. The cropping pattern which is relatively high labor intensive requires the excess demand for labor for that certain period. In the study area, the excess demand for labor is created in the month of January, when the land preparation and transplanting of HYV Boro is started. Use of labor is also increased in the month of May- the harvesting period of this HYV Boro.

Wage rate of agricultural labors vary place to place and period to period. Within each village, the effective wage rate of male labor, particularly for land preparation, transplanting, weeding, harvesting and threshing activities is higher than the female.

Wage is mainly paid in cash in the study area; payment of wage for all operation is done extensively at time rate 8 hours/ day. Female labors are observed to have lower wage rate than male labors for any agricultural activities. These female labors are mainly used in post harvesting activities of crops. The payment of these female labors is very often paid in kind.

4.1.7.4 Animal

The farmers in the study area raise cattle, goat, sheep, chicken and duck. Monitoring of information indicated that chicken and duck population gradually increased per household in the study area due to implementation of the government project namely “One household one farm” support, invention of improved breeds and proper vaccination program (DAE, 2013). This support is not merely extended to other animals like cattle, goat etc.

4.1.7.5 Fishery

Most of the homestead has one or more ponds where culture of fishes like Roie, Katla, Mrigel, Silver carp, Mirror carp, Thai sarpoti are cultivated. High yielding breeds of these fishes are cultivated in paddy cum fish farming.

4.1.8 Institution

There is one college, one government boys’ high school, one girl s’ high school, seven government primary school and one *madrassa* (Religious school) in the study area. Boys and girls in the study area can get their education there.

4.2 Agriculture in Basail Upazila

4.2.1 Introduction:

Basail Upazila is located 14 K. m far away from Tangail district. The total area covered by this Upazila is 158 sq. Km having total number of population is 176,002. 80% of its population directly or indirectly depends on agriculture. Total cultivable land in the Upazila is 13,124 ha. Cropping intensity is 193%. Total number of union in the Upazila is 6 and number of pourashava 1. Total number of block in the Upazila is 18. There are 35 Agro-ecological zone (AEZ) in the country. This Upazila is located under AEZ 8 and 9. The remarkable rivers in the Upazila are namely Louhajang, Bongsai and Langulia. Rice is the main cereal crop in the area. Besides this mustard, wheat, jute and pulses are cultivated by the farmers also. The agricultural production of the farmers in the area is in increasing trend in utilizing modern technology in their production process. The ongoing activities conducted by the agricultural extension workers on organic fertilizer, green manure, compost, integrated Pest Management (IPM), integrated Crop Management (ICM), disease management and compost management are helpful and fruitful initiatives for the farmers.

4.2.2 Socio-economic condition:

Agriculture is the basic means to get the livelihood of the people of Basail Upazila. Once the local variety (LV) Aman, mustard and jute were the dominating crops and majority of the lands were used as single cropped area. But, now a day's HYV Boro, T. Aman, B. Aman, wheat, pulses and vegetables are cultivated merely. Majority of the lands are used as double or, triple cropped land by introducing modern technology. By adopting this modern technology the cropping intensity has been increased. Presently, this attained cropping intensity of this Upzila is 193%. Due to this, poverty level has been reduced and literacy rate has been increased. As a result present literacy rate is 52% in the Upazila.

4.2.3 Agricultural and demographic scenario

Total cultivable land:13,124 ha

Number of male population: 89,000

Number of female population:87,002

(Source: DAE, 2013)

Weather: Not so hot or, nor so cold. The highest temperature is 37.10⁰ c. The lowest temperature is 10.20⁰c. The average rainfall is 1,530 mm.

AEZ: 8,9

The total area covered in AEZ 8: 7,200 ha

The total area covered in AEZ 9: 5,924 ha

Main crops: The major cultivated varieties in the study area are HYV Boro, T. Aman and B. Aman in paddy cultivation as major crop. Mustard, jute, wheat or pulses are cultivated as minor crops. Besides these, potatoes and some other vegetables are cultivated in the Upazila. Spices namely chili, ginger and onion are cultivated at home-stead gardening.

Net cropped area: 13,124 ha

Single cropped area: 3,525 ha

Double cropped area: 7,041 ha

Triple cropped area: 2,558 ha

Total cropped area: 25,281 ha

High land: 202 ha

Medium high land: 3,552 ha

Medium low land: 2,541 ha

Low land: 5,657 ha

Very low land : 1,374 ha

4.2.3.1 Farmers category and landlessness of the farmers

Table 4.2.3.1.1 presents category-wise number of the farmers in Basail Upazila. The highest number of the farmers is in small farmer's category and the lowest number of farmers is in large farmers' category. It is found based on the study that the percentage of landless household was 46.00% in Bangladesh in 1988 but increased to 49.60% in 1995 (Rahman and Manprasert, 2006). Again this percentage of landless farmers in Basail Upazila is 24.34% and these landless farmers are merely dependent on share cropping as a tenant for getting their livelihood.

Table 4.2.3.1.1 Category- wise number of the farmers

Farmers category	Number
Large farmers	1,034
Medium farmers	4,501
Small farmers	7,528
Marginal farmers	7,488
Landless farmers	6,612
Total farmers	27,163

(Source: DAE, 2013)

4.2.3.2 Cultivated area according to major cropping pattern

Table 4.2.3.2.1 presents percentage- wise cultivated area under major cropping pattern. The highest cultivated area is covered by HYV Boro- B. Aman- fallow cropping pattern. This is due to higher yield of HYV Boro and better advantage in cultivating flood tolerant variety B. Aman. The lowest cultivated area is under cultivation of Wheat- Jute- T. Aman cropping pattern. The reason for this lowest cultivated area under this cropping pattern is due to lower yield of wheat, jute and T. Aman compare to the yield of other cultivated crops in the area.

Table 4.2.3.2.1 Cultivated area according to major cropping pattern

Serial No.	Cropping pattern			Cultivated area (ha)	Percentage
	Rabi	Kharif I	Kharif II		
1.	HYV Boro	Fallow	T. Aman	486	3.70
2.	HYV Boro	Fallow	Fallow	250	1.90
3.	HYV Boro	B. Aman	Fallow	5,000	38.09
4.	Mustard	HYV Boro	B. Aman	4,300	32.76
5.	Mustard	HYV Boro	T. Aman	200	1.52
6.	Wheat	Jute	T. Aman	64	0.48

(Source: DAE, 2013)

Reasons for keeping the land fallow in Kharif I:

- (i) In HYV Boro- Fallow- T. Aman cropping pattern, 50-55 days land remain fallow due to lack of suitable cultivable crop on that time;
- (ii) In HYV Boro -Fallow cropping pattern, no more crop cultivation is possible in Kharif I due to comparatively low land and stagnant rain water;

Reason for keeping the land fallow in Kharif II:

- (i) In HYV Boro – Fallow cropping pattern, no more new crop cultivation is possible due to stagnant water after harvesting of HYV Boro;

4.2.3.3 Cultivated crop area and variety-wise production in the 2011- 2012

Table 4.2.3.3.1 presents cultivated crop area and variety-wise production in the Upazila. The highest cultivated area as well as production is covered by HYV Boro and the lowest cultivated area as well as production is covered by LV paddy.

Table 4.2.3. 3.1 Cultivated crop area and variety- wise production in the year 2011- 2012

Crop	Main variety	Cultivated area (ha)	Yield/ha (Ton)	Total production (Ton)
HYV Boro	BR-28, BR- 29, BR-45	10,793	3.72	40,150
LV paddy	Aloy, Patjag, Kalijira, Bashiraj	100	1.50	150
Jute	Tosha	327	7.50	2452.50
Jute	Deshi	146	6.4	934.40
B. Aman	Chamara, Digha, Lal	7,200	0.85	6,120

(Source: DAE, 2013)

4.2.3.4 Cultivated area, yield and production of high yielding variety (HYV)/ cross variety (CV) and local variety (LV) in the year 2011-2012

Table 4.2.3.4.1 presents variety-wise cultivated area, yield and production in the year 2011-2012. From the table it is found that the highest cultivated area as well as production is covered by cross variety and lowest cultivated area as well as production is covered by local variety in cultivation of Boro. In cultivation of T. Aman, both cultivated covered area as well as production is higher in cross variety than local variety. In case of Aus, only cross variety is cultivated, but for B. Aman only local variety is cultivated. Again, in wheat cultivation, cross variety is cultivated only with and without irrigation system and both area as well as production covered by without irrigation is higher than with irrigation system.

Table 4.2.3. 4.1 Cultivated area, yield and production of HYV/

CV/LV (Variety- wise) in the year 2011- 2012

Crops	Variety	Cultivated area (ha)	Yield/ha (Ton)	Total production (Ton)
Boro	HYV	600	4.50	2700.00
	CV	10,793	3.65	39,394.45
	LV	23	1.50	34.5
	Total	10,822	-	39,445.95
T. Aman	CV	620	2.20	1,364.00
	LV	100	1.05	150.00
	Total	720	-	1,514.00
Aus	CV	5	2.00	10.00
	LV	-	-	-
	Total	5	-	10.00
B. Aman	LV	7,200	0.85	6,120.00
Wheat	CV (With irrigation)	12	2.50	30.00
	CV(Without irrigation)	52	1.95	101.40
	Total	64	-	131.95

(Source: DAE, 2013)

4.2.3.5 Cultivated area, yield and production of other crops in the year 2011- 2012

Table 4.2.3.5.1 presents area, yield and production of other crops in the year 2011-2012. From the table it is found that local variety of mustard, pulses (*Kheshari*), sweet potatoes and chili are cultivated but cross variety of potatoes and pulses (*Masur*) are cultivated by the farmers.

Table 4.2.3. 5.1 Cultivated area, yield and production of other crops in the year 2011- 2012

Crops	Main variety	Cultivated area (ha)	Yield/ ha (Ton)	Total production (Ton)
Mustard	Cross variety BARI-9, BARI-14, BARI-15	52	1.00	52.00
	Local variety Tori- 7	5,093	0.80	4,074.40
	Total	5,145	-	4,126.40
Pulse (<i>Kheshari</i>)	Local variety	38	1.10	41.80
Til	Local variety	6	0.80	4.80
Potato	Cross variety Dimond, Cardinal, Multa	58	15.00	870.00
	Local variety Lal pakri	48	8.00	384.00
	Total	106	-	1,254.00
Sweet potato	Local variety	24	18.00	432.00
Pulse(<i>Masur</i>)	BARI- 3	30	0.75	22.50
Chili	Local variety	7	1.20	8.40

(Source: DAE, 2013)

4.2.3.6 Variety- wise statistics of cereal crop

Tables (4.2.3.6.1, 4.2.3.6.2) present variety-wise statistics of cereal crops. From the tables it is found that

Cross variety is the dominating variety for all the cereal crops except B. Aman. This B. Aman is cultivated in local variety only.

Table 4.2.3. 6.1 Variety- wise statistics of major cereal crop

Year	Boro (ha)			T. Aman (ha)		
	Cross Variety	Local Variety	Total	Cross Variety	Local Variety	Total
2008-2009	10,132	16	10,148	475	63	538
2009-2010	10,625	18	10,643	502	72	574
2010-2011	10,687	21	10,708	523	80	603
2011-2012	10,799	23	10,822	620	100	720

(Source: DAE, 2013)

Table 4.2.3. 6.2 Variety- wise statistics of minor cereal crop

Year	Local Variety rice (<i>Aus</i>) (ha)			B. Aman (ha)
	Cross Variety	Local variety	Total	
2008-2009	1	-	1	4,988
2009-2010	2	-	2	5,102
2010-2011	3	-	3	5,895
2011-2012	5	-	5	7,200

(Source: DAE, 2013)

4.2.3.7 Cultivated area, yield and production of fruits, vegetables and spices

Table 4.2.3.7.1 presents area, yield and production of fruits, vegetables and spices. From the table it is found that local and cross variety are cultivated in cultivation of these fruits, vegetables and spices.

Table 4.2.3. 7.1 Cultivated area, yield and production of fruits, vegetables and spices

Name	Variety	Cultivated area (ha)	Yield/ha (Ton)	Total production (Ton)
Fruits: Mango, Jackfruit, Litchi, Guava, Banana, Papaya etc.	Local and cross variety			
		1,005	8.00	8040.00
Vegetables: Radish, Cauli flower, Cabbage, Bean, Sweet guard, Carrot, Bringel	Local and cross variety	263	15.00	3,945.00

(Source: DAE, 2013)

4.2.3.8 Other agricultural statistics

Tables (4.2.3. 8.1, 4.2.3. 8.2, 4.2.3. 8.3, 4.2.3. 8.4, 4.2.3. 8.5) present other agricultural statistics in Basail Upazila. Those depict the various aspects of agricultural production.

Table 4.2.3. 8.1 Net cropped area according to cropping season

Cropping season	Net cropped area (ha)
Rabi	13,124
Kharif I	13,122
Kharif II	8,170

(Source: DAE, 2013)

Table 4.2.3. 8.2 Production scenario of food production

Year	Total production (Ton)
2008- 2009	44,985
2009- 2010	46,430
2010- 2011	47,231

(Source: DAE, 2013)

Table 4.2.3.8.3 Demand of chemical fertilizer and its uses

Name of chemical fertilizer	2010-2011		2011-2012	
	Demand (Ton)	Allotment (Ton)	Demand (Ton)	Allotment (Ton)
Urea	5,280	5,280	5,485	5,415
TSP	502	502	546	523
MOP	850	850	900	875
DAP	680	680	705	670
SSP	-	-	-	-
NPKS	203	203	245	294
Zypsum	150	150	197	197
Zinc	90	90	100	100

(Source: DAE, 2013) Note; number of dealer 10

Table 4.2.3.8.4 Uses of insecticides (2011-2012)

Crop	Cultivated area (ha)	Used insecticides	
		Liquid (Liter)	Solid (Kg)
HYV Boro	10,822	2,000	6,000
Aus	5	3	-
B. Aman	7,200	-	-
T. Aman	720	500	2,000
Wheat	64	1	
Mustard	5,145	100	-
Jute	473	20	-
Vegetables	189	5	-
Tree plantation	1,005	100	-
Total	25,623	2,729	8,000

(Source: DAE, 2013)

Table 4.2.3.8.5 Food production situation in the year 2011-2012

Total production	Total demand	Surplus
47, 231 Ton	28,587 Ton	18,644 Ton

(Source: DAE, 2013)

4.2.3.9 Remarkable successful activities

Table 4.2.3.9.1 presents noticeable good initiatives in farming. Those are helpful for sustainable farming in long run.

Table 4.2.3.9.1 Good quality seed production in farmer's level and use of Guti (Modified) urea

	Good quality seed production		Guti (Modified)urea	
Year	Boro (Ton)	T. Aman (Ton)	Boro (ha)	T. Aman (ha)
2009- 2010	22	9	490	150
2010-2011	25	7	550	170
2011-2012	30	10	600	200

(Source: DAE, 2013)

4.2.3.10 Problems in attaining proper agricultural development

There are some problems prevailing in the Basail Upazila. These problems are needed to be solved for the betterment of agricultural development in Basail Upazila. These problems are as follows:

- Poverty of the farmers;
- Lack of adequate training facilities;
- Lack of trained farmers;
- Scarcity of good quality seed;
- Lack of more mechanization;
- Reluctance of the farmers in accepting new technology;
- Reluctance in cultivating vegetables;
- Lack of adequate irrigation facilities;
- Attack of pest and diseases in the cultivated crops;
- Tendency of the farmers in using more urea;
- Tendency of the farmers in using less manure due to lack of proper knowledge about soil nutrient;
- Ignorance in preparing and storing of compost fertilizer;
- Lack of knowledge in cultivating summer vegetables;
- Lack of knowledge in mixed fruit gardening;

(Source: DAE, 2013)

4.2.3.11 Potentialities for the improvement of agriculture

There are some potentialities for the improvement of agriculture in Basail Upazila. These potentialities are as follows:

- » It is possible to improve agricultural production by providing training of the farmers in integrated crop management (Proper variety, soil nutrient, water management etc.) in the cultivation process of the farmers;
- » Fruits and vegetables production can be increased by home stead gardening of fruits and vegetables;
- » Mixed cropping can be cultivated for better agricultural production as well as best use of agricultural land;
- » In over all, it is assumed that agricultural production can be increased in a large scale in ensuring proper and timely supply of HYV seed, irrigation, chemical fertilizer and other required inputs for the farmers ;

(Source: DAE, 2013)

4.2.3.12 On-going project

There are some on-going projects for the betterment of farming in Basail Upazila. These projects including their objectives are mentioned below:

1. Reducing the yield gap project

The objectives of this yield gap reducing project are as follows:

- (i) To motivate the farmers in using balance doze of fertilizer;
- (ii) To inspire the farmers in time plantation of seedling;
- (iii) To encourage the farmers to transplant seedling of appropriate age;
- (iv) To encourage the farmers in using good quality seed;

2. Storage of paddy wheat seed in the farmer's level project

The main objective of this project is to ensure the proper seed of paddy and wheat among the farmers. To attain this goal the specific objectives are:

- (i) To encourage the farmers in seed production and storage this produced seed properly;

- (ii) To motivate the farmers in using good quality seed;
- (ii) To reduce the poverty level of the farmers by the obtained earnings from this processing and marketing activities;

3. Storage of pulses, oil seed and onion seed in the farmer's level project

The main objective of this project is to encourage farmers in storing the seed of pulses, oil seed and onion properly. To attain this goal the specific objectives are:

- (i) To reduce the deficit of the seed of pulses, oil seed and onion in their cultivation process;
- (ii) To motivate the farmers in the extension activities;
- (iii) To increase the number of seed producer in the farmers level;

4. Integrated pest management (IPM) project

The main objective of this project is to increase the production level under the eco-friendly farming. To attain this goal, the specific objectives are:

- (i) To attain self-sufficiency in agricultural production without damaging public health and environment;
- (ii) To help the small farmers in increasing their earning;
- (iii) To establish IPM club to motivate the farmers in IPM activities;
- (iv) To encourage the farmers in eco-friendly trend in farming;

Chapter5. Agricultural Production in the Different Land Tenure Arrangements in Basail Upazila

5.1 Introduction

The word tenancy is part and parcel related with various sorts of tenure arrangements in land use. Land tenure refers to the arrangements of rules, institution and process through which people gain legitimate access to land in this land use arrangements. They use land and participate in the benefits deriving from it and they hold, manage and transect it. These arrangements involve diverse set of land rights-from outright ownership to a range of other land holding use rights (lease hold, servitudes, grazing right etc.). Land tenure arrangements are administered by land tenure policies. Bangladesh is an agricultural developing country. The total area of Bangladesh is 144,000 sq. km and population is 150 million, having cultivable area of 8.44 million hectare. The contribution of agriculture sector in the share of Gross Domestic Product (GDP) is 23.50% and this sector ensures 52% of total employment of the country (BBS, 2011). The following three farming categories are prevailing in the country:

(I) Owner farming (II) Owner cum tenant farming (III) Tenant farming.

Among these farming categories the following tenancy arrangements are observed:

(a) Share cropping (b) leasing (c) Mortgaging

Seven patterns of land are cultivated among these farming categories. Owner farmers cultivate owned land and mortgaged land in owner farming. In cultivating this owned land owner farmers get the whole amount of the produced crop as net revenue after subtracting the production cost. In case of mortgaged land, cultivators need not to pay any share of the produced output to the land owner but need to pay a certain amount of mortgaged money and duration of this mortgaged land persist until the mortgaged money can be repaid by *the* mortgagor (who mortgaged out the land). Owner cum tenant farmers cultivate owned land, mortgaged land, leased land and share cropped land.

In cultivation of this leased land, a certain amount of money is needed to pay annually to the land owner by the lessee (who leased in the land in lease system). The terms and condition of mortgaged land in owner cum tenant farming is same as mortgaged land in owner farming.

Again tenant farmers cultivate share cropped land only in their renting in system in tenant farming by providing half of the produced crop to the land owner according to the legal provision of land reform ordinance 1984. This crop sharing arrangement is applied in case of owner cum tenant farmers share cropped land also.

In Bangladesh the percentages of owner, owner cum tenant and tenant farmers are 65%, 22% and 13% respectively (BBS, 2011). These percentages of owner, owner cum tenant and tenant farmers in the study area are 48%, 28% and 24% respectively (DAE, 2013). These percentages of both owner as well as owner cum tenant farmers were higher than these percentages both in Bangladesh as well as in the study area, but this percentage of tenant farmers was lower than this percentage of both in Bangladesh as well as in the study area in 1996. Again, the percentage of owner farmers was higher than this percentage but the percentages of both owner cum tenant and tenant farmers were lower than these percentages in both in Bangladesh as well as in the study area in 2008 (Table 2.2.3.1, Table 2.2.4.1). This was due to their socioeconomic condition in respect of farming.

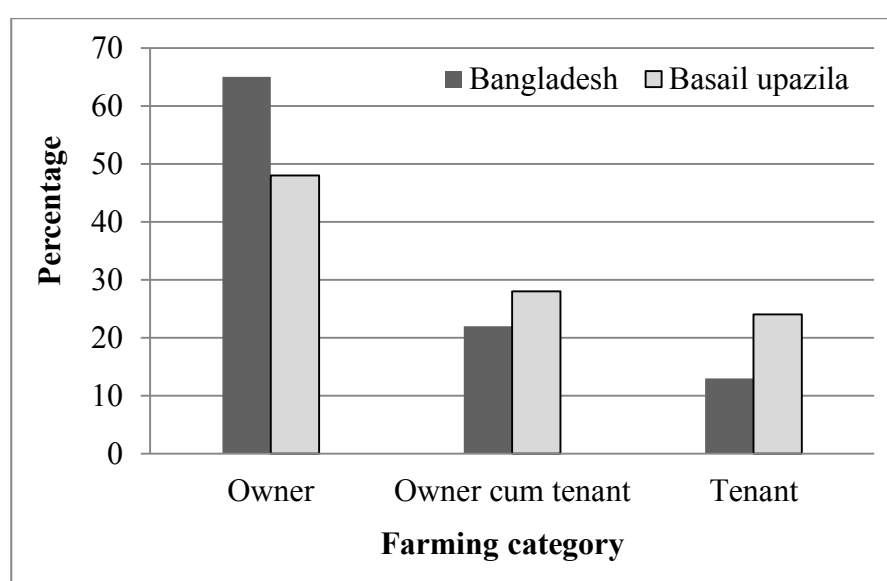


Figure 5.1.1 Farming category in the study area as well as in Bangladesh

Source: BBS, 2011, Source: DAE, 2013

Unequal distribution of income is generated from unequal distribution of land ownership. From the depiction of distribution of land ownership among the households it is found that 2%hh owned 25% of land, 10% hh owned 53% of land and the rest 88% hh owned only 22% of land in the country in 1979. There was absolutely unequal distribution. As a result 80% household enjoyed 20% of income and rest of 20% household enjoyed 80% income in 1980. In the end of nineteenth century tenure complexity reached its highest, 10-15 layers occupied the intermediary interest who all shared the peasant surplus. In this scenario, poorest and upper richer group increased and middle income group decreased (Ullah, 1996). Again, it is found that land ownership pattern affects per hectare gross revenue by using the efficient use of inputs under different land tenure system. In case of Bangladesh, about one-fifth of the

total operated area is under some kind of tenancy arrangements with share cropping covering about one-half of the land (Tenaw and et al., 2009).

It is found based on the studies (Ahmed, 2012; Asadullah, 2005) as evidence in case of Bangladesh that the terms of tenancy in Bangladesh were very oppressive. In large portion of the cases, the share of land owner was 50 percent of the produced crops as rent without sharing any parts of the cost and at least 5 per cent of the cases the share of rent was more than 50 per cent (Ullah, 1996).

It is also detected from study that, there was a negative impact of rental cost on the contract choice of cash rental arrangements (Bamatraf, 2000).

Technical efficiency varies due to adaptation of proper varieties (Barmon, 2013). Again, it is also found based on the study that, in cultivation of high yielding varieties, if input cost is shared by the land owner then the adaptation rate becomes higher. But if this input cost is not shared by the land owner then this adaptation rate becomes lower in case of share cropping arrangement. But this adaptation rate becomes highest in case of cash rental arrangement (Hossain, 1991).

Moreover, it is found from a conducted study in Bangladesh truly depicted based on land reform ordinance 1984 scenario that, in one-half tenancy system of share cropping- the total produce was shared between owner and tenant farmers in a 50:50 ratio. In that case the owner shared around 20 percent of the input cost, mostly the cost of seed and part of the land preparation cost. The rest 80 percent of the production cost - irrigation, fertilizer, pesticide and harvesting was borne by the tenant. Financially solvent tenant never took land under one-half tenancy system. On the other hand, in two- third system of share cropping arrangement- tenant farmers got two-thirds of the total produce; in that case, owner farmers did not contribute in any input cost. The higher share for the tenant, result into higher investment and consequently generate higher land productivity in this two- thirds system of share cropping. As a result it is found that two- thirds system of share cropping was at least 5-20% more productive than one- half system (CIRDAP, 2009).

After independence, proper measures were taken for the improvement of agricultural production as well as proper use of agricultural lands in the country by adapting necessary strategies to establish security and incentive measures by materializing the claim of Tebhaga (Three shares) movement in tenancy system including deregulation of input supply policy and introducing agricultural credit by the government of Bangladesh (Fujita, 2010). Land reform ordinance 1984 was formulated and declared for the security and incentive in tenancy system as well as better utilization of agricultural lands in the country. Before this land

reform ordinance 1984 tenancy right was not addressed properly, measures were taken to improve this tenancy right as well as betterment of agricultural production for the required utilization of agricultural lands by this land reform ordinance 1984 to attain the above mentioned research based fruitful outcome in agricultural production.

5.2 Research Location and Methodology

This study was carried out at Basail upazila of Tangail district in Bangladesh based on 150 respondents. 50 respondents were taken equally for each category by stratified random sampling technique to trace out the agricultural production in the different land tenure arrangements based on the cultivated crops in a cropping year. The major cultivated crops in the study area were HYV Boro and T. Aman. B. Aman, mustard, jute, wheat or pulses were cultivated as minor crops. Normally two or three crops were cultivated in each plot of land among these crops in a year. Gross revenue of the farmers was calculated based on these cultivated crops in their operated farm area including obtained gross revenue from paddy cum fish farming. In calculating this gross revenue, the produced quantity of crops was multiplied by per unit market price of that concerned crop but in case of paddy cum fish farming the obtained gross revenue from paddy cum fish farming was taken into account considering the subsidized fingerlings from the government. Moreover, evidence suggests that concurrent paddy cum fish farming systems can improve paddy yields by as much as 10- 20 per cent in Bangladesh, possibly due to better mulching, fertilization of soils through fish waste, and better weed control (Dey et al. 2012). These issues were considered accordingly. This paddy cum fish farming is the one of the innovative ideas of the farmers to earn more revenue from the best utilization of the land resource in crop cultivation.

In calculating the total production cost of the farmers land use cost, human labor, mechanized power (in the study area draft/animal power for tillage was replaced by mechanized power tiller), seed, irrigation and material cost were taken into account.

In addition, the opportunity cost of home supplied inputs was considered including home supplied labor also. Rental cost of share cropped land was taken based on the value of the half of the produced crop of the share cropped land considering the other sharing aspects of half of the share- this was practiced only for major crops but this was not practiced for minor crops (e.g. In cultivation of T. Aman in the share cropped land of owner cum tenant farmers, no rental cost was needed as owner cum tenant farmers received the advantage in cultivation of this T. Aman free of land use cost/without rental cost in their share cropped land according

to the condition to provide half of the produce of the HYV Boro to the land owner), other benefits those were provided to the share croppers by the land owner in this 50: 50 crop sharing system (e.g. share croppers were provided the advantage of paddy cum fish farming without rental cost in the condition in providing half of the share of major crops also). These issues were considered accordingly. Irrigation cost was calculated as one fourth of the produced crop according to the prevailing customary rule, but in practice- this irrigation cost depends on needed period of irrigation, times of irrigation, level of land etc. In calculating this irrigation cost these related matters were considered accordingly also. Mortgaged cost of land was taken based on the paid amount and other concerned aspects in the study area. Basically, this mortgaged cost depends on the interest rate of the available credit sources of the farmers. This interest rate varied between formal and informal credit sources. In the study area owner farmers were cultivating mortgaged land also and mortgaged cost in owner farmers mortgaged land and owner cum tenant farmers mortgaged land was different based on their socioeconomic condition and available credit sources of the farmers. Land use cost was taken based on the mortgaged cost of owner as well as owner cum tenant farmers in calculating cost of production. The material cost was calculated including the cost of chemical fertilizer, weedicide and pesticide for all the cultivated land categories. Net revenue (NR) was calculated gross revenue subtracting the total cost of production ($NR = GR - TC$), where GR=gross revenue and TC= total cost of production.

It was found in the study area that if half of the seed cost was provided to the tenant by the land owner then land owner claimed half of the produced by-product. But sometimes without sharing this seed cost the half of the produced by-product was claimed also based on customary rule. To avoid this complexity the price of the by product was not taken into consideration to calculate the gross revenue.

The stratified random sampling technique was needed as the percentages of owner, owner cum tenant and tenant farmers were very disproportionate in the study area (Figure 5.1.1). Then the collected data were analyzed by using statistical analytical software STATA13. BCR was used to identify the profitability of crop cultivation in crop wise as well as land category wise based on the different categories of lands under different land tenure arrangements in the study area. This BCR is the ratio of gross revenue and total cost. $BCR = \frac{\text{Gross revenue}}{\text{total cost}}$. Analysis of Variance (ANOVA) was used to get the mean difference of net revenue among owner, owner cum tenant and tenant farmers based on overall study area.

5.3 Result and discussion

5.3.1 Farm size and other socioeconomic characteristics

Tables (5.3.1.1, 5.3.1.2, 5.3.1.3) present the farm size and other socioeconomic characteristics of the sample households. In this study, farm size is considered based on operated farm size to detect the agricultural production in the prevailing different land tenure arrangements. This farm size in cultivation of owner owned and mortgaged land is 0.73 and 0.53 ha respectively. The farm size in cultivation of owner cum tenant owned, mortgaged and share cropped land is 0.75, 0.81 and 0.75 ha respectively. Again the farm size in cultivation of tenant share cropped land is 0.71 ha. But it is found based on study that farm size of 1.01 to 2.02 ha group is most efficient in agricultural production in Bangladesh (Bilkis, 2012). From Table 5.3.1.1, it is also found that there is a difference of age of the HHH, off- farm income and other socioeconomic characteristics among owner, owner cum tenant and tenant farmers. Moreover, tenant farmers are in less advantageous position than owner farmers and even owner cum tenant farmers in consideration of all the socioeconomic perspectives.

Table 5. 3.1.1 Socioeconomic characteristics of the sample households

Variables	Owner	Owner cum tenant	Tenant
Age of the HHH (year)	50.22 (10.43)	50.32 (9.39)	43.62 (9.79)
Education of the HHH (year)	4.34 (3.55)	3.76 (2.53)	2.16 (1.88)
Home stead (ha)	0.03 (0.02)	0.03 (0.01)	0.020 (0.013)
Family member (LFU)	3.54 (0.86)	3.56 (0.81)	3.14 (0.90)
Livestock (LSU)	3.06 (1.21)	2.92 (0.68)	2.32 (0.91)
Off-farm income (Tk/year)	100,270 (77,068)	55,000 (50,598)	34,828 (16,178)

Source : Field survey (2013)

Note: The name of Bangladesh currency is Taka 1 US Dollar=77.98 Taka Figures and figures in the parentheses indicate mean value and Std. Dev. respectively

Table 5. 3.1.2 Distribution of respondents by farm category and tenure arrangements

Farm category	Tenure arrangements			
	Owned	Mortgaged	Fixed rented	Share cropped
Owner	50 (100)	15 (30)	-	-
Owner cum tenant	50 (100)	7 (14)	-	50 (100)
Tenant	-	-	-	50 (100)

Source : Field survey (2013)

Note: Figures in the parentheses indicate percentage of total

Table 5.3.1.3 Farm category and farm size of the respondent farmers

Farm category	Owner		Owner cum tenant			Tenant
Land category	Owner owned land	Owner mortgaged land	Owner cum tenant owned land	Owner cum tenant mortgaged land	Owner cum tenant share cropped land	Share cropped land
Farm size (ha)	0.73 (0.56)	0.53 (0.25)	0.75 (0.34)	0.81 (0.27)	0.75 (0.34)	0.71 (0.52)

Note: Figures and figures in the parentheses indicate mean value and Std. Dev. respectively

5.3.2 Cropping pattern, production and yield in the cultivated area

There are various cropping patterns prevailing in the study area. This cropping pattern varies among the farming categories in cultivation of their crops. The major cropping pattern in the owner owned land is mustard- HYV Boro - paddy cum fish farming, but HYV Boro- T. Aman - paddy cum fish farming and HYV Boro- B. Aman - paddy cum fish farming patterns are also practiced in this land category. The average yield of HYV Boro, mustard, T. Aman and B. Aman in Bangladesh is 3.90, 1.95, 2.26 and 1.90 ton/ha respectively (BBS, 2011). This average yield is 6.50, 1.00, 2.00 and 1.50 ton/ ha respectively in the study area (DAE, 2011). But this average yield among the respondent farmers in owner owned land is 6.54, 0.96, 1.45 and 1.37 ton/ ha respectively. BR- 28, BR- 29 variety of HYV Boro is commonly cultivated in the study area. The average yield of this variety is higher than other cultivated HYV variety of Boro.

Table 5.3.2.1 Cultivated crops, production and yield in the owner owned land

Crops	Area (ha)	Production (Ton)	Yield (Ton/ ha)
HYV Boro (n= 50)	31.47(0.63)	205.71(3.2)	6.54(2.14)
Mustard (n= 15)	11.34(0.68)	10.84(0.27)	0.96(0.39)
T. Aman (n= 10)	10.88(0.69)	15.73(0.47)	1.45(0.54)
B. Aman (n= 10)	4.42(0.67)	6.02(0.29)	1.37(0.32)

Source : Field survey (2013)

Note: Figures in the area and production indicate total, figures in the yield indicates mean value and figures in the parentheses indicate Std. Dev. respectively

The dominating cropping pattern in owner mortgaged land is HYV Boro - B. Aman - paddy cum fish farming, but some farmers are cultivating some other minor crops also in this owner mortgaged land. Farmers are cultivating S.L- 8 variety of HYV Boro in this land category. The average yield of this HYV Boro variety is lower than other variety of HYV Boro but taste is better than other HYV Boro variety. Owner farmers are cultivating this variety for their home consumption though yield is lower and this is affordable for the solvent owner farmers. They are also cultivating LV B.Aman in this land category. Due to this the average yield of HYV Boro in owner mortgaged land is 2.18 ton/ha and average yield of LV B. Aman is 2.04 ton/ha.

Table 5. 3.2.2 Cultivated crop, production and yield in the owner mortgaged land

Crops	Area (ha)	Production (Ton)	Yield (Ton/ ha)
HYV Boro (n= 15)	4.99(0.18)	10.88(1.33)	2.18(3.61)
B. Aman (n= 5)	1.47(0.17)	3.00(0.42)	2.04(0.32)

Source : Field survey (2013)

Note: Figures in the area and production indicate total, figures in the yield indicates mean value and figures in the parentheses indicate Std. Dev. respectively

The noticeable cropping pattern in owner cum tenant owned land is mustard- HYV Boro - paddy cum fish farming. This mustard is cultivated as cash crop in this land category. The average yield of HYV Boro, mustard and T. Aman in owner cum tenant owned land is 5.08, 0.90 and 1.85 ton/ ha respectively.

Table 5.3.2.3 Cultivated crop, production and yield in the owner cum tenant owned land

Crops	Area (ha)	Production (Ton)	Yield Ton/ ha
HYV Boro (n= 50)	16.89(0.26)	85.94(1.61)	5.08(1.78)
Mustard (n =23)	8.28(0.25)	7.49(0.24)	0.90(0.30)
T. Aman (n= 25)	8.27(0.25)	15.26(0.69)	1.85(0.56)

Source : Field survey (2013)

Note: Figures in the area and production indicate total, figures in the yield indicates mean value and figures in the parentheses indicate Std. Dev. respectively

The most common cropping pattern in owner cum tenant mortgaged land is mustard -HYV Boro - paddy cum fish farming, but few others minor crops are cultivated also. The average yield of HYV Boro and mustard is 5.87 and 0.96 ton/ ha respectively in this land category.

Table 5.3.2.4 Cultivated crop, production and yield in the owner cum tenant mortgaged land

Crops	Area (ha)	Production (Ton)	Yield Ton/ ha
HYV Boro (n=7)	1.81(0.11)	10.63(0.61)	5.87(2.45)
Mustard (n=3)	1.13(0.13)	1.09(0.12)	0.96(0.42)

Source : Field survey (2013)

Note: Figures in the area and production indicate total, figures in the yield indicates mean value and figures in the parentheses indicate Std. Dev. respectively

Again, the most dominating cropping pattern in owner cum tenant share cropped land is mustard-HYV Boro - paddy cum fish farming, but some cost effective crops (e.g. pulses) are cultivated also in this land category. The average yield of HYV Boro, mustard and T. Aman in this land category is 5.09, 0.93 and 1.29 ton/ ha respectively.

Table 5.3.2.5 Cultivated crop, production and yield in the owner cum tenant share cropped land

Crops	Area (ha)	Production (Ton)	Yield Ton/ ha
HYV Boro (n= 50)	19.04(0.25)	97.09(2.00)	5.09(6.5)
Mustard (n= 24)	10.54(0.27)	9.79(0.38)	0.93(0.50)
T. Aman (n= 25)	10.54(0.27)	13.69(0.34)	1.29(0.48)

Source : Field survey (2013)

Note: Figures in the area and production indicate total, figures in the yield indicates mean value and figures in the parentheses indicate Std. Dev. respectively

HYV Boro - T. Aman - paddy cum fish farming is the most common cropping pattern in tenant share cropped land. Apart from, this, some other flood tolerant crops (e.g. LV B. Aman) are cultivated by them to overcome the damage of flood. The average yield of HYV Boro, T. Aman and B. Aman in this land category is 5.26, 1.52 and 1.40 ton/ ha respectively.

Table 5. 3.2.6 Cultivated crop, production and yield in the tenant share cropped land

Crops	Area (ha)	Production (Ton)	Yield Ton/ ha
HYV Boro (n= 50)	35.14(0.52)	184.96(3.48)	5.26(1.91)
T. Aman (n= 24)	16.92(0.43)	25.65(0.74)	1.52(0.54)
B. Aman (n= 23)	18.21(0.59)	25.58(1.01)	1.40(0.48)

Source : Field survey (2013)

Note: Figures in the area and production indicate total, figures in the yield indicates mean value and figures in the parentheses indicate Std. Dev. respectively

5.3.3 Crop wise cultivated area in the study area

Table 5.3.3.1 presents the crop wise share of cultivated area among the farmers in the study area. There was a variation in this share in cultivation of various crops in different land categories. But HYV Boro covered the dominant share in all of these categories.

Table 5.3.3.1 Percentage distribution of cultivated area of crops in the study area

Land tenure category	Total area (ha)	Crops	Crop wise	
			Area (ha)	Percentage
Owner (owned land)	58.11	HYV Boro	31.47	54.16%
		Mustard	11.34	19.51%
		T. Aman	10.88	18.72%
		B. Aman	4.42	7.61%
Owner (mortgaged land)	6.46	HYV Boro	4.99	77.24%
		B. Aman	1.47	22.76%
Owner cum tenant (owned land)	33.44	HYV Boro	16.89	50.51%
		Mustard	8.28	24.76%
		T. Aman	8.27	24.73%
Owner cum tenant(mortgaged land)	2.94	Mustard	1.13	38.44%
		HYV Boro	1.81	61.56%
Owner cum tenant (share cropped land)	40.12	HYV Boro	19.04	47.46%
		Mustard	10.54	26.27%
		T. Aman	10.54	26.27%
Tenant (share cropped land)	70.27	HYV Boro	35.14	50.01%
		T. Aman	16.92	24.08%
		B.Aman	18.21	25.91%

Source : Field survey (2013) Note: Figures indicate mean value

5.3.4 Item wise production cost of major cultivated crops

Tables (5.3.4.1, 5.3.4.2, 5.3.4.3) present item wise production cost of major cultivated crops. From the tables it is found that highest incurred item wise cost was for material cost and the lowest incurred item wise cost was for seed in HYV Boro cultivation both for owner owned land and owner cum tenant owned land. But in cultivation of HYV Boro in in owner cum tenant share cropped land and tenant share cropped land , the highest incurred item wise cost was for rental cost and the lowest for seed . Again, in cultivation of T. Aman in owner cum tenant owned land and owner cum tenant share cropped land the highest item wise cost was incurred for human labor. The lowest item wise cost was incurred for seed in owner cum tenant owned land, but this lowest incurred item wise cost was for rental cost in owner cum tenant share cropped land.

This was because, owner cum tenant farmers were getting advantage in cultivation of T. Aman without rental cost in the condition to provide 50: 50 share of produced HYV Boro to the land owner. This T. Aman cultivation is risky and very often washed away by flood.

Table 5.3.4.1 Item wise production cost of owner owned land and owner cum tenant owned land in HYV Boro (Taka/ha)

Variables	Owner owned land (cost)	Owner cum tenant owned land (cost)
Land use cost	4,931(3,620)	1,812(1,206)
Human labor	7,918(3,655)	4,045(1,825)
Power tiller	2,001(715)	1,086(557)
Seed	1,295(693)	676(414)
Material cost	12,040(5,737)	6,077(2,685)
Irrigation	10,670(4,816)	5,676(2,925)

Source : Field survey (2013)

Note: Figures and figures in the parentheses indicate mean value and Std. Dev. respectively

Table 5.3.4.2 Item wise production cost of owner cum tenant share cropped land and tenant share cropped land in HYV Boro (Taka/ha)

Variables	Owner cum tenant (cost)	Tenant (cost)
Rental cost	9,764(7,808)	17,697(11,537)
Human labor	4,263(1,836)	7,421(2,370)
Power tiller	1,187(586)	2,083(351)
Seed	585(515)	638(844)
Material cost	4,941(3,026)	9,482(4,198)
Irrigation	5,259(3,146)	9,537(4,021)

Source : Field survey (2013)

Note: Figures and figures in the parentheses indicate mean value and Std. Dev. respectively

Table 5. 3.4.3 Item wise production cost of T. Aman in owner cum tenant owned land and owner cum tenant share cropped land (Taka/ha)

Variables	Owner cum tenant owned land (cost)	Owner cum tenant share cropped land (cost)
Land use cost	604(524)	N/A
Land rental cost	N/A	-
Human labor	1,892(869)	2,235(905)
Power tiller	1,101(628)	1,331(653)
Seed	531(311)	362(354)
Material cost	1,773(854)	1,625(996)

Source : Field survey (2013)

Note: Figures and figures in the parentheses indicate mean value and Std. Dev. respectively

5.3.5 Per unit price of produced crop and input

Table 5.3.5.1 presents per unit price of crops and inputs. From the table, it is found that owner and tenant farmers obtain the equal price and this price is lower than obtained price of owner cum tenant farmers from HYV Boro. This might be due more concern of owner cum tenant famers about market price than both owner and tenant farmers and other related aspects of the farmers in getting the per unit price. In T. Aman, highest per unit price is obtained by tenant farmers and lowest by owner cum tenant farmers. This might be tenant farmers are more concerned about market price of T. Aman than owner or, owner cum tenant farmers. Again, there is a variation among the per unit input price of owner, owner cum tenant and tenant farmers in getting various inputs based on their socioeconomic perspectives in crop cultivation.

Table 5.3.5.1 per unit price of crops and inputs

Variable	HYV Boro			T. Aman		
	Owner	Owner cum tenant	Tenant	Owner	Owner cum tenant	Tenant
Per unit price of produced crop						
HYV Boro/ T. Aman (Taka/ton)	13,333 (4,373)	14,186 (4,666)	13,333 (4,826)	16,000 (5,920)	14,906 (4,880)	16,373 (5,773)
Per unit price of input						
Human labor(Taka/m-d)	300 (138)	307 (138)	309 (98)	309 (118)	310 (146)	316 (97)
Seed (Taka/kg)	35 (18)	53 (32)	85 (32)	35 (13)	35 (21)	67 (24)
Urea (Taka/kg)	20 (9)	18 (8)	19 (8)	20 (3)	19 (10)	20 (10)
TSP (Taka/kg)	26 (13)	25 (13)	26 (12)	26 (3)	27 (14)	28 (14)
MOP(Taka/kg)	15 (7)	15(7)	12 (6)	13 (2)	15 (8)	15 (8)

Source : Field survey (2013)

Note: Figures and figures in the parentheses indicate mean value and Std. Dev. respectively

5.3.6 Crop wise revenues and total cost of major cultivated crops

Table 5.3.6.1 depicts the gross revenue, total production cost and net revenue of different cultivated crops of the farmers.

Gross revenue:

In HYV Boro cultivation, obtained gross revenue in owner owned land is higher than that of owner cum tenant owned land or, owner cum tenant share cropped land. Again, in cultivation of T.Aman, obtained gross revenue in owner cum tenant owned land is higher than owner cum tenant share cropped land also. In cultivation of other crops, the highest gross revenue is

obtained by owner mortgaged land and lowest by owner owned land. This obtained gross revenue varies due to cultivation of different varieties and other concerned factors of agricultural production including obtained per unit price.

Total cost:

In HYV Boro cultivation, the highest total cost is incurred by owner owned land, the lowest by owner cum tenant owned land. In cultivation of T. Aman, incurred total cost is higher in owner cum tenant owned land than owner cum tenant share cropped land. In cultivation of other crops, the highest incurred total cost is by owner mortgaged land lowest by owner cum tenant owned land. This total cost varies due to eco-friendly oriented farming and other concerned issues in agricultural production.

Net revenue:

In HYV Boro cultivation, highest net revenue is obtained by owner cum tenant owned land and lowest by tenant share cropped land. In cultivation of T.Aman, obtained net revenue in owner cum tenant owned land is higher than owner cum tenant share cropped land. In cultivation of other crops, the highest net revenue is obtained by owner mortgaged land and the lowest by owner owned land. This obtained net revenue varies due to lack of proper input use, high rental cost of share cropped land and other related matters concerning net revenue of the farmers.

Table 5. 3.6.1 Revenues and cost of major cultivated crop cultivation

Land tenure category	Number of respondent farmer	Gross revenue (Taka/ha)	Total cost (Taka/ha)	Net revenue (Taka/ha)
HYV Boro				
Owner (owned land)	(n=50)	87,157(28,589)	38,855(13,715)	48,302(22,070)
Owner cum tenant (owned land)	(n= 50)	72,305(23,778)	19,372(9,215)	52,933(17,740)
Owner cum tenant (share cropped land)	(n=50)	60,750(87,044)	25,999(11,450)	34,751(11,005)
Tenant (share cropped land)	(n=50)	70,181(25,521)	46,858(9,723)	23,323(12,150)
T. Aman				
Owner cum tenant (owned land)	(n=25)	27,082(26,965)	5,901(3,005)	21,181(5,912)
Owner cum tenant (share cropped land)	(n=25)	21,801(25,011)	5,553(3,530)	16,248(3,690)
Other crops				
Owner (owned land)	-	3,343(3,258)	12,738(1,362)	10,131(7,368)
Owner (mortgaged land)	-	70,000(64,993)	34,654(21,897)	43,341(22,104)
Owner cum tenant (owned land)	-	-	411(399)	11,732(5,919)
Owner cum tenant(mortgaged land)	-	50,000(44,123)	14,926(11,219)	40,483(14,017)
Owner cum tenant (share cropped land)	-	-	15,466(4,090)	12,642(3,776)
Tenant (share cropped land)	-	17,319(3,743)	15,466(7,257)	17,094(4,055)

Source : Field survey (2013)

Note: Figures and figures in the parentheses indicate mean value and Std. Dev. respectively
 Net revenues from other crops are the difference between obtained net revenues from the cultivated major crops and other cultivated minor crops

5.3.7 Crop- wise Benefit Cost Ratio (BCR) of the major cultivated crops of the farmers

Table 5.3.7.1 presents crop- wise BCR of the different categories of land among farmers under different tenure arrangements in the study area. It is depicted that the highest BCR (4.58) is obtained by owner cum tenant farmers from owned land in cultivation of T. Aman and the lowest BCR (1.49) is obtained by tenant share cropped land in HYV Boro cultivation. This was because of high rental cost in providing 50: 50 produced outputs sharing in HYV Boro cultivation.

Table 5.3.7.1 Crop- wise BCR of the farmers

HYV Boro	
Land tenure category	BCR
Owner (owned land)	2.24
Owner cum tenant (owned land)	3.73
Owner cum tenant (share cropped land)	2.34
Tenant (share cropped land)	1.49
T. Aman	
Owner cum tenant (owned land)	4.58
Owner cum tenant (share cropped land)	3.93
Other crops	
Owner (owned land)	0.26
Owner (mortgaged land)	-
Owner cum tenant (owned land)	-
Owner cum tenant(mortgaged land)	-
Owner cum tenant (share cropped land)	-
Tenant (share cropped land)	1.12

Source: Field survey, 2013

5.4 Land tenure category wise gross revenue of the farmers

Table 5.4.1 presents the land tenure category wise gross revenue of the farmers. The highest gross revenue is obtained by owner cum tenant farmers owned land and the lowest by owner cum tenant farmers mortgaged land. This gross revenue varies due to lack of proper intensive use of land, available supply of high yielding varieties of seed and favorable market price of the produce.

Table 5.4.1 Gross revenue of the farmers (Taka/ha)

Land tenure category	Gross revenue from crop	Gross revenue from paddy-Fish(P-F)	Total gross revenue	Percentage of obtained gross revenue from P-F
Owner (owned land)	90,500(32,247)	19,526(6,604)	110,026(38,852)	17.75%
Owner (mortgaged land)	70,000(64,993)	7,995(7,221)	77,995(72,215)	10.25%
Owner cum tenant (owned land)	99,387(31,031)	12,143(4,636)	111,530 (35,667)	10.89 %
Owner cum tenant(mortgaged land)	50,000(44,123)	5,409(4,363)	55,409(48,486)	9.76%
Owner cum tenant (share cropped land)	82,551(27,273)	12,622(10,445)	95,173 (130,567)	13.26 %
Tenant (share cropped land)	87,500(29,264)	15,241(4,764)	102,741(34,028)	14.83%

Source : Field survey (2013)

Note: Figures and figures in the parentheses indicate mean value and Std. Dev. respectively

5.5 Item wise production cost in the different land tenure category

Tables (5.5.1, 5.5.2, 5.5.3) present item based land tenure category wise production cost of the famers. This item based land category wise production cost varies among the farmers according to their socioeconomic condition in getting these inputs in the cultivation process.

From the tables, it is found that the highest incurred item wise cost was for material and the lowest incurred item wise cost was for seed in both owner owned land and owner cum tenant owned land. In cultivation of mortgaged land, the highest incurred item wise cost was for material in owner mortgaged land but this highest item wise cost was incurred for human labor in owner cum tenant mortgaged land. Again, seed was the lowest item wise cost both for owner mortgaged land as well as owner cum tenant mortgaged land. In cultivation of share cropped land the highest item wise incurred cost was for land rental and the lowest incurred item wise cost was for seed in both in owner cum tenant share cropped as well as tenant share cropped land.

Table 5.5.1 Production cost of owned land (Taka/ha)

Variables	Owner (cost)	Owner cum tenant (cost)
Land use cost	6,575 (4,827)	2,416 (1,609)
Human labor	11,878 (5,483)	6,067 (2,738)
Power tiller	4,002 (1,430)	2,173 (1,115)
Seed	2,590 (1,386)	1,353 (828)
Material cost	15,878 (7,862)	7,999 (3,753)
Irrigation	10,670 (4,816)	5,676 (2,925)

Source : Field survey (2013)

Note: Figures and figures in the parentheses indicate mean value and Std. Dev. Respectively

Table 5.5.2 Production cost of mortgaged land (Taka/ ha)

Variables	Owner (cost)	Owner cum tenant (cost)
Land mortgage cost	6,575 (4,827)	2,416 (1,609)
Human labor	7,322 (2,687)	6,452 (5,954)
Power tiller	2,406 (792)	2,036 (945)
Seed	1,621(932)	1,067 (739)
Material cost	9,589 (2,460)	1,702 (3,546)
Irrigation	7,141(2,494)	1,253 (3,097)

Source : Field survey (2013)

Note: Figures and figures in the parentheses indicate mean value and Std. Dev. respectively

Table 5.5.3 Production cost of share cropped land (Taka/ ha)

Variables	Owner cum tenant (cost)	Tenant (cost)
Land rental cost	9,764 (7,808)	23,597(15,379)
Human labor	6,394 (2,754)	11,132 (3,556)
Power tiller	2,374 (1,173)	4,166 (702)
Seed	1,170 (1,031)	1,276 (1,688)
Material cost	6,571 (4,054)	12,616 (5,670)
Irrigation	5,259 (3,146)	9,537 (4,021)

Source : Field survey (2013)

Note: Figures and figures in the parentheses indicate mean value and Std. Dev. respectively

5.6 Total production cost of different land tenure category

Table 5.6.1 depicts the land tenure category wise total production cost of the farmers. The highest total cost is incurred by tenant share cropped land and the lowest by owner cum tenant mortgaged land.

This cost of production varies in cultivation of land by different tenure categories due to government supplied subsidized seed, fingerlings and different socioeconomic condition of the farmers in their production process.

Table 5.6.1 Total cost of the farmers (Taka/ha)

Land category	Total cost
Owner (owned land)	51,593(15,077)
Owner (mortgaged land)	34,654 (21,897)
Owner cum tenant (owned land)	25,684(12,371)
Owner cum tenant (mortgaged land)	14,926 (11,239)
Owner cum tenant (share cropped land)	31,532(15,540)
Tenant (share cropped land)	62,324(16,980)

Source : Field survey (2013)

Note: Figures and figures in the parentheses indicate mean value and Std. Dev. respectively

5.7 Land category wise BCR of the farmers

Figure 5.7.1 presents BCR of the different categories of land among farmers under various land tenure arrangements in the study area.

It is found that the highest BCR (4.34) is obtained by owner cum tenant farmers from owned land and the lowest BCR (1.65) is obtained by tenant share cropped land.

Again, the BCR in both owner mortgaged land (2.25) and owner cum tenant mortgaged land (3.71) is higher than this tenant share cropped land. This obtained BCR in mortgaged land is needed to compare with tenant share cropped land, because owner cum tenant farmers are getting some subsidized input support from the government but tenant farmers are not getting this support.

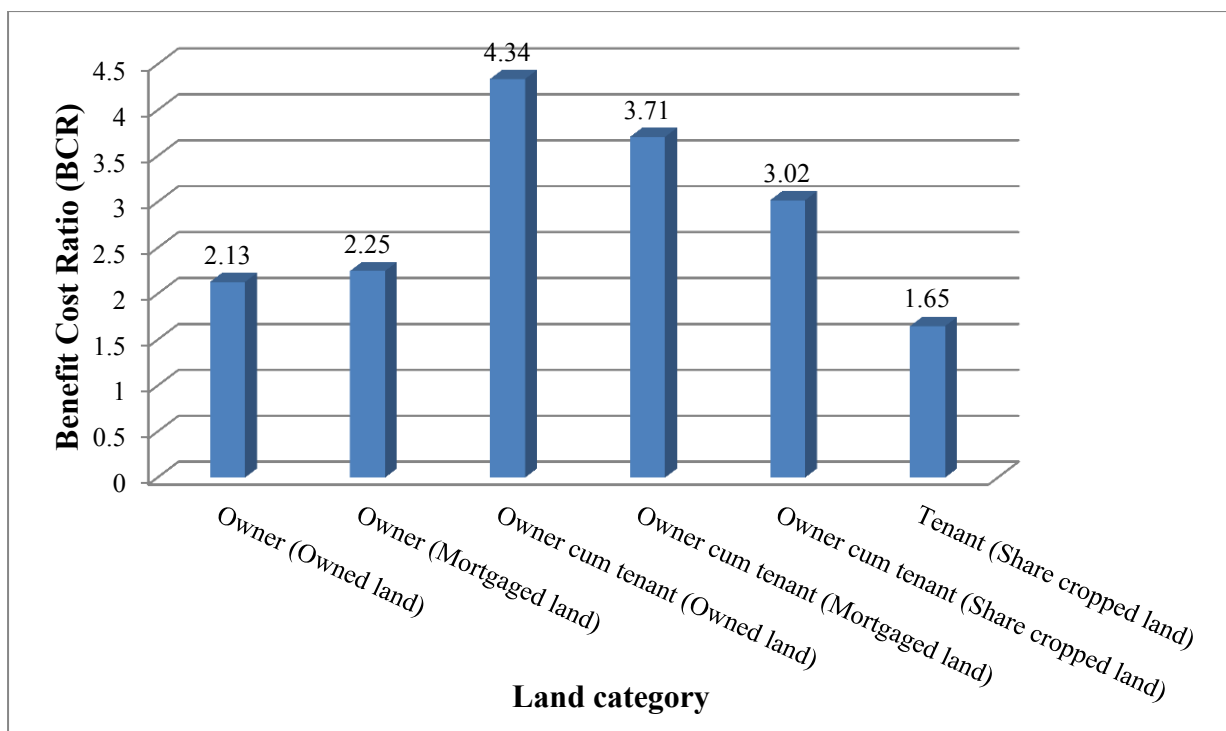


Figure 5.7.1 Benefit Cost Ratio (BCR) of crop cultivation under different land tenure arrangements

From the foregoing discussion, it can be discerned that there is a potentiality of agricultural improvement by encouraging mortgage system in providing short term agricultural credit support for the farmers. Implementation of this mortgaged system might be helpful to lead to attain higher BCR attaining higher gross production for the betterment of agricultural production in Bangladesh.

5.8 Land tenure category wise net revenue of the farmers

Table 5.8.1 presents the land tenure category wise net revenue of the farmers. From the net revenue analysis of different farming categories, it is found that the obtained net revenue in owner operated owned land is higher than owner operated mortgaged land. Owner cum tenant operators obtain higher net revenue in owned land than that of mortgaged and share cropped land. The highest net revenue is obtained by owner cum tenant owned land. The lowest by the tenant share cropped land. This net revenue varies due to high rental cost of share cropped land, per unit price of output as well as input.

Table 5.8.1 Net revenue of the farmers (Taka/ha)

Land tenure category	Net revenue
Owner (owned land)	58,433(29,438)
Owner (mortgaged land)	43,341 (22,104)
Owner cum tenant (owned land)	85,846(23,659)
Owner cum tenant (mortgaged land)	40,483 (14,017)
Owner cum tenant (share cropped land)	63,641(14,781)
Tenant (share cropped land)	40,417(16,205)

Source : Field survey (2013)

Note: Figures and figures in the parentheses indicate mean value and Std. Dev. respectively

5.9 Analysis of Variance (ANOVA) for the Net revenue of the farmers

The result reveals that, the mean difference among net revenue in the different cultivated tenure categories of land of owner, owner cum tenant and tenant farmers are statistically significant difference from zero (Table 5.9.1), indicates that there was a significant difference among the net revenue in the different tenure categories of land of the owner, owner cum tenant and tenant farmers.

Table 5.9.1 summary of ANOVA of the net revenue in the cultivated land of owner, owner cum tenant and tenant farmers

Land tenure category	Net revenue (Taka/ha)	P value
Owner owned land (n= 50)	58,433 (29,438)	0.0000***
Owner mortgaged land (n=15)	43,341 (22,104)	
Owner cum tenant owned land (n=50)	85,846(23,659)	
Owner cum tenant mortgaged land (n= 7)	40,483(14,017)	
Owner cum tenant share cropped land (n=50)	63,641(14,781)	
Tenant share cropped land (n= 50)	40,417 (16,205)	

Note: Number of observation: 222 Figures and figures in the parentheses indicate mean value and Std. Dev. respectively ***Significant at 1% level of significance

5.10. Output and input cost sharing between land owner and tenant farmers

Though, according to the land reform ordinance 1984, tenant will provide human labor, land will be provided by the land owner, rest others input costs will be shared between land owner and tenant farmers equally and produced output will be shared on the same ratio. But in practice output sharing is conducted between land owner and tenant farmers properly according to this land reform ordinance 1984 but input cost sharing are not practiced accordingly except irrigation (Table 5.10.1). As a result, obtained gross revenue of the tenant farmers is 102,741 Taka/ ha, total cost except input cost sharing 62,324 Taka/ha and total cost with input cost sharing 48,527 Taka/ ha. This total cost is 57,556 after sharing irrigation cost (Source table 5.4.1, 5.5.3). Those give the $BCR = \frac{\text{Gross revenue}}{\text{total cost}} = 2.12$, if cost were shared properly; but in reality, the obtained BCR for the tenant farmer is 1.78 after sharing irrigation cost only.

Table 5.10.1 Output and input cost sharing ratio between land owner and tenant farmers

Variables	Sharing ratio	
	Owner	Tenant
Output	50	50
Input:		
Power tiller	-	100
Seed	-	-
Fertilizer	-	100
Irrigation	50	50
Weedicide	-	100
Over all	34.56%	65.44%

Source: Field survey (2013)

5.11 Conclusion and Recommendation

In conclusion, it is concluded that there was a crop wise variation in obtained BCR as well as net revenue in cultivation of different types of crops among the farmers; again noticeable difference was there in cultivation of various land categories. Tenant farmers obtained both lowest BCR and lowest net revenue among these categories. Rental cost of share cropped land, socioeconomic infrastructure and favorable cultivation process including proper land tenure arrangements play a vital role in obtained net revenue of the farmers. Proper policy implementation maintaining the equity issue in land tenure arrangements is needed for the betterment of this net revenue of the cultivators, which will create a viable socioeconomic infrastructure as well as better atmosphere for the agricultural production.

Implementation of this equity issue of land reform ordinance 1984 might be helpful to lead to attain higher net revenue for the tenant farmers as well as higher gross production in share cropping arrangements having favorable cultivation process and technological transformation for the betterment of agricultural production in Bangladesh.

Chapter 6. Technical Efficiency of the Farmers of Basail Upazila in Bangladesh: Stochastic Frontier Approach

6.1 Introduction

Agriculture is the backbone of the economy of Bangladesh. The contribution of agriculture sector in the share of gross domestic product is 23.50% and this sector contributes for the major share of the total employment in the country (BBS, 2011). The Three farming categories of (a) Owner (b) Owner cum tenant and (c) Tenant farmers are prevailing in the country based on the tenancy arrangements of (i) share cropping (ii) leasing and (iii) mortgaging arrangements.

Owned land, mortgaged land, leased land and share cropped land are cultivated by these farming categories in seven different patterns. Owner farmers cultivate owned land and mortgaged land in owner farming. In cultivation of owned land, owner farmers obtain the whole amount of produced crop as net revenue after subtracting the production cost. In the case of mortgaged land, cultivators need to pay a fixed amount of mortgaged money but need not to pay any share of the produced output to the land owner and duration of this mortgaged land persist until the mortgaged money can be repaid by the mortgagor (who mortgaged out the land). Owner cum tenant farmers generally cultivate owned land, mortgaged land, leased land and share cropped land. In cultivation of the leased land, a certain amount of leased money is needed to pay annually to the land owner by the lessee (who leased in the land in lease system). The same terms and conditions of mortgaged land is applicable in owner cum tenant farmers mortgaged land also. Again tenant farmers cultivate share cropped land only in their renting in system in tenant farming by providing half of the produced crop to the land owner according to the legal provision of land reform ordinance 1984. This crop sharing is applied in case of owner cum tenant share cropped land also. There are some core issues: land ownership, size of farm holding, utilization of farming resources of the tenant farmers, impact on production, maintain the soil quality and rational way of cultivation are involved in cultivating these various categories of land by the owner, owner cum tenant and tenant farmers those lead them to attain various level of technical efficiency. In conducting these different forms of land tenure arrangements, farm size varies among these various categories of farmers. Technical efficiency is related with this farm size of the farmers.

That is depicted based on the study conducted by Rahman et al. (2012), from a farm specific technical efficiency of rice grower, it is found that the technical efficiency of large (3.04^+ ha), medium (up to 3.04 ha), small (up to 1.01 ha) and marginal (less than 0.20 ha) farmers were 88%, 92%, 94% and 75% respectively, and it is recommended to take initiative to increase the technical efficiency of marginal farms.

According to the land reform ordinance of Bangladesh tenant will provide human labor, land will be provided by the land owner and rest other input cost will be shared between the land owner and tenant farmers in 50:50 ratio and the produced output will be shared based on the same ratio between the land owner and tenant farmers to get proper incentive in agricultural production (LRB, 1982).

Though this legal provision is existed but in practice, output sharing is conducted according to this legal provision only but input cost sharing is not practiced properly (Ullah, 1996).

Measuring technical efficiency (TE) is one of the methods for understanding how farmers could maximize the benefits from the proper utilization of existing resources and technologies. This method can be conducted adopting production, cost or profit function. This production based method is termed as technical efficiency.

This study analyzes the technical efficiency of different categories of farmers to detect the actual production level and deviated from the maximum attainable production level of the farmers. This study also identifies the impact of the factors associated with this technical efficiency.

6.2. Research location and methodology

This study was carried out at Basail upazila of Tangail district in Bangladesh based on 150 respondents equally 50 for each category. The area of Basail upazila is 158 sq.km, population is 176,002. Data were collected by stratified random sampling technique to trace out the proper impact on technical efficiency under different land tenure arrangements based on the cultivated crops in a cropping year. The major cultivated crops in the study area were HYV Boro and T. Aman. B. Aman, mustrd, jute, wheat or pulses were minor crops. Normally two or three crops were cultivated in each plot of land among these crops within a year. The stratified random sampling technique was needed as the percentages of owner, owner cum tenant and tenant farmers were very disproportionate in the study area (DAE, 2013). Then the collected data were analyzed by using statistical analytical software STATA13. Stochastic frontier approach was used to measure the technical efficiency of the different categories of farmers based on their gross revenue of output ha^{-1} in the cultivated various types of land.

This study considers the stochastic frontier approach with the assumption that the actual production cannot exceed the maximum possible production with the given input quantities and it is suggested to determine the factors responsible for inefficiency (Aigner et al., 1977 and Meeusen and van den Broeck, 1977).

It was used in a two stage procedure. In first stage TE was computed and in the second stage socioeconomic variables of farm households were regressed against this TE using Tobit regression method to identify their impact. Since the value of TE is in the range of 0 to 1, it justifies using Tobit regression technique (Nargis and Lee, 2013; Hossain et al., 2013).

The stochastic frontier model used in this study as follows:

$$\ln Y_i = \beta_0 + \beta \ln X_i + V_i - U_i \dots \quad (1)$$

Where, logarithm Y_i is the gross revenue of output ha^{-1} in different types of cultivated land, β is the vector of parameters to be estimated, X_i presents inputs. These inputs includes per hectare cost of human labor, power tiller, seed, material cost (Cost of fertilizer, insecticides and pesticides), irrigation and land use cost in various categories of cultivated land of the different tenure groups of farmers. Land use cost was taken based on the cultivated land of the farmers as ownership patterns as well as cultivated land categories were different among owner, owner cum tenant and tenant farmers. This land use cost was taken at the rate of the cost of mortgaged land both for owned land and mortgaged land of owner as well as owner cum tenant farmers based on their cultivated mortgaged land but this land use cost was taken at the rate of the cost of share cropped land of both for owner cum tenant and tenant farmers based on their cultivated share cropped land in the study area. It was found in the study area that if half of the seed cost was provided to the tenant by the land owner then land owner claimed half of the produced by-product, and even sometimes without sharing this seed cost the half of the produced by-product was claimed also based on customary rule (Practiced rule according to custom). To avoid this complexity, price of by-product was not taken into account in estimating gross revenue. V_i Present the error term accounting for random variation in gross revenue, due to the factors outside the control of farmers. Another error term U_i presents error associated with farm level inefficiency and this is assumed to have zero mean with variance (σ_u^2) and distributed half normally. Similarly, V_i is assumed to have zero mean and constant variance (σ_v^2) and distributed normally with independent with each U_i .

Both of these error terms are supposed to be uncorrelated with explanatory variables X_i . The log likelihood function for half normal model is given in equation (2). This likelihood function estimates whether the variation among the observation is due to inefficiency. From the likelihood function we get σ^2 and λ^2 .

Where, $\sigma^2 = \sigma_u^2 + \sigma_v^2$ and $\lambda^2 = \sigma_u^2 / \sigma_v^2$. If $\lambda=0$, it indicates there is no inefficiency effect and the variation in the data is due to random noise only. The higher the value of λ the more will be inefficiency effects explained by the model.

$$\ln L(Y_i|\beta, \sigma\lambda) = -\frac{1}{2}\ln(\pi\sigma^2) + \sum_{i=1}^n \ln \Phi\left\{\frac{-\varepsilon_i\lambda}{\sigma}\right\} - \frac{1}{2\sigma^2} \sum_{i=1}^n \varepsilon_i^2 \quad \dots \quad (2)$$

Where, Y_i is the vector log of gross revenue of output ha^{-1} in different types of cultivated land $\varepsilon_i = V_i - U_i = \ln Y_i - X_i \beta$ is the composite error and $\Phi(X_i)$ is a cumulative distribution function of the standard normal variable evaluated at X_i .

The TE of the farmers in the context of stochastic frontier function can be expressed as:

$$TE_i = \frac{Y_i}{Y_i^*} = f(X_i; \beta) \exp(V_i - U_i) / f(X_i; \beta) \exp(V_i) = \exp(-U_i) \quad \dots \quad (3)$$

Where, Y_i^* is the maximum possible gross revenue of output ha^{-1} in different types of cultivated land, Y_i , X_i , β , V_i , TE_i and U_i are as explained earlier. TE_i measures the gross revenue of output ha^{-1} in different types of cultivated land of the farmers relative to the maximum possible gross revenue of output ha^{-1} in different types of cultivated land that can be produced using the same cost of input vectors. This value of TE_i is 0 to 1.

If $TE_i=1$, Y_i achieves the maximum value of $f(X_i; \beta) \exp(V_i)$. If TE_i is less than 1, that indicates the shortfall of gross revenue of output from the maximum possible level. This situation is characterized by stochastic elements, which vary among the farmers. The following equation (4) was used to identify the impact of socioeconomic variables on TE.

$$TE_i = \delta_0 + \delta \ln Z_i + \omega_i \quad \dots \quad (4)$$

Where, δ presents the parameters associated with socioeconomic variables (Z_i) and ω_i is the error term. The variables for the study were chosen considering both production theory and local context of the farmers. Analysis of variance (ANOVA) was used to analyze the mean difference of technical efficiency in cultivated different categories of land of the farmers. Tobit regression analysis was used to identify the impact of the factors associated with technical efficiency. In using this stochastic frontier approach Wald χ^2 test shows significant result ($P=0.0000$), that indicates the fitness of the model. All of these stochastic frontier approach, ANOVA and Tobit regression analyses were used based on overall study area.

For this regression analysis Tobit regression method was used, because (a) though ordinary least square (OLS) is frequently used regression method, but this method requires innovative approach. The constraints of OLS and complementary advantages of Tobit model in working with censoring data. (b) Tobit model performs more accurately than OLS when data are subject to a ceiling or floor effect. (c) Tobit model is an alternative analysis of approach according to requirement.

Before running this Tobit model data were validated using Variance Inflation Factor (VIF) and Breusch- Pagan/ Cook- Weisberg test for multicollinearity and heteroskedasticity respectively.

Table 6.2.1 presents explanatory variables and expected sign of the Tobit model. The expected sign of age of the HHH was hypothesized positive. This was because of more age of the HHH leads to attain more maturity in farming. Education of the HHH was hypothesized positive, as it was found based on the study that in addition to raising rice productivity and boosting potential output household education significantly reduces production inefficiencies (Asadullah, 2005). The expected sign of land status was hypothesized positive; this was because land ownership leads to attain better financing in farming. The expected sign of family member was hypothesized positive. This was due to considering better utility of family member in farming. The expected sign of farm size was hypothesized positive, as larger farm size leads to attain better financial solvency in farming. Off-farm income was hypothesized positive, this was because, off-farm income provides better utility in financing in farming. Credit was hypothesized positive, as better credit facilities provides better financing in farming. Adoption of new crop has better advantages, considering those advantages; adoption of new crop was hypothesized positive. Extension services is helpful to keep in touch with the innovative technologies for the farmers in their farming. Considering this reason, the expected sign of extension services was hypothesized positive. Value of asset was hypothesized positive. This asset has better utility in farming. Considering this utility aspect, this value of asset was hypothesized positive. The expected sign of livestock was hypothesized positive also. This was due to considering better utility of livestock in farming.

Table 6.2.1 Explanatory variables, measurement unit and expected sign of the Tobit model

Variables	Measurement unit	Expected sign
Age of the HHH	Year	+
Education of HHH	Year of formal education	+
Land status of HHH	1= Owner owned land, 2= Owner mortgaged land, 3=Owner cum tenant owned land, 4=Owner cum tenant mortgaged land, 5= Owner cum tenant share cropped land, 6=Tenant share cropped land (dummy)	+
Family member	LFU	+
Ln farm size	Hectare	+
Ln off- farm income	BDT/ Year	+
Credit	1=Yes, 0=No (dummy)	+
Adoption of new crop	1=Yes, 0=No (dummy)	+
Extension services	1=Yes, 0=No (dummy)	+
Value of asset	BDT	+
Livestock	LSU	+

Note: BDT= Bangladesh Taka, 1 US Dollar=77.98 BDT

6.3 Results and discussion

(1) Farming category and Socioeconomic characteristics

Table 6.3.1.1 presents the socioeconomic characteristics of the respondent farmers. Presently in Bangladesh the percentages of owner, owner cum tenant and tenant farmers are 65%, 22% and 13% respectively (BBS, 2011). This respective percentages of owner, owner cum tenant and tenant farmers in the study area are 48%, 28% and 24% respectively (DAE, 2013).

The average farm size in cultivation of owner owned land and owner mortgaged land are 0.73 ha and 0.53 ha respectively. The average farm size in cultivation of owner cum tenant owned land, mortgaged land and share cropped land are 0.75 ha, 0.81 ha and 0.75 ha respectively. Again, the average farm size in cultivation of tenant share cropped land is 0.71 ha.

The percentage of credit facility availing farmers in cultivation of both owner owned land and mortgaged land is 98%. This percentages of credit facility availing farmers in cultivation of owner cum tenant owned, mortgaged and share cropped land are 98%, 98% and 94% respectively. Again this percentage of credit facility availing farmers in cultivation of tenant share cropped is 0.

Tenant farmers are not getting any credit from formal sources due to lack of collateral. Though tenant farmers should get collateral right of rented land according to the legal provision of land reform ordinance 1984 (LRB, 1982).

The interest rate between formal and informal credit sources varies significantly in the study area. This interest rate is 6% for the agricultural credit received from formal sources, but this interest rate becomes 18% for the credit received from informal sources (DAE, 2013).

The mean value of asset in cultivation of owner owned land and owner mortgaged land are 481,164 BDT and 653,333 BDT respectively. The mean value of asset in cultivation of owner cum tenant owned land, mortgaged land and share cropped land are 369,600 BDT, 118,571 BDT and 360,600 BDT respectively. Again, the mean value of asset in cultivation of tenant share cropped land is 50,164 BDT.

From the discussion of socioeconomic characteristics of the farmers, it is concluded that tenant farmers are in most dis-advantageous position in farming among these different tenure categories of farmers in consideration of farm size and all other socioeconomic aspects.

Table 6.3.1.1 Socio- economic characteristics of the sample households

Variables	Owner owned land (n= 50)		Owner mortgaged land (n= 15)		Owner cum tenant owned land (n= 50)		Owner cum tenant mortgaged land (n=7)		Owner cum tenant share cropped land (n=50)		Tenant share cropped land (n= 50)	
	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range
Age of the HHH (Year)	50.22 (10.43)	30-72	50.73 (11.64)	32-72	50.32 (9.39)	32-65	46.42 (13.74)	32-65	50.32 (9.39)	32-65	43.62 (9.79)	22-65
Education of the HHH (Year)	4.34 (3.55)	0-14	5.40 (4.73)	0-14	3.76 (2.53)	0-14	3.42 (1.51)	2-5	3.76 (2.53)	0-14	2.16 (1.88)	0-8
Family member(LFU)	3.54 (0.86)	2-5	3.73 (0.96)	2-5	3.56 (0.81)	2-5	2.85 (0.69)	2-4	3.56 (0.81)	2-5	3.14 (0.90)	2-5
Farm size (ha)	0.73 (0.56)	0.23-4.08	0.53 (0.25)	0.22-0.91	0.75 (0.34)	0.23-2.26	0.81 (0.27)	0.34-1.02	0.75 (0.34)	0.23-2.26	0.71 (0.52)	0.23-2.72
Off- farm income (BDT)	100,270 (77,068)	0-240,000	84,733 (79,028)	0-240,000	55,000(50,598)	0-240,000	28,000 (23,180)	12,000-80,000	55,000 (50,598)	0-240,000	34,828(16,178)	0-84,000
Extension services availing farmer %	20	-	27	-	0	-	0	-	12	-	2	-
Credit availing farmer %	98	-	98	-	98	-	98	-	94	-	0	-
New crop adopting farmer %	100	-	100	-	100	-	100	-	94	-	94	-
Weed management adopting farmer %	20	-	27	-	0	-	0	-	12	-	2	-
Value of asset (BDT)	481,164 (191,749)	70,000-800,000	653,333 (546,321)	200,000-4000,000	369,600 (361,146)	40,000-4000,000	118,571 (58,431)	50,000-200,000	360,600 (50,779)	40,000-3500,000	50,164(25,000)	12,000-400,000
Livestock (LSU)	3.06(1.21)	0.7-9.1	2.24 (0.76)	0.7-3.2	2.92 (0.68)	0.7-3.1	5.50 (4.50)	3.3-6.50	2.92 (0.68)	0.3-4.2	2.32 (0.91)	0.30-4.10

Source: Field survey (2013) Note: n= Observation, SD= Standard deviation

(2) Study variables

Table 6.3.2.1 presents the mean and standard deviation of the study variables. The mean gross revenue of owner owned and mortgaged land is 110,026 BDT ha⁻¹ and 77,995 BDT ha⁻¹ respectively. The mean gross revenue of owner cum tenant owned, mortgaged and share cropped land is 111,530 BDT ha⁻¹, 55,409 BDT ha⁻¹ and 95,173 BDT ha⁻¹ respectively. Again, the mean gross revenue in tenant share cropped land is 102,741 BDT ha⁻¹. The average cost of human labor in cultivation of owner owned and mortgaged land is 11,878 BDT ha⁻¹ and 7,322 BDT ha⁻¹ respectively. The average human labor cost in owner cum tenant owned, mortgaged and share cropped land is 6,067 BDT ha⁻¹, 6,452 BDT ha⁻¹ and 6,394 BDT ha⁻¹ respectively. Again the average human labor cost in tenant share cropped land is 11,132 BDT ha⁻¹. Average cost of power tiller in cultivation of owner owned and mortgaged land is 4,002 BDT ha⁻¹ and 2,406 BDT ha⁻¹ respectively. The average power tiller cost in owner cum tenant owned, mortgaged and share cropped land is 2,173 BDT ha⁻¹, 2,036 BDT ha⁻¹ and 2,374 BDT ha⁻¹ respectively. Again the average power tiller cost in tenant share cropped land is 4,166 BDT ha⁻¹. The average cost of seed in cultivation of owner owned and mortgaged land is 2,590 BDT ha⁻¹ and 1,621 BDT ha⁻¹ respectively. The average seed cost in owner cum tenant owned, mortgaged and share cropped land is 1,353 BDT ha⁻¹, 1,067 BDT ha⁻¹ and 1,170 BDT ha⁻¹ respectively. Again the average seed cost in tenant share cropped land is 1,276 BDT ha⁻¹. The average material cost in cultivation of owner owned and mortgaged land is 15,878 BDT ha⁻¹ and 9,589 BDT ha⁻¹ respectively. The average material cost in owner cum tenant owned, mortgaged and share cropped land is 7,999 BDT ha⁻¹, 1,702 BDT ha⁻¹ and 6,571 BDT ha⁻¹ respectively. Again the average material cost in tenant share cropped land is 12,616 BDT ha⁻¹. The average cost of irrigation in cultivation of owner owned and mortgaged land is 10,670 BDT ha⁻¹ and 7,141 BDT ha⁻¹ respectively. The average irrigation cost in owner cum tenant owned, mortgaged and share cropped land is 5,676 BDT ha⁻¹, 1,253 BDT ha⁻¹ and 5,259 BDT ha⁻¹ respectively. Again the average irrigation cost in tenant share cropped land is 9,537 BDT ha⁻¹. The average land use cost in cultivation of both owner owned land and mortgaged land are 6,575 BDT ha⁻¹. The average land use cost in both in owner cum tenant owned land and mortgaged land are 2,416 BDT ha⁻¹. Again the mean land use cost in owner cum tenant share cropped land and tenant share cropped land are 9,764 BDT ha⁻¹ and 23,597 BDT ha⁻¹ respectively. The highest land use cost is obtained in the tenant share cropped land and the lowest in owner cum tenant mortgaged land. This is because, owner cum tenant farmers are getting some input support from the government and they have some bargaining power in getting share cropped land but tenant farmers are neither getting this input support nor they have this bargaining power like owner cum tenant farmers. This cost of production varies in different categories of cultivated land of the farmers based on their socioeconomic condition in conducting their crop cultivation process.

Table 6.3.2.1 Mean and standard deviation (SD) of the of the study variables of stochastic frontier model

Variables	Mean(±SD)Owner owned land (n=50) BDT ^{ha-1}		Mean(±SD)Owner mortgaged land (n=15) BDT ^{ha-1}		Mean(±SD)Owner cum tenant owned land (n=50) BDT ^{ha-1}		Mean(±SD)Owner cum tenant mortgaged land (n=7) BDT ^{ha-1}		Mean(±SD)Owner cum tenant share cropped land (n=50) BDT ^{ha-1}		Mean(±SD)Tenant share cropped land (n=50) BDT ^{ha-1}	
	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range
Gross revenue	110,026 (38,852)	11,690- 234,650	77,995 (72,215)	43,980- 247,000	111,530 (35,667)	7,764- 177,840	55,409 (48,486)	48,800- 172,900	95,173 (130,567)	49,400- 98,800	102,741 (34,028)	73,400- 247,000
Human labor cost	11,878 (5,483)	980- 3,380	7,322(2,687)	882- 11,761	6,067(2,738)	1,470- 10,585	6,452(5,954)	3,308- 22,053	6,394 (2,754)	980- 11,761	11,132 (3,556)	2,205- 16,540
Power tiller cost	4,002 (1,430)	882- 8,821	2,406 (792)	882- 3,920	2,173 (1,115)	490-6,616	2,036 (945)	735- 3,308	2,374 (1,173)	490- 6,616	4,166 (702)	2,129- 4,940
Seed cost	2,590 (1,386)	392- 4,631	1,621(932)	551- 3,528	1,353 (828)	294-3,528	1,067 (739)	441- 2,940	1,170 (1,031)	500- 3,920	1,276 (1,688)	500- 4,442
Material cost	15,878(7,862)	980- 39,696	9,589 (2,460)	3,528- 14,114	7,999(3,753)	1,960- 14,114	1,702(3,546)	1,470- 11,761	6,571 (4,054)	735- 15,122	12,616 (5,670)	3,193- 18,525
Irrigation cost	10,670 (4,816)	441- 22,053	7,141 (2,494)	2,646- 11,761	5,676 (2,925)	1,470- 10,585	1,253(3,097)	470- 10,585	5,259 (3,146)	735- 11,761	9,537 (4,021)	2,940- 16,540
Land use cost	6,575 (4,827)	2,205- 49,098	6,575 (4,827)	2,205- 49,098	2,416 (1,609)	816-39,696	2,416(1,609)	816- 39,696	9,764 (7,808)	1,017- 38,593	23,597 (15,379)	6,616- 88,214

Source : Field survey (2013) Note: BDT= Bangladesh Taka, 1 US Dollar=77.98 BDT

(3) Stochastic Frontier Production Function

Table 6.3.3.1 presents the findings from stochastic frontier model. The significant log likelihood using the wald test signifies the fitness of the model ($P=0.0000$).

Moreover, the likelihood ratio test for the absence of inefficiency in the model criteria was rejected ($P=0.000$). Indicating that the inefficiency effect explained in the model is higher than random noise.

Marginal effects of the relevant input variables were estimated on gross revenue to complement the analysis and these marginal effects were used to discuss the effect of the concerned explanatory variable on gross revenue of the farmers considering the effect of other variables constant. Seed, power tiller and irrigation had positive effect. But human labor, material cost and land use cost had negative effect on gross revenue. The marginal effect of seed is 0.052, indicates that 1% increase in seed cost leads to increase the gross revenue of output ha^{-1} by 0.052%. This indicates the positive impact of seed on gross revenue in farming. The marginal effect of power tiller is 0.481, indicates that 1% increment of power tiller cost leads to increase the gross revenue of output ha^{-1} by 0.481%. This depicts the positive association of power tiller in increasing gross revenue in farming. The marginal effect of irrigation is 0.213, indicates that 1% increase in irrigation cost leads to increase the gross revenue of output ha^{-1} by 0.213%. This reveals better utility of irrigation in agricultural production. The marginal effect of human labor is -0.022, indicating that 1% increase in cost of human labor leads to decrease the gross revenue of output ha^{-1} by 0.022%. This is due to under-utilization of family member. The marginal effect of material cost is -0.794, indicating that 1% increment in material cost leads to decrease the gross revenue of output ha^{-1} by 0.794%. This is due to material cost used in higher price is not economically viable for them in compare to cheaper compost and manure. In the study area compost and manure are used in a cheaper price, even cost accounting is not calculated properly. The marginal effect of land use cost is -0.002, indicates that 1% increment in land use cost leads to decrease the gross revenue of output ha^{-1} by 0.002%. The reason behind this negative impact of increased land use cost is the decreasing impact on net revenue in farming.

Table 6.3.3.1 Maximum likelihood estimates and marginal effects

Variables	Coefficients	P value	Marginal effects
Human labor cost	-0.031 (0.00004)	0.000***	-0.022
Power tiller cost	0.757 (0.00004)	0.000***	0.481
Seed cost	0.107 (0.00001)	0.000***	0.052
Material cost	-1.092 (0.00001)	0.000***	-0.794
Irrigation cost	0.302 (0.00005)	0.000***	0.213
Land use cost	-0.004 (0.00002)	0.000***	-0.002
Constant	13.30 (0.0001)	0.000***	

Log likelihood:-226.33*** $\sigma^2 = 1.80$ $\lambda = 3.85$ likelihood ratio= 1.2*** N= 222, *** indicates significant at 1% level of significance

(4) Analysis of Variance (ANOVA) for the technical efficiency of the farmers

The result reveals that, the mean difference among technical efficiency in the cultivated different categories of land of the owner, owner cum tenant and tenant farmers are statistically significant difference from zero (Table 6.3.4.1), indicates that there was a significant difference among the technical efficiency of various categories of cultivated land of the farmers.

Table 6.3.4.1 summary of ANOVA of the technical efficiency of the farmers

Land tenure category	Technical efficiency		P value
	Mean (SD)	Range	
Owner owned land (n= 50)	0.479 (0.23)	0.058-0.999	0.0000***
Owner mortgaged land (n=15)	0.569 (0.24)	0.189-0.981	
Owner cum tenant owned land (n=50)	0.439 (0.17)	0.032-0.767	
Owner cum tenant mortgaged land (n= 7)	0.389 (0.22)	0.196-0.833	
Owner cum tenant share cropped land (n=50)	0.340 (0.19)	0.024-0.999	
Tenant share cropped land (n= 50)	0.320 (0.18)	0.022-0.793	

Note: Number of observation: 222 ***Significant at 1% level of significance

The result shows that there is 48% mean technical efficiency in owner owned land. Indicates that technical efficiency in owner owned land could improve by 52%. This mean technical efficiency in owner mortgaged land is 57%, indicates that technical efficiency in owner mortgaged land could improve by 43%.

The mean technical efficiency in owner cum tenant owned land is 44%. Which indicates that this technical efficiency in owner cum tenant owned land could improve by 56%. The mean technical efficiency in owner cum tenant mortgaged land is 39%, indicates that technical efficiency in owner cum tenant mortgaged land could improve by 61%. The mean technical efficiency in owner cum tenant share cropped land is 34%, indicates that technical efficiency in owner cum tenant share cropped land could improve by 66%.

The mean technical efficiency in tenant share cropped land is 32%, indicates that technical efficiency in tenant share cropped land could improve by 68%.

The highest technical efficiency is obtained by owner mortgaged land (57%). This is due to better advantages in farming in owner mortgaged land. Again the lowest technical efficiency is obtained by tenant share cropped land (32%). This is due to lack of proper incentive in cultivation of share cropped land.

Moreover, it is also found (Table 6.3.4.1) that the highest variation is observed in owner cum tenant share cropped land (2.4%-99.9%). This is due to lack of proper incentive in cultivation of owner cum tenant share cropped land. Again the lowest variation is observed in cultivation of owner cum tenant mortgaged land (19.6%- 83.3%). This might be better advantages in cultivation of owner cum tenant mortgaged land.

(5) Analysis of Variance (ANOVA) for the technical efficiency of the owner cum tenant and tenant farmers in cultivating share cropped land (addressing cost sharing issue of share cropped land in the stochastic frontier model)

Table 6.3.5.1 presents summary result of the ANOVA in cultivating share cropped land of the owner cum tenant and tenant farmers. From the result it is found that there is a statistically significant difference from zero among the technical efficiency of owner cum tenant and tenant farmers in cultivating share cropped lands in seed cost sharing and not sharing condition. From the table it is found that the obtained technical efficiency of seed cost sharing arrangement in owner cum tenant sharecropped land (59.10%) is higher than the obtained technical efficiency in without seed cost sharing arrangement (54.80%) in cultivation of share cropped land. Again, in case of technical efficiency in tenant share cropped land in seed cost sharing arrangement (59.70%) is higher than obtained technical efficiency in without seed cost sharing arrangement (49.00%). The highest technical efficiency is obtained in tenant share cropped land under seed cost sharing arrangement. The reason for attaining this highest

technical efficiency might be for getting incentive in seed cost sharing by the land owner as well as best working effort of the tenant farmers in their cultivation process. The lowest technical efficiency is obtained in tenant share cropped land under without seed cost sharing condition. This is due to lack of incentive in not sharing the seed cost by the land owner.

Table 6.3.5.1 summary of ANOVA of the technical efficiency of the farmers in cultivating share cropped land

Land tenure category	Technical efficiency		P value
	Mean (SD)	Range	
Owner cum tenant share cropped land seed cost shared (n=11)	0.591(0.18)	0.291 -0.948	0.0899*
Owner cum tenant share cropped land seed cost not shared (n=39)	0.548 (0.14)	0.291-0.948	
Tenant share cropped land seed cost shared (n= 25)	0.597 (0.15)	0.00001-0.803	
Tenant share cropped land seed cost not shared (n= 25)	0.490 (0.16)	0.203-0.769	

Note: Number of observation: 100 *Significant at 10% level of significance

(6) Technical efficiency based on seed cost shared status by two land tenure categories

Table 6.3.6.1 presents technical efficiency based on seed cost shared status by two land tenure categories. From the table it is found that there is a statistically significant difference from zero in all the cases based on seed cost except owner cum tenant share cropped land. The reason for this statistically significant difference is due to better incentive of shared seed cost by the land owner.

Table 6.3.6. 1 Technical efficiency based on seed cost shared status by two land tenure categories (Estimation based on seed cost)

Land tenure category	Seed cost sharing status		Mean TE (SD)	Seed cost not shared	Mean TE (SD)	P- value
	Seed cost shared	Shared no. of observations		No. of observations		
Owner cum tenant share cropping	(n=11)	0.591 (0.18)	(n=39)	0.548(0.14)	0.4236	
Tenant share cropping	(n=25)	0.597 (0.15)	(n=25)	0.490(0.16)	0.0195**	
Total share cropping	(n=36)	0.5860 (0.16)	(n=64)	0.5256 (0.15)	0.0622*	

Note: ** and * indicate 5% and 10% level of significance

(7) Impact of socioeconomic variables on technical efficiency of the farmers

Table 6.3.7.1 presents the summary result of the impact of socioeconomic variables. We tested eleven socio economic explanatory variables against technical efficiency in Tobit regression analysis. These explanatory variables were selected based on production theory and local context of the farmers in the light of their production process.

From the analysis, it is found that the direction of the response of the variable credit was as per the hypothesis and this credit had significant positive impact on technical efficiency. This is due to better utility of credit in farming. Couples of studies reported similar result (Ahmed, 2011; Shameen and Chawdhury, 2013; Khondker and et al., 2013).

The study conducted by Ahmed (2011) on “Technical efficiency of agricultural farms in Khulna, Bangladesh” considers three sub-sectors: rice cultivation, fish cultivation and livestock rearing in farming and found that there was about 76%, 81% and 73% variations of output due to technical inefficiency for the farms of these three sub-sectors respectively. It was found that availability of credit significantly and positively affect the efficiency level of the farms.

From the conducted study by Shameen and Chadhury (2013) on “Agricultural growth and agricultural credit in the context of Bangladesh”- it is found that there had been a positive correlation between agricultural credit and greater agricultural production.

The study conducted by Khondker and et al. (2013) on “The role of credit on food production and food security in Bangladesh” is a national level conducted study based on 1,200 households in all over the country including the study area (Tangail district). This study was

conducted by the bureau of economic research University of Dhaka with support of the national food policy capacity strengthening program of USAID and FAO. The study reveals that availability of credit had a significant positive impact on agricultural production.

Given a positive association between agricultural credit and agricultural production in this study it is recommended to expand the credit disbursement program for the farmers including relaxation aspect of collateral for the sake of marginal farmers and landless share croppers.

Land status of owner cum tenant was significant but did not show expect sign, this is due to lack of proper incentive in cultivation of share cropped land. The study conducted by (Ahmed et al., 2002) reported similar findings. According to this study share cropping is less technically efficient than owner cultivation and fixed rental due to restrictions imposed on them by the land owners, thus in this study it is recommended for the policy to facilitate more efficient transections of land between farmers to reduce inefficiencies associated with these land tenure arrangements. Farm size was significant but did not show expect sign. Similar result was reported in the study conducted by Rahman et al. (2012). The reason for the case of farm size, this might be due to extensive use of owned land of the owner farmers as well as owner cum tenant farmers. The value of asset was significant but did not show expected sign, this finding is similar to the study conducted by Rahman et al. (2012). This might be due to extensive use of asset in farming of the owner farmers. Other variables did not show significant impact on technical efficiency.

Table 6.3.7.1 Parameter estimates of the Tobit model

Variables	Coefficients	P value
Age of the HHH	0.119(.07)	0.121
Education of the HHH	0.021(.02)	0.398
Land status (Owner mortgaged land)	-0.076(0.05)	0.174
Land status (Owner cum tenant owned land)	-0.033(0.04)	0.400
Land status (Owner cum tenant mortgaged land)	-0.070 (0.08)	0.385
Land status (Owner cum tenant share cropped land)	-0.140 (0.04)	0.001***
Land status (Tenant share cropped land)	0.030 (0.07)	0.651
Family member	0.012(0.07)	0.853
Ln farm size	-0.048(0.03)	0.086*
Ln off- farm income	-0.001(0.003)	0.666
Credit	0.188(0.06)	0.004***
Adaptation of new crop	0.038(0.09)	0.670
Extension services	0.033(0.04)	0.453
Value of asset	-0.027 (0.01)	0.034**
Livestock	-0.008(0.01)	0.435
Cons	0.081(0.33)	0.803

Note: Number of observation: 222 LR chi2 (15) 51.97*** Figures in the parentheses indicate Std. Err. ***, ** and * Significant at 1%, 5% and 10% level of significance respectively

6.4 Conclusion and recommendation

In this study technical efficiency of different categories of cultivated land of the farmers was estimated in stochastic frontier approach and analyzed the estimated technical efficiency using ANOVA.

It is found that there was a statistically significant differences from zero in the level of technical efficiency in their cultivated various categories of lands of the owner, owner cum tenant and tenant farmers. This technical efficiency becomes higher in share cropped lands if

input cost is shared by the land owner. It was also identified the impact of socioeconomic variables on technical efficiency employing Tobit regression analysis; it was found significantly positive influence of credit on technical efficiency.

From the discussions it can be discerned that, there is a potentiality for the enhancement of technical efficiency in share cropped lands in ensuring the input cost sharing provision according to legal provision of land reform ordinance 1984 in cultivation of share cropped lands and extending to ensure the collateral right of rented land for the tenant farmers in proper implementation of the land reform ordinance 1984 to make their access in getting credit from formal sources. That will lead to attain higher technical efficiency in share cropped lands of the tenant farmers. Improvement of more credit facilities for the owner as well as owner cum tenant farmers, will lead to enhance their higher technical efficiency also. This study recommends the government to take necessary measures on that direction.

Chapter7. Summary Conclusion and Recommendation

7.1 Summary

Land is one of the very important factors of production in an agrarian developing country like Bangladesh. Land reform ordinance 1984, the existing legal provision was formulated and declared by the government of Bangladesh in due respect for the improvement of agricultural production as well as the proper utilization of agricultural lands in the country by properly addressing the tenancy issue of share cropped land. The academic contribution of this thesis lies in evaluation of implementation and agricultural production aspect of this land reform ordinance 1984, which is a very important issue in the national perspective of Bangladesh. The aim of this thesis is to analyze the various aspects of land tenure arrangements on agricultural production based on with and without implementation of this legal provision of land reform ordinance 1984. The study area was selected at Basail Upzila (sub -district) of Tangail district in Bangladesh, as the farmers of this Upazila get location advantages in farming those can represent the various regional characteristics of land tenure arrangements in the country, including cropping patterns and other concerned issues in terms of land tenure and rented land in farming. Other related aspects those effects on land tenure and agricultural production were also assessed. Data for this study were collected from 150 respondents of equally 50 from each category of owner, owner cum tenant and tenant farmers. This data were collected from January to March, 2013 by stratified random sampling technique based on the cultivated crops in a cropping year. Then the collected data were analyzed by statistical analytical software Stata 13 according to the objectives of the study. There are two core chapters (Chapter 5 and 6) have been incorporated in this thesis. These include analyses of various aspects of agricultural production according to land tenure arrangements and existing technical efficiency of the farmers in the cultivated various categories of land of the farmers. This Thesis has attempted to locate the most relevant theoretical models to explain the econometric outcomes in the relevant chapters to attain concerned target. The earlier chapters established the relationship between agricultural production and various aspects of land tenure arrangements. Land issues aspects of Bangladesh as well as study area have been explained in these chapters.

In compare to other south Asian countries agriculture plays a dominant part in the overall economy of Bangladesh specially, among South Asian Association for Regional Co-operation

(SAARC) countries. There are eight countries in SAARC. This SAARC was formed in 1980 for the regional co-operation in attaining the economic development among these 8 countries of Bangladesh, India, Bhutan, Pakistan, Sri-Lanka, Maldives, Nepal and Afghanistan. It is found based on the study (Ahmed, 2012) that agriculture sector contributes for the 4th highest (52%) for the employment opportunity in Bangladesh, though the per capita land is lowest (0.12 ha) among these SAARC countries. This indicates the necessity of proper land use arrangements in Bangladesh. Land is the single most important asset for the livelihood of people in Bangladesh and tenancy arrangements are commonly used in order to get access of land for the landless poor. This thesis explores agricultural production in the different land tenure arrangements based on these various tenancy arrangements among different categories of farmers.

The current agricultural policies are focused on economic restructuring for attaining proper agricultural development. This provides the rationale for this research to study land and livelihood based on the agricultural production according to different land tenure arrangements. Therefore, the first core chapter (chapter 5) attempts to analyze the agricultural production in the different land tenure arrangements of Basail Upazila of Tangail district in Bangladesh. This study shows that output sharing is conducted according to this legal provision of land reform ordinance 1984 but input cost sharing are not practiced accordingly in share cropped land. Those lead the tenant farmers in getting lack of proper incentive. That is revealed in both benefit cost ratio (BCR) and analysis of variance of net revenue of the farmers. From the analysis of variance, it is found that there is a statistically significant difference from zero among the net revenue of cultivated various categories of land of the owner, owner cum tenant and tenant farmers. Again, BCR in owner cum tenant mortgaged land is higher than that of both the owner cum tenant or tenant share cropped land. This indicates the potentiality to transform share cropped land into mortgaged land for the cultivators.

The second core chapter (chapter 6) identifies the technical efficiency of different categories of land of the farmers. From this study it is found that there is a statistically significant difference from zero among the technical efficiency of various categories of cultivated land of the farmers. This technical efficiency becomes higher in share cropped lands, if input cost is shared by the land owner according to the legal provision of land reform ordinance 1984. It is also found significantly positive influence of credit on this technical efficiency.

Owner and owner cum tenant farmers are getting credit from formal sources as they have their owned land to use as collateral for getting this credit. But tenant farmers are not getting any credit due to lack of collateral, because they do not have their owned land, but according to the legal provision of land reform ordinance 1984 tenant farmers should get the collateral right of their rented land. Though, this legal provision is prevailing, but presently they are not getting this collateral right of their rented land due to lack of proper implementation of this legal provision. If this land reform ordinance 1984 is implemented properly then tenant farmers will get the collateral right of their rented land that will lead to attain higher technical efficiency by receiving credit from formal sources for the tenant farmers.

From the analyses, it can be detected that, proper implementation of land reform ordinance 1984 is needed for achieving the proper incentive in cultivation of share cropped land, enhancement of technical efficiency, Profitability in crop cultivation for the cultivators as well as for the better outcome of agricultural production in Bangladesh.

7.2 Conclusion and Recommendation

The findings of the study show that output sharing is conducted according to the legal provision of land reform ordinance 1984 but input cost sharing is not practiced accordingly in share cropped land. Those lead the tenant farmers in lack of proper incentive. That is revealed in BCR analysis as well as net revenue analysis in chapter 5. This BCR was calculated based on the gross revenue and total cost of the cultivated different categories of land of the farmers. This was calculated in both major cultivated crop- wise and land category wise. From crop-wise BCR, it is found that the highest BCR (4.58) is obtained by owner cum tenant farmers in cultivation of T. Aman and the lowest BCR (1.49) is obtained by tenant share cropped land in HYV Boro cultivation, though HYV Boro is one of the major cultivated crops and yield level is also higher. This is due to high rental cost of share cropped land.

Again from the land category - wise BCR of the farmers, it is found that the highest BCR (4.34) is obtained by owner cum tenant farmers owned land and the lowest BCR (1.65) is obtained by tenant share cropped land. But noticeable aspect can be found from obtained BCR in owner mortgaged land (2.25) and owner cum tenant mortgaged land (3.71), which are higher than tenant share cropped land. This obtained BCR in mortgaged land should be compared with tenant share cropped land as owner cum tenant farmers are getting some subsidized input in the form of government support, but tenant farmers are unable to get this government support as tenant farmers do not have any cultivated owned land. Moreover, BCR (3.71) in owner cum tenant mortgaged land is higher than both the cultivated share cropped land of the owner cum tenant and tenant farmers. This depicts the profitability to transform the share cropped land into mortgaging arrangement for the cultivators. The reasons for the

variation of these obtained BCR are due to the factors affecting gross revenue and total cost of the farmers.

Net revenue (NR) is the net gain from the cultivated land of the farmers ($NR=GR-TC$), where, GR=gross revenue, TC=total cost. In analyzing crop-wise net revenue of the farmers, it is found that, in cultivating HYV Boro the highest (BDT 52,933 ha⁻¹) net revenue is obtained by owner cum tenant owned land and lowest (BDT 23,323 ha⁻¹) by tenant share cropped land.

From T. Aman cultivation, the obtained net revenue in owner cum tenant owned land (BDT 21,181 ha⁻¹) is higher than owner cum tenant share cropped land (BDT 16,248 ha⁻¹).

Again, from the cultivation of other crops, the highest (BDT 43,341 ha⁻¹) net revenue is obtained by owner mortgaged land and the lowest (BDT 10,131 ha⁻¹) by owner owned land.

From the land category –wise net revenue of the farmers, it is revealed that the obtained net revenue (BDT 58,433 ha⁻¹) in owner operated owned land is higher than owner operated mortgaged land (BDT 43,341 ha⁻¹).

Owner cum tenant operators obtained net revenue (BDT 85,846 ha⁻¹) in owned land is higher than both mortgaged (BDT 40,483 ha⁻¹) and share cropped land (BDT 63,641 ha⁻¹).

The highest (BDT 85,846 ha⁻¹) net revenue is obtained by owner cum tenant owned land, but the lowest (BDT 40,417 ha⁻¹) by the tenant share cropped land.

The reasons for the variation in the obtained net revenues are due to purchasing price (whole sale and retail price), rental cost and other related issues in farming.

From the analysis of variance of the net revenue from the cultivated land of the farmers, it is found that there is a statistically significant difference from zero among the net revenue of the cultivated different categories of land of the owner, owner cum tenant and tenant farmers. Factors related to gross revenue and total cost are responsible for this originated variation in the net revenue.

The second core chapter (chapter 6) identifies the technical efficiency (TE) of different categories of cultivated land of the farmers. Stochastic frontier model was used to measure this TE of the farmers based on the gross revenue ha⁻¹ in their cultivated different categories

of land. In the study area, if seed cost is shared by the land owner, then land owner claimed half of the produced by product, but sometimes this half of the produced by-product is claimed also based on customary rule (prevailing rule according to custom). For the simplicity the price of by-product was not included in calculating gross revenue. This TE is the measurement of gross revenue of output ha^{-1} in the different types of cultivated land of the farmers relative to the maximum possible gross revenue of output ha^{-1} in different types of cultivated land of the farmers that can be produced with same cost of input vectors. It was used in a two-step procedure. In first step TE was computed. In the next step, socioeconomic variables were regressed against this TE to identify their impact in Tobit regression method. Using this Tobit regression is justified as the value of TE is in the range of 0 to 1 (Nargis and Lee, 2013; Hossain et al., 2013). Though ordinary least square (OLS) regression method is widely used approach, but Tobit regression method was needed to use in this study as Tobit regression method is an alternative analysis of approach according to the requirement, there are complementary advantages of Tobit method in working with censoring data, moreover Tobit method performs more accurately than OLS regression method when data are subject to ceiling or floor effect. In using this stochastic frontier model ha^{-1} human labor cost, power tiller cost, seed cost, material cost (cost of fertilizer, insecticides and pesticides), irrigation cost and land use cost were taken as explanatory variables.

The different farming categories are cultivating different categories of land and their ownership patterns are also different, due to this land use cost was taken for the owned land and mortgaged land based on the cultivated mortgaged land both for owner as well as owner cum tenant farmers at the cost rate of their cultivated mortgaged land. But for the share cropped land this land use cost was taken at the cost rate of the cultivated share cropped land both for owner cum tenant and tenant farmers in the study area.

Analysis of variance was used to detect the mean difference of technical efficiencies in the various cultivated land categories of the farmers.

In using the stochastic frontier approach, the significant log likelihood using Wald test depicts the fitness of the model ($P=0.0000$). Moreover the likelihood ratio test for the absence of inefficiency in the model criteria was rejected ($P=0.000$). That indicates the satisfactory inefficiency effect explained by the model. Marginal effect of the explanatory input variables were estimated on gross revenue as a complementary aspect of this analysis. These values of marginal effect were used to discuss the effect of the concerned explanatory variable on gross

revenue of the farmers considering the effect of other variables constant to get the impact of the explanatory variables. Seed (0.052), power tiller (0.481) and irrigation (0.213) had positive effect. This indicates that these inputs had positive effect on gross revenue of output ha^{-1} . But, human labor (-0.022), material cost (-0.794) and land use cost (-0.002) had negative impact on this gross revenue of output ha^{-1} . From the analysis of variance it is found that there is a statistically significant difference from zero among the technical efficiency of various categories of land of the farmers.

The highest (57%) technical efficiency is obtained by owner mortgaged land; this highest technical efficiency is obtained due to better advantages in farming in owner mortgaged land. Again the obtained technical efficiency in the tenant share cropped land is the lowest (32%) level among these different categories of cultivated land. This technical efficiency becomes higher in share cropped lands if input cost is shared by the land owner according to the legal provision of land reform ordinance 1984.

From the Tobit regression analysis, it is also found significantly positive influence of credit on this technical efficiency.

In analyzing socioeconomic characteristics of the farmers it is found that the percentage of credit facility availing farmers in cultivation of both in owners owned and mortgaged land is 98%. This percentages of owner cum tenant owned, mortgaged and share cropped land are 98%, 98% and 94% respectively. But, the percentage of this credit facility availing farmers in tenant share cropped land is 0. These tenant farmers are not getting any credit from formal sources as they do not have any collateral (due to lack of owned land to use as collateral to get credit from formal sources). Though tenant farmers should get collateral right of their rented land according to the legal provision of land reform ordinance 1984 (LRB, 1982). From the various analyses, it can be detected that there is potentiality to increase the technical efficiency by ensuring collateral right of rented land for the tenant farmers to get their required credit from formal sources, improvement of more credit facilities for the owner as well as owner cum tenant farmers. These necessary measures should be taken by the government for the better outcome of agricultural production in Bangladesh.

From the above mentioned various analyses on agricultural production according to land tenure arrangements, it can be holistically detected that, proper implementation of land reform ordinance 1984 is needed for achieving the proper incentive in cultivation of share cropped land, enhancement of technical efficiency, Profitability in crop cultivation for the cultivators as well as for the required outcome of agricultural production in Bangladesh. This study recommends the government to take necessary measures on that vision.

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Appendices

Appendix 1 Category- wise number of the farmers, cropped area and topography-wise cultivated land in the Basail Upazila

Category- wise number of the farmers

Farmers category	Number
Large farmers	1,034
Medium farmers	4,501
Small farmers	7,528
Marginal farmers	7,488
Landless farmers	6,612
Total farmers	27,163

(Source: DAE, 2013)

Cultivated cropped area

Net cropped area: 13,124 ha

Single cropped area: 3,525 ha

Double cropped area: 7,041 ha

Triple cropped area: 2,558 ha

Total cropped area: 25,281 ha

(Source: DAE, 2013)

Topography- wise cultivated land

High land: 202 ha

Medium high land: 3,552 ha

Medium low land: 2,541 ha

Low land: 5,657 ha

Very low land : 1,374 ha

(Source: DAE, 2013)

Appendix 2 Cultivated areas according to major cropping pattern

Serial No.	Cropping pattern			Cultivated area (ha)	Percentage
	Rabi	Kharif I	Kharif II		
1.	HYV Boro	Fallow	T. Aman	486	3.70
2.	HYV Boro	Fallow	Fallow	250	1.90
3.	HYV Boro	B. Aman	Fallow	5,000	38.09
4.	Mustard	HYV Boro	B. Aman	4,300	32.76
5.	Mustard	HYV Boro	T. Aman	200	1.52
6.	Wheat	Jute	T. Aman	64	0.48

(Source: DAE, 2013)