Local knowledge to assess land, soil quality and crop associations: A Case Study of Debiganj Upazila in Bangladesh

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Abstract
This study comprises land type, soil quality and agricultural crop production of the study area. Accordingly, some areas are chosen to carry out investigation, of which one is more useful for the farmers. My study area is Debiganj Upazilla under Panchagarh district. There are two types of data are used such as Primary and Secondary data. A questionnaire survey was conducted involving 100 respondents almost equally taken from each of the area. The respondents are almost middle gather rich farmers usually farm the land using modern farming system and get high yield. Data analysis techniques are Bivariate, Exploratory statistic, Multivariate etc. The cropping pattern of my study area varies from ancient to modern period. All types of land are not suitable for same crop production so various types of land produced different types of crops. Although various types of crops are grown but mainly rice, jute, wheat, nut grow abundantly in my study area. It is the age of science. Due to advancement of science and technology life is more comfortable and easy in all sector .The production cost has increased before to future. Advanced technology is used in crop production and highly yield seeds are used in agricultural field for the better production. Irrigation system has been changed from the past and now a day's agricultural crops land are being watered by pump and it is very costly .So production cost has increased in many times. The advancement of science and technology crop production has increased. But before the development of science and technology man have to strive and some time they cannot get any food for their survival. At present time man does not have to strive for food. They can easily have plenty of food for their home and the government of our country is richer in food security status.

***Index Terms**:* Local knowledge, Crop association,soil quality, Farmers' criteria, land type , land use,crop production

Local Terms: Bhita, Danga, Dohola, Bala mati, Jharjara mati, Athal mati

Introduction

Bangladesh is an agricultural country. With some three-fifths of the population engaged in farming. Though nowadays with the development of technology agriculture production has changed but still most of the farmers of Bangladesh use their indigenous knowledge for cultivation. Indigenous knowledge includes the complex of practices and decisions made by local people. It is based on experience passed from one generation to the next, but nevertheless, it changes, adapts and assimilates new ideas. (Warbuton and Martin (1999)
In the past, agricultural and natural resource management development projects were often based on top-down transfer of expert knowledge from research institutions to the 'intended beneficiaries'. Nowadays, it has become clear that local knowledge is a valuable resource for sustainable development and it should play a central role in any development programme. However, despite recognition in principle that local knowledge is a valuable source, its contribution is often limited due to a general lack of understanding of what local knowledge actually is and how it can be explored. N. Oudwater and A. Martin (2003)**.**Farmers' interest in soils is to sustain higher yield of crops of their choice; hence they classify soils on the basis of topsoil conditions. Farmers' knowledge of soils is inherited, acquired through generation-long in situ practical experience and is reflective of their close interaction with the physical environment. A.M.S. Ali (2003)**.**Like other district Panchagarh district also contribute in countries economic by providing huge amount of agricultural production. All over in Bangladesh grow different type of agriculture production and different region has different production. But good or profitable agriculture production depends on proper land use and irrigation system. Irrigation is very important for any crops. My study area is Debiganj Upazila in Panchagarh district.

Data

The present research mainly conducted based on primary data.Primary data are mainly Questionnaire survey, Informal

interview, Focus group Discussion. Personal observation, individual interview and survey technique, focus group discussion that will be concluded in local people and household of the respondent's. For this study secondary data were collected from different published and unpublished sources. Some mentionable sources of data are Soil Research Development Institute(SRDI) journal, published and unpublished reports and dissertations.

Objectives

- To investigate the land types of Debiganj upazila based on the farmer's local knowledge;
- To assess the farmer's local knowledge about the soil quality;.
- To analyze the agricultural crop selection for farming based on land type and soil quality.

Methodology

The collected information about net cropped area, total cropped area which was recorded for analysis the main parts of the research explained by exploratory statistical analysis. Ms excel is used for data entry and graphical representation. For descriptive part maps have been produce by using Arc View GIS 3.3.To analyze the land type of the study area data are collected by questionnaire survey. To know the land type of the study area it is need to know the land type classification, quality of land type, land use of the study area. If these data collected than we can compare the land type, land use with Bangladeshi land type, land use.

In the study area maximum people are directly and indirectly involved in agriculture. Among them I have interviewed (in - depth interview) randomly with ten farmers. My study area is consisted of 10 union. Data were collected from one union. A total of 100 farmers' were selected from 4 villages (4 villages from). From each of a village 20-30 farmers' were sampled and data were collected for the study. Debiganj, among the selected farmers, there were mixed groups of marginal, poor farmers and day laborers different age

Study Area

I have studied much research paper; thesis paper about my upazilla, but in every paper has lacking about the cropping pattern and land and soil quality. It is my home town upazilla and I have chosen this site so that the cropping pattern, socio-economic condition and land and soil quality can be comprehended clearly. It is bounded by Boda and Panchagarh sadar upazilas on the north, Birganj, Khansama and Nilphamari sadar upazilas on the south, Domar upazila and west bengal state of India on the east, Thakurgaon sadar and Boda upazilas on the west. There are a number of Indian enclaves in the upazila, most noted of which are Behula Danga, Balapara, Court Bhajni and Dahala Khagrabari.

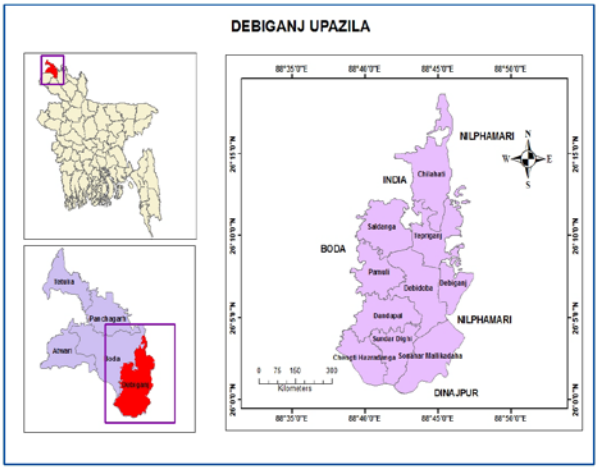


Figure 1: location of the study area

Land use,Cultivable land 25359 hectares, fallow land 288 hectares; single crop 15%, double crop 64%, treble crop 21%. Arable land under irrigation 39%. Land control Among the peasants, 45% are landless, 15% small peasant, 25% marginal, 10% intermediate and 5% rich; cultivable land per head 0.19 hectare.

Land type variation of the study area:

My study area has various type of landform. According to SRDI there are mainly three types of land form found. These are high land, medium high land and medium low land. Medium high land is the most dominant landform of my study area. And according to the questionnaire survey it also found that medium high land is the most dominant landform of the study area.

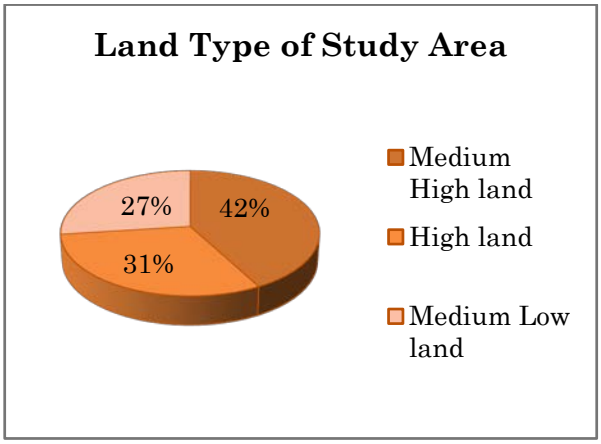


Figure 2: Land type variation of study area by (%) Source: field survey,2015

The land type variations of the study area are mostly high land, medium high land and medium low land. Generally rice and jute are cultivated in medium low land and medium high land. High land is cultivated for wheat, maize, peanut and various type of vegetable. Percent of medium high land is more than high land

and medium low land. High land is 31%, medium high land is 42% and medium low land is 27%.(figure:2)

Land type class of Bangladesh		Land type class of study area		
land type	% of total	Local Name	SRDI Name	%of total
High land	20%	Bhita	High Land	31%
Medium high land	39%	Danga	Medium high land	42%
Medium low land	15%	Dohola	Medium low land	27%
Low land	8%			
Very low land	2%			

Table 1: Compares between Bangladesh and study area's land type

Source: field survey,2015

Land use of study area

Debiganj upazila of Panchagarh district which is located in the northern part of Bangladesh. Northern part of Bangladesh is higher than other part of Bangladesh so land type and agriculture are mostly different from other part of the country. Medium type land is most dominated land type of my study area. From the above diagram we can see that 64% land are used for cultivated double crop which means most of the land of the study area is capable to cultivate two types of crops in the study area.

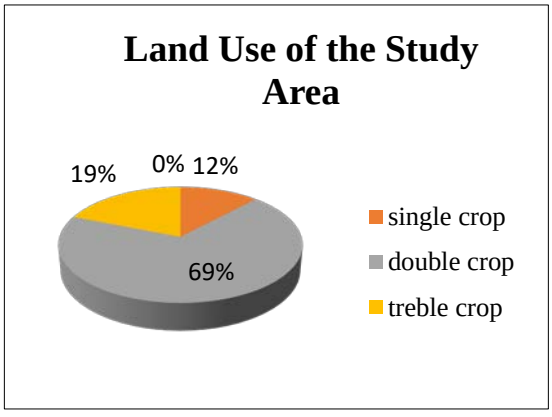


Figure 3: Land use of study area by crops

Source: field survey,2015

From the above diagram, land of the study area are used mainly two types of crops in a year.69% of land which means most in the land are cultivated two crops and 19% land are cultivated three types of crops and 12% lands are used for single crops. Double croppedarea is used for cultivating Boro and Aman. (figure 3)

Table 2: Compares between Bangladesh and study area's land use

Land use by SRDI		Land use by questionnaire	
Land use types	Area (in %)		Area (in %)
Single cropped area	21	Single cropped area	12
Double cropped area	64	Double cropped area	69
Treble cropped area	15	Treble cropped area	19

Source: field survey,2015

Agricultural Land use:

Different land are use for different cultivation of crops. Cultivation of crops in different land on land type.

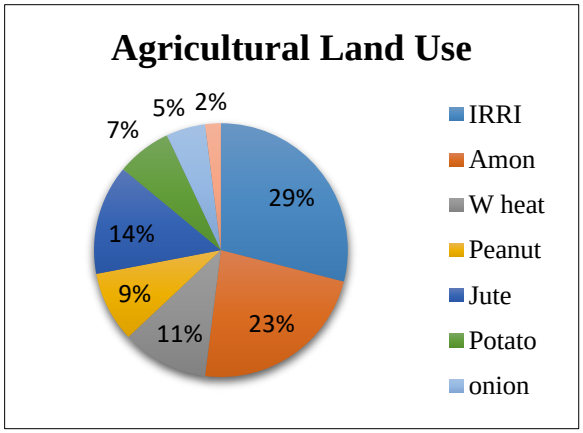


Figure 4: Agricultural Land use of the study area
Source: field survey,2015

From the above diagram, it is found that, two types of crops are mainly produce IRRI is cultivated in 29% and Amon rice is 23% land of the study area. In the study area 14% land is used for jute cultivation. Peanut and wheat are also two important crops of the study area. Another art of the land are used for potato, onion, corn etc. cultivation.**(**Figure 4)

Irrigation system for different land type in the study area

Groundwater system firstly used in northern district of Bangladesh and also more particularly in those place where surface water was not easily and adequately available.The groundwater based irrigation techniques have huge capabilities to expand irrigation, because these two techniques there are

HTWs (Hand Tube wells) used in many places mostly in 'char' area where water table is very high and one or two pipes are enough to draw groundwater for irrigation purposes.

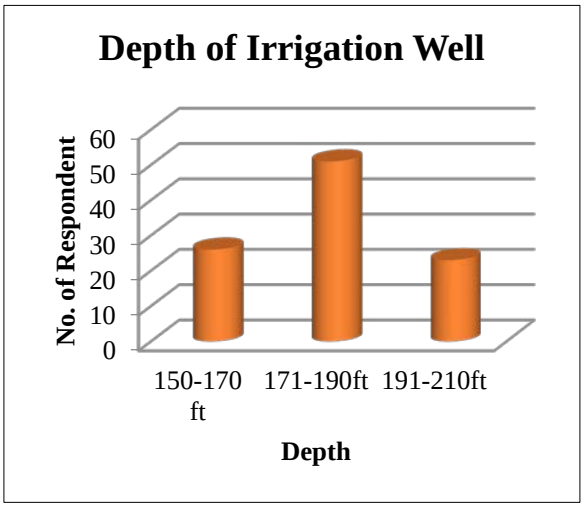


Figure 5: Irrigation system of study area

Source: field survey,2015

It was found that in the study area the main irrigation system is STW. The depth of the STW is varies by type of land. The depth of STW is more in high land. From the above diagram we can see that highest depth is 210ft and the lowest depth is 150ft(figure 3)

Soil Suitability class	Soil type	Land type	Total area(%)	Principal land use	Farmers' rating of soil quality
1	bele–doash maati	Bhita	31	homestead trees, cropland, fallow /grazing	Poor
2	pali–doash maati	Danga	42	cropland	Good
3	aintel–doash maati	Dohola	27	cropland	Medium

farmers' Criteria of classification of soils:

The farmers distinguish soil types primarily on the basis of color, consistence, texture, organic matter content, drainage, salinity, acidity, and fertility of soils. They use indigenous methods such as visual observation while tilling, tasting by tongue, feeling and rubbing with fingers to determine various soil properties. Farmers' measurements of soil properties are rather qualitative than quantitative except for soil fertility, which is quantitatively determined by per acre yield of rice.Farmers' criteria and methods of classification of soils Soil property/criterion Method of determination of soil properties Percentage of total farmers (%) Bulk density feel the soil compactness while tilling feel the soil weight by hand. Texture while tilling, observe the presence of sand, silt, and clay.

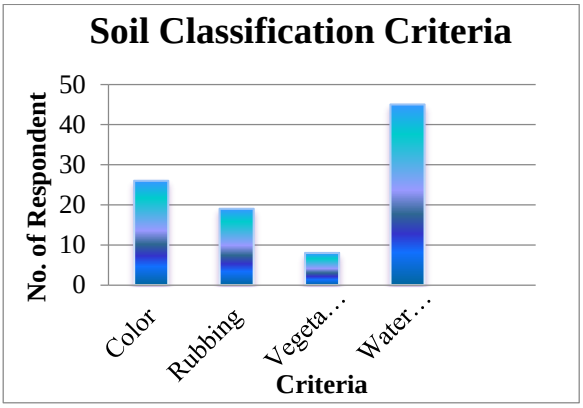


Figure 6: soil classification criteria of farmer

Source: Field study, 2015

Farmers are classifying soil on the basis of various criteria. These are color of soil, rubbing, vegetation growing capacity, amount of water content of soil ete. Deep or dark color of soil represent clay soil, brown color represent silty soil and light color represent sandy soil. Clay soil has dark vegetation and more water holding capacity .In my study area 45% farmer classify soil by water holding capacity of soil, more than 25% classify by color.(figure 6)

Table 3 : Farmer's knowledge of soil suitability classification of the study area

Source: Field study, 2015

This type of soil is slightly light grey in color, less compact, well drained and less fertile. About 42% of the village soils in the land is dark grey pali–doash maati which is more compact, poorly drained, rich in organic matter, and fertile. Farmers identified the dark grey soils of dohola land immediately near of the settlement to be aintel maati (clay) that occupies 42% of the village soils. This type of soil is highly compact, poorly drained and less fertile. Dark grey and black soils found which are recognized as aintel–doash maati that covers 27% of the

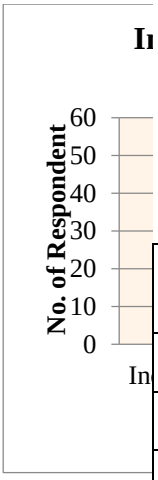
village land. Farmers viewed this soil to be less compact, poorly drained, rich in organic matter and least fertile.(table 3)

Soil texture and their local name:

Table 4: Percentage of Soil texture and their local name

Source: Field study, 2015

Above table shows the soil classification of study area. The graph represents silty soil as highest (45%) and clay soil as lowest (21%). Sandy loam soil is ideal for Paddy, potato, wheat, jute, kaun, and this type of soil requires heavy irrigation and generally found on high and medium land.



Name of Soil Texture	Local Name	Percentage
Sandy loam	Bala mati	34
Silty loam	Jharjara mati	45
Silty clay	Athal mati	21

Fertility of soil of the study area

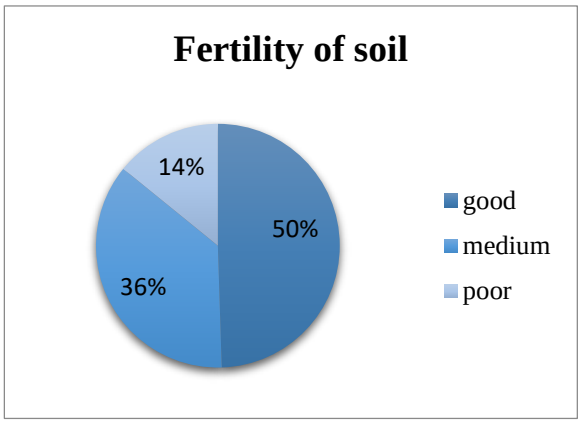


Figure 7 : fertility of soil of the study area

Source: Field study, 2015

Fertility of soil of our country is almost good for which various type crop grow every where among the country. In my study area 50% land quality is good. Medium land 36% and poor land 14%.(figure 7)

Increase and decrease of fertility of the study area:

Figure 8: Increase and decrease of fertility of the study area

Source: Field study, 2015

Fertility of soil are increasing now a days. Because of using various fertilizer production capacity of soil is more than before. From the above graph 50% soil of the study are increasing fertility. Thus, the farmers' knowledge of soils has greater utility toward the sustainability of agriculture in the village. On the other hand, the scientific classification of the village soils is based on quantitative measurement of physical and chemical properties of topsoil of a large number of sampled plots. Results of this analysis will make a valuable contribution to the national database on soils and will have greater utility for fertilizer recommendations.

Crop production season of the study area:

Table 5: crop production by season

Cropping Season	Month	Crops
Kharif 1	March-May	Jute, Maize.
Kharif 2	June-October	Amon,garlic, Ginger, different kinds of summer vegetables.
Robi Crop	Nov-February	IRRI,Wheat,Peanut,Potato,Onion

Source: Field survey, 2015

Kharif 1 (Mid March to Mid July) is characterized by unreliable rainfall and varies in timing, frequency and intensity from year to year, and provides only an intermittent supply of moisture for such crops as broadcast Aman, Aus, amaranths, teasle gourd, etc. During this transition period, soils intermittently become moist and dry. The relative lengths and frequency of such periods depend on the timing and intensity of pre-monsoon rainfall during this season in individual years. With the expansion of irrigation facilities, some of the Pre-kharif crops are now gro kinds of summer vegetables wn under irrigated conditions. These include Jute, Maize.

Kharif 2 (Mid -July to Mid October) starts from May when the moisture supply and from rainfall plus soil storage is enough to support rainfed or un-irrigated Kharif crops. The period of excess precipitation is called the humid period. The crops most extensively cultivated during the Kharif season are Aus, broadcast Aman,Transplant Aman, sesame, different kinds of summer vegetables, ginger, turmeric, pepper, green chilli, different kinds of aroids, cotton, mungbean, black gram, etc. Most Kharif crops are subject to drought and flood in areas without water control.

Rabi (Mid- October to Mid- March) season starts at the end of the humid period and lasts to the pre-kharif season. The mean starting date of the Rabi season ranges from 1-10 October and the mean end dates range from 1-10 February .Most common Rabi or winter crops are wheat, maize, Boro rice, mustard, groundnut, potato, sweet potato, sugarcane, chickpea, grass pea etc.

Table: 6 Type of crop production

Types of Crop	Name of the crops
Food crops	Rice, Wheat, Maize, peanut, Oilseeds, Potatoes, Sugarcane, Fruits, Spices, Vegetables etc.
Cash crops	Jute

Source: Field survey, 2015

Types of crop production of the study area:

In my study area two types of crops are cultivated. These are food crops and cash crops. In my study area mainly food crops are cultivated. About 81% land are used to produce food crops and 19% are used to produce cash crops.(figure 8)

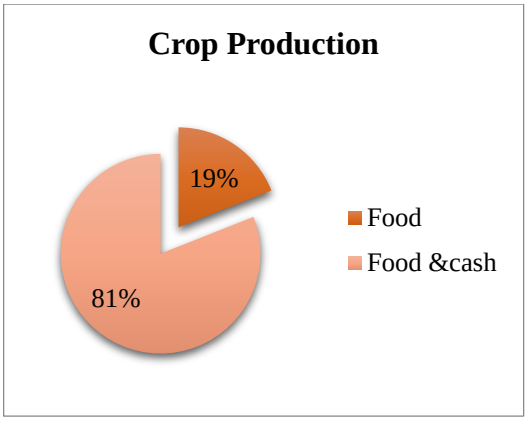


Figure 9: crop production f the study area

Source: Field survey, 2015

Amount of crop production of the study area:

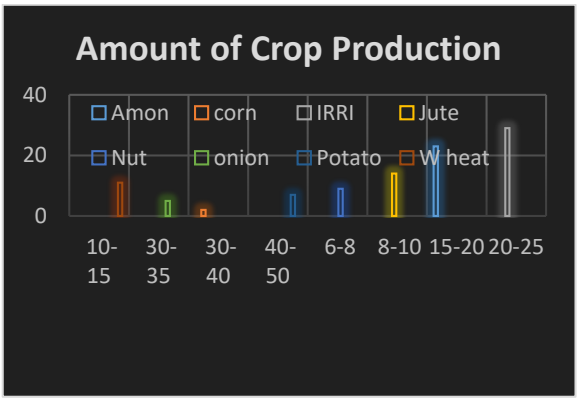


Figure 10: amount of crop production

Source: Field survey, 2015

Various types of crops are produced in Debiganj upazila. These are rice, wheat, jute, peanut , various types of vegetables. Amount of crop production depend on land fertility, irrigation, seeds etc. From the above graph it is found that IRRI is the most cultivated crops among others crops and IRRI is produced 20-25 mon in 1 acre. Production of Amon rice is 10-15 mon, wheat production is 10-15 mon, jute production is 8-10, peanut is 6-8 etc..(figure 5.7)

Crop production risk of the study area:

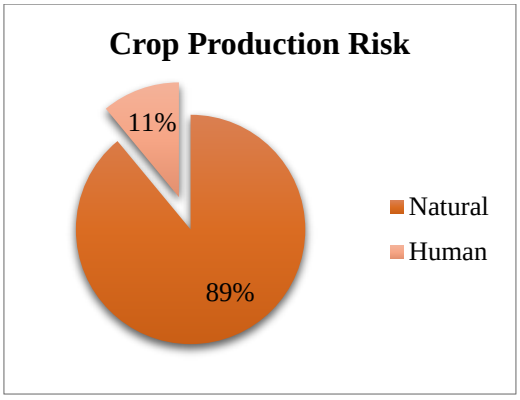


Figure 11: crop production risk

Source: Field survey, 2015

Crop production risk of the study area:

Bangladesh is a disaster prone country. Flood is occurs generally almost every year which is damage crop production. In the northern part of Bangladesh crop production are damage by drought. Though my study area is located in the northern part crop production are damage by drought less or more. The natural risk for crop production is 89% and human risk is 11%. (figure 11)

Increasing and decreasing of food production of the study area:

Now a day because of using fertilizer, insecticide, irrigation production of crops are increasing than before. Farmer are more conscious and have more agricultural knowledge than before which help to produce better crops. Production of crops of the study areas are increasing more than 80%.(figure 5.9)

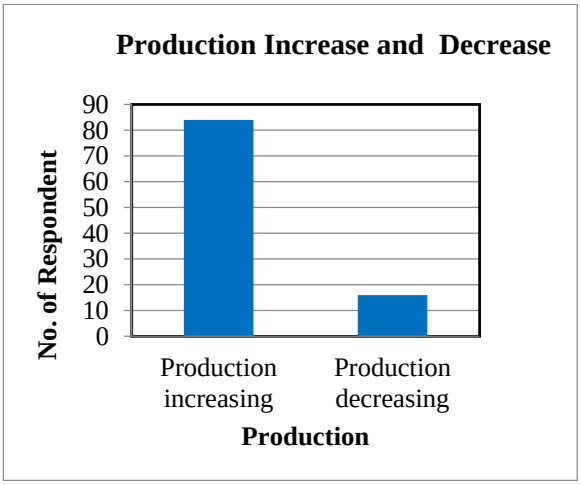


Figure 12: increase and decrease of production

Source: Field survey, 2015

Seasonal cropping pattern of Bangladesh and study area:

Table 7: seasonal cropping pattern of study area

Cropping Season	Month	In Bangladesh	In study area
Kharif - 1	March-May	sugarcane,maize ,jute, amaranths, groundnut, banana, sesame, lady's finger, teasle gourd, sweet gourd, white gourd, bitter gourd, ribbed gourd, ginger, turmeric etc	Jute, Maize.
Kharif - 2	June-October	Aus, broadcast Aman,Transplant Aman, sesame, different kinds of summer vegetables, ginger, turmeric, pepper, green chilli, different kinds of aroids, cotton, mungbean, black gram, etc	Amon, garlic, Ginger, different kinds of summer vegetables.
Robi Crop	Nov-February	wheat, maize, Boro rice, mustard, groundnut, sesame, potato, sweet potato, sugarcane, lentil, chickpea, grass pea etc.	IRRI, Wheat, maize Peanut, Potato, Onion

Source: Field survey, 2015

Association of land type, soil quality and crop production

High land and crop production:

There are 31% high land of the study area according to questionnaire survey. This high land are little or not flooded. These land are used to cultivated maize, peanut, various type of vegetable

Table 8: Association of land type and crop production

Land type	Local Name	Total amount	Crop selection by

		(%)	farmer
High land	Bhita	31	Various type of vegetables, garlic, onion, maize etc
Medium high land	Danga	42	Aman rice, peanut, maize, vegetable, jute
Medium low land	Dohola	27	Boro rice, Amon rice, jute

Source: Field survey, 2015

Medium High land and crop production:

In my study area a great portion of land is medium high land. This type of land are mainly silty soil. Rice, wheat, jute, are cultivated in this land.

Low land and crop production:

According to the questionnaire 27% land are low land. Low and means silty clay soil.Low land are suitable for cultivate IRRI, jute, amon etc.

Table 9: Soil quality and crop Suitability

Soil type	**Soil name**	**Local name**	**Total amount (%)**	**Crop production**
Bele–doash maati	Sandy loam	*Bala mati*	34	garlic, onion, maize, various type of vegetables, etc
Pali–doash maati	Silty loam	*Jharjara mati*	45	Aman rice, peanut, maize, vegetable, jute
Aintel – doash maati	Silty clay	Athal mati	21	Boro rice, Amon rice, jute

Source: Field survey, 2015

Bele–doash maati: Bele–doash maati of the Bhita land that is drought-prone, infrequently flooded, and suitable for settlement and aman wheat, maize and vegetable cultivation. Farmers rated this soil to be 'poor' quality.

Pali–doash maati: Pali–doash maati of the danga land covers 42% of the village soils. This soil is drought-prone, annually flooded, and suitable for multiple croppings of aman and boro rice, jute and was ranked as the 'best' quality soil.

Aintel doash maati: Aintel doash maati annually flooded, poorly drained, and is suitable for jute, boro rice, aman rice,onion. And the farmers rated this soil as 'poor' quality

Conclusion

From the above analysis, my study area is mainly medium high land dominated area. Though more portion of the land of the study area is medium land, land of the study area is not as flooded as other lower land of Bangladesh. In the study area in winter season wheat and IRRI are cultivated by irrigation. Irrigation well are used for cultivation in dry season. Mainly two types of crops are mainly produce IRRI is cultivated in 29% and Amon rice is 23% land of the study area. in the study area. 14% land are used for jute cultivation. Peanut and wheat are also two important crops of the study area. Another art of the land are used for potato, onion, corn etc. cultivation**.**

Farmers' knowledge of soil management and sustainability in agriculture for many generations, the farmers have developed various indigenous soil management strategies to cope with tidal flooding, drought, soil fertility loss and salinity, and maintained a highly sustainable farming practice. To cope drought, and manage the surface water resource, they dig ponds and khals as reservoirs, build and maintain water retention walls around each field (ails), and adjust field surface slopes to achieve its uniformity. Conservation tillage and soil–moisture monitoring and cultivation of drought-resistant cultivars are commonly practiced here. The three widely used methods of soil fertility management on rice fields are crop rotation, conservation tillage, and cattle grazing on crop residue. Farmers cultivate aman rice during the haimantic season, vegetable and tobacco during the robi season, and leave the land fallow during the kharif (summer) to regain soil fertility. They believe that the cultivation of legumes increases soil fertility. Farmers leave crop residues on the field and allow cattle and other animals to graze on it to gain multiple sustainable benefits.

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