

**FLOOD DISASTER MITIGATION IN DND:
LAND USE PERSPECTIVE**



A Dissertation for the Degree of Master in Disaster Management

By
Md. Ruhul Amin Munshi
Student ID: 05268008

Summer 2008

Postgraduate Programs in Disaster Management (PPDM)
BRAC University, Dhaka, Bangladesh

Dedicated to

**My
Mother and Father who are in haven
Leaving behind me alone on earth.**

ACKNOWLEDGEMENT

All praise goes to Almighty Allah, then I am expressing my heartiest gratitude, sincere indebtedness and best regards to Dr. & Engr. S I Khan D. Sc. and Dr. Fuad Hasasn Mullik, Chairman & Professor, Department of Architecture, BRAC University for their enthusiastic guidance, continues persuasions, invaluable instructions and constant encouragement throughout the research and in the preparation and completion of this dissertation. I am grateful to Mr. Humayan Kabir, Assistant professor, Department of Geography and Environment, University of Dhaka and Coordinator, PPDM, BRAC University for his suggestions and valuable advices to me that helped me a lot to this end.

I have the great pleasure to thanks to Mr. Selim Bhuiayn, XEN, Flood Forecasting & Warning Centre, Mr. Misbah Uddin Khan, XEN, Demra Pamp House both from BWDB. Thanks also go to Ms. Rekah Yasmin, librarian, Ministry of Water Resources, Mr. Ahamed Ali Upazila Agricultural Officer, Narayanganj Sadar Upazila for their sincere help in information collection. Special thanks to Mr Imran Reza and his friends for their spontaneous help in primary data collection.

Mr. Faruk Hossain, a student of Department of Geography and Environment, University of Dhaka helps a lot through extending his hands in supplying many necessary inputs, maps and photos to complete the thesis. I offer sincere thanks to him. My daughter Ms Rumana Amin and My son Inam Ahamad help me throughout my work, thanks to them also.

I like to thank the people I meet, interviewed, discussed, and asked for comments & opinions about different aspect of the DND area to complete the paper.

Again I am grateful to Dr Fuad Hasan Mullik for his moral support, encouragement and CIDA for providing me with a full scholarship throughout the course.

Md. Ruhul Amin Munshi

ABSTRACT

The DND is a leading irrigation project executed by BWDB (erstwhile EPWDB) during 1962-68 to reduce the food deficit and to fulfill the national objectives of attaining self-reliance in food grain production. The project area covers 56.79 km² that disperse from south of Dhaka and north of Narayanganj. This project was cordoned by flood control embankment in order to keep the area beyond the reach of natural hazard like seasonal flood. The major components of this project were road- cum- embankment, khal, irrigation canal, drainage canal, intake canal, water control structure and a pump station. After the completion of this project the area under it become flood free that initiated development pressures both from Dhaka and Narayanganj cities. Due to this unavoidable fact the area increasingly turned towards rapid unplanned urbanization and on the other hand the existing pump drainage systems proves inadequate to drain out rainwater in the rainy season and excess wastewater from home and industry. In the last few years, owing to heave rainfall the water logging has become a major disaster within the project area. Besides, waste sewerage in conjunction with rainwater aggravated the whole atmosphere of the project. The present study is taken to find out the reasons for drainage congestion and suggest remedial measures to mitigate the flood impact of that area.

Household survey had been conducted for primary data collection. Focus Group Discussions (FGD) were arranged in different locations with various types of people in order to collect views, comments and suggestions on causes and possible measures to get rid of the problem. Concern officials of BWDB, District Administrations, Road & Highway Department, Agricultural Department, LGED and Upazila Administration were consulted and experts recommendations has been considered for causes and remedies to solve the problem.

The study revealed that some of the major causes of water logging are; heavy rain fall within short span of time, obstruction of drainage water by rapid expansion of scattered settlements and industries, encroachments and silting up of khals and canals, absence of Master Plan for land use, construction of unplanned roads without adequate water crossing point, accumulation of polythene in the drainage systems, illegal and unplanned fish Garth, boundary walls, lack of public awareness and education etc. However the main two causes of water logging in unplanned and rapid urbanization and unplanned road construction.

Water logging problem in DND creates serious negative impacts on social and personal life. Respondents who are living on the low lying areas reported that their homes and latrines has gone down under filthy water resulting in serious health hazards and various water borne diseases. Many crops fields have also gone under water that causes damage to agriculture production. Fisheries have lost all of their production as water overflowed due to water logging. Damage of roads, loss of business, less industrial production and loss of employment happened. Change of occupation and transfer of land and other property occurred. Many people had lost their homestead temporarily and displaced there by. Deficiency of food, shelter, pure water and essentials has decreased the living standard of the area. In sum water logging water logging disrupts the normal life and activities of people.

In order to get rid of water logging problem, a comprehensive and appropriate plan should be taken by coordinating all concerned govt. departments, public representatives and above all local communities. The study reveals that re-excavation of khals and canals, eviction of unauthorized encroachment on the bank of khals, canals, and cleaning up of drainage systems, removal of unwanted obstructions on water paths, creation of water retention ponds and most importantly setting up of two/three additional pump house at different suitable locations are short time measures to minimize the adverse impact of water logging. Effective land use planning including land zoning, and planned land transformation will help to mitigate water logging sufficiently. Creation of public awareness is essential in this respect. To keep the DND project healthier and habitable water logging needs to be solved without any delay.

ABBREVIATIONS

BSCIC-Bangladesh Small & Cottage Industries Corporation

BWDB-Bangladesh Water Development Board

CIDA-Canadian International Development Agency

DAP-Detail Area Planning

DMDP-Dhaka Metropolitan Development plan

DND- Dhaka-Narayanganj- Demra

FAP-Flood Action Plan

FGD-Focus Group Discussion

HYV-High Yielding Variety

IECo-International Engineering Corporation

IRRI-International Rice Research Institute

JICA-Japan International Cooperation Agency

MPO- Master Plan Organization

NGO- Non Governmental Organization

PDB-Power Development Board

PRSP-Poverty Reduction Strategy Paper

PWD-Public Works Department

RAJUK-Rajdhani Unnoyn Kartipakya

UN-United Nations

WASA-Water and Sewerage Authority

WDB-Water Development Board

XEN-Execcutive Engineer

OPERATIONAL DEFINITIONS OF TERMS

Cordon Approach: According to cordon approach, it is necessary to cordon off areas in order to protect them from flooding. Its purpose is to seal off floodplains from adjoining rivers. Under this approach, the goal of flood control gets transmuted into that of flood-prevention.

District: An important administrative unit in Bangladesh comprising a number of Upazilas and, or thanas under the control of a Deputy Commissioner.

DMDP: Dhaka Metropolitan Development Plan, a package of Structure Plan, Master Plan and Detailed Area Plan. The DMDP is being prepared to develop Dhaka City in a planned way for 20 years (1995-2015).

Drainage System: It includes Khals and Channels, either constructed or natural, passes through surface or underground or both that are usually used to drain out the floodwater.

Fish Garth: Artificial pond for pisciculture surrounded by fence, net, brick wall etc on crop field.

Homestead: Homestead means a dwelling house with the land under it, together with any courtyard, garden, tank, place of worship and private burial or cremation-ground attached and appertaining to such dwelling house, and includes any house or for purposes connected with agriculture or horticulture and such lands within well-defined limits, whether vacant or not, as are treated to be appertaining thereto;¹

Irrigation System: System of water supply toward crop fields through Khals, canals and other waterways.

Khals: Distributaries of water from rivers that created artificially or naturally and used as intake channel of water from river in the rainy season and drainage channel of flood as well as rainwater after rainy season. Shyampur khal, Pagla khal and Fatullah khal etc. are some major khals in DND area.

¹Article 2 (14) of The State Acquisition and Tenancy Act, 1950

Land: Land means land which is cultivated, uncultivated or covered with water at any time of the year, and includes [benefits arising out of land] houses or buildings and also things attached to the earth, or permanently fastened to anything attached to the earth.²

Malik: A “Malik” means proprietor. A malik is not necessarily a rent-receiver of rent. Therefore it cannot be said that, just because a transferor is a malik in respect of part of the transferred land, he is a rent- receiver.³

Monsoon: Rainy season starting in June and ending in September.

Orographic rain: Mountains induce rain (Gk oros = mountain, grapin= to write). Bangladesh and adjoining areas in India is under the influence of monsoons. From June to October large quantities of warm moist air travel from the Indian Ocean north over Bangladesh and to the Himalayan slopes as monsoon winds. Upper air turbulence and the long mountainous Barrier stretching East-West make this moist air rise and, as a result cool off and bring about enormous amounts of orographic rains over Bangladesh territory.⁴

Palasiding: A system of protecting land, roads, embankment and other important establishments from river erosion using log, bamboo and fence.

Polder: A Dutch term used for the land enclosed by an embankment, which is used to exclude external water usually with the help of pump or tidal drainage.

RAJUK: Rajdhani Unnayan Kartipakkha (Capital Development Authority), a statutory body established under law. This organization is responsible for the planning, settlement and planned development of Dhaka Mega City. It is also responsible for supervision and monitoring of building construction. The present planning area of RAJUK covers nearly 1528 square kilometer (590 square mile). This organization is now preparing the DMDP for Dhaka city.

Raiyat: Who holds land by cultivating it either by himself or by members of his family or by servants or by bargadars or by with the aid of hired labourer or with the aid of partners.⁵

² Article 2 (6) of The State Acquisition and Tenancy Act, 1950

³ Abdur Noor vs Province of East Pakistan 18 DLR 666.

⁴ Disaster in Bangladesh, Selected readings, Edited by K. Nizamuddin, DRTMC, 2001.

⁵ Article 2(9), The State Acquisition and Tenancy Act, 1950.

Retention Area: Natural or manmade depression usually reserved in urban area to retain the flood or rainwater.

Thana: The fourth order (below the Division, District and Upazila) local government unit in Bangladesh.

Union: Smallest administrative unit of the local government (division of a Upazila/Thana).

Water Logging: Stagnant of water either flood, rain or discharge from other source such as industry, household etc in built up areas due to lack of proper drainage system. It has created many adverse impacts on health, crop production, road communication, livelihood, income and expenditure etc.

CONTENTS

<i>Acknowledgement</i>	<i>i</i>
<i>Abstract</i>	<i>ii</i>
<i>Abbreviations</i>	<i>iii</i>
<i>Operational Definitions of Terms</i>	<i>iv</i>
<i>Contents</i>	<i>vii</i>
<i>List of Tables</i>	<i>xi</i>
<i>List of Figures</i>	<i>xii</i>
<i>List of Photographs</i>	<i>xiii</i>

CHAPTER ONE: INTRODUCTION

1.1 Background of the study	1
1.2 Objectives.....	2
1.3 Hypothesis	3
1.4 Rationale	3
1.5 Research Design	4
1.6 Methodology	5
1.7 Data Collection	6
1.8 Data Analysis	6

CHAPTER TWO: THE FCDI PROJECT AND THE SOCIO ECONOMIC PROFILE

2.1 The FCDI Project	7
2.2 Scope of the Study	10
2.3 Topography and Soil.....	11
2.4 Hydrology.....	14
2.4.1 External Hydrology	14
2.4.2 Internal Hydrology	14
2.5 The Climate	15
2.5.1 Temperature	15
2.6 Population Increase	16
2.7 Land Ownership	18

2.8	Land Category	21
2.9	Sources of Income.....	23

CHAPTER THREE: LAND USE

3.1	Land use in Bangladesh	24
3.2	Land Use in DND	25
3.2.1	Pre Embankment Time	29
3.2.2	Land Use till '80s	30
3.2.3	Land Use in '90s	32
3.2.4	Present Situation	35
3.2.4.1	Settlement	35
3.2.4.2	Industry and Commerce	36
3.2.4.3	Road Communication.....	36
3.2.4.4	Other Establishments.....	37
3.2.4.5	Fisheries.....	38
3.2.4.6	Agriculture.....	38
3.2.4.7	Retention Pond.....	39
3.3	Future trend.....	39

CHAPTER FOUR: POLICY AND LAWS RELATING TO LAND USE

4.1	National Land Use Policy-2001.....	43
4.2	Land Zoning.....	44
4.3	Sectors of Land Use in Bangladesh.....	44
4.4	Agricultural Production.....	45
4.5	Habitation.....	45
4.6	Industrialization.....	45
4.7	Other Uses of Lands.....	46
4.8	Stop Misuse of Acquired Land.....	46
4.9	Land Data bank.....	46
4.10	Main Features of Future Land Use.....	46
4.11	Awareness Rising.....	47
4.12	National Committees on Land Use.....	48
4.13	Relevant Laws on Land.....	48
4.13.1	The State Acquisition and Tenancy Act 1950(Act xxviii of 1951).....	48

4.13.2	The Bangladesh Land Holding(limitation) Order, 1972(P.O. No. 98 of 1972)...	49
4.13.3	The Land Reform Ordinance, 1984(Ordinance No. X of 1984).....	50
4.13.4	The Bangladesh (East Bengal) Embankment and Drainage Act of 1953.....	50
4.14	Miscellaneous Laws and Regulations on Land Use.....	51

CHAPTER FIVE: FLOOD AND WATER LOGGING

5.1	Introduction.....	52
5.2	External Flood.....	53
5.3	Internal Water Logging.....	54
5.3.1	Printing Media Reports on Water Logging.....	57
5.4	Causes of Flood.....	59
5.4.1	Rajuk's Study Report.....	59
5.4.2	Technical committee's report.....	59
5.4.3	Present Study Findings.....	60
5.4.4	People Perception.....	60
5.4.5	Frequency of Floods.....	61
5.4.6	Water Level.....	62
5.4.7	Time of Occurrence.....	62
5.4.8	Duration of Floods.....	63

CHAPTER SIX: AGRICULTURE

6.1	Cropping Patterns.....	64
6.1.1	Before Embankment.....	64
6.1.2	After Embankment.....	64
6.2	Major Crops.....	65
6.2.1	From Pre-project to 1982.....	65
6.2.2	Present Situation.....	67
6.3	Land Available for Agriculture.....	68

CHAPTER SEVEN: IRRIGATION, DRAINAGE SYSTEMS AND FLOOD CONTROL

7.1	Existing Flood Control Embankment.....	70
7.2	The Pumping Station, Demra.....	70
7.3	Irrigation Facilities.....	72
7.4	Drainage Systems and Discharge.....	74

7.5 Flood Control Measures.....	77
7.5.1 Retention Pond.....	77
7.5.1.1 JICA’s Proposal in 1992.....	78
7.5.1.2 Technical Committee’s Suggestion in 2005.....	78
7.5.1.3 RAJUK’s Proposals in 2005.....	78

CHAPTER EIGHT: FINDINGS, RECOMMENDATIONS AND FUTURE RESEARCH

8.1 Findings	79
8.2 Recommendations	80
8.3 Future Research Direction	81

CHAPTER NINE: CONCLUSION 82

BIBLIOGRAPHY..... 84

APPENDIX..... 89

List of Tables

Table No.	Title	Page No.
2.1	Climatological Indicators	16
2.2	Population Growth	17
2.3	Present Land Holding	19
2.4	Land Categories	21
2.5	Sources of Income	23
3.1	Land Use in DND; past, present, future	26
3.2	Land Use in DND in 2005	28
3.3	Land Use	29
3.4	Land Use in 1990	33
3.5	Existing Land Use in DND.....	40
5.1	Frequency of Floods	61
6.1	Crop Production	66
6.2	Crop Production; past and present.....	67
6.3	Diminishing Trend in Agricultural Land.....	69
7.1	Irrigation Demand of Water from 1981-2004	73
7.2	Draining out Hour of Water (1981-2004)	75

List of Figures

Figure No.	Page No.
1.1 Flow Diagram of Data Collection and Study Method	4
2.1 Location of the Study Area	8
2.2 DND Project Area	9
2.3 Area-Elevation Curve DND	12
2.4 Soil Profile in DND Area at Different Land Level	13
2.5 Population Growth	17
2.6 Population Growth Rate	18
2.7 Land Categories	21
2.8 Land Level in DND and its Surrounding Area	22
3.1 Land Use in DND	27
3.2 Land Use for Agriculture	27
3.3 Land Use in 2005 in DND	28
3.4 Land Use	30
3.5 Land Use in 1990	33
3.6 Land Use in DND and its Surrounding Area, 1990	34
3.7 Land Use in DND and its Surrounding Area, 2010	42
5.1 Frequency of Floods	61
6.1 Crop Production	68
6.2 Diminishing Trend in Agricultural Land	69
7.1 Present Drainage System in DND Area	76

List of Photographs

Photo No.		Page No.
3.1	Dhaka- Chittagong Road	37
5.1	Water Logging in South Matuail	52
5.2	Water Logging in Built-up Area in DND	54
5.3	Water logging in front of Mannan High School, Matuail	56
6.1	Crop Production in DND Area	64
7.1	Existing Pump Station of DND Area, Shiddirgonj, Demra	71
7.2	Encroachment of Drainage <i>Khals</i> in DND Area	74
7.3	Retention Pond on Crop Land in DND Area	77

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Bangladesh is a country of natural disaster. From the time immemorial this land have been suffering from various natural and man made disaster such as flood, cyclone, tornado, nor'wester drought, riverbank erosion, tidal surge, arsenic poisoning, earthquake, famine war etc. The country is basically a big delta and situated in the lower basin of three mighty rivers- the Ganges, the Bramhaputra and the Megna. Moreover the country is heavily influenced by rainfall and snowmelt from Himalayas and the Meghalaya plateau. The rainfall runoff from the vast hilly areas coupled with snow melt in the Himalayas brings huge inflow of water to Bangladesh through three above-mentioned big rivers during the monsoon season. Again from June to September huge quantities of warm moist air travel from the Indian Ocean and the Bay of Bengal to north, over Bangladesh. This moist air cannot travel beyond Himalayas and goes upward and cools down that bring about enormous amount of orographic rain into Bangladesh territory. As a result one-third to one fifth of the country is annually flooded by over flowing rivers during monsoon (June- September). River floods are annual phenomena causing untold miseries to the people and damages to crops, properties and infrastructures in the affected areas.

The DND area is located in-between Dhaka (Parts of Demra& Shampur thanas) and Narayanganj (Parts of Fatullah & Siddirganj thanas) is mainly a low-lying flood plain of three rivers namely Buriganga, Balu and Sitalakhya. . This area had been flooded every year under water up to 5-15 feet during monsoon¹. Most of the years the farmers of the area lost their rainy season crops to some extent depend upon flood severity. In the dry season many land had been kept as fellow without cultivation. Because there are little rainfall in the dry season and there was no irrigation and drainage facilities for crop production. There were some natural water bodies as fisheries. Considering these characteristics of that area the then Pakistan government had taken Dhaka-Narayanganj-Demra flood control, irrigation and drainage project in 1962. East Pakistan Water and Power Development Board (EPWPDB) completed the project from 1964- 1968. The aim of the project was enhance food production by facilitating full proof three crops transact in terms of flood control, irrigation, drainage and agricultural extension facilities.

The project area is divided into two units, area-I, has gross area of 8340 hectares located south of the Dhaka-Demra road. This area had been provided full proof flood protection by means of heightened roads cum embankments that surrounded the area like as a triangle The area-II has gross area of 2470 hectares that lies north of the Dhaka-Demra road. The area-II has not been

¹ Socio-Economic Evaluation report, BWDB, 1984.

given protection from flood in the rainy season as to unit-I, but provided with irrigation facilities in the dry season with the facility of access water discharge by gravity drainage. The area-II has close proximity to Dhaka city at the southeast and area- I has located in-between Dhaka city at the southeast & Narayanganj town at the northwest. Consequently lands are aggressively used from both areas for homesteads, brickyards, roads, industries, markets, institutions and other development purposes. As a result croplands has been shrinking rapidly day by day.

Earlier when the embankment was not built and flood protection of the area-I was not ensured homesteads had been built on highland or raised land. Apart from that other purposes use of lands were limited. But after the embankment project was completed people's perception has got stronger that the area inside it is flood protected and then they have started multipurpose and indiscriminate use of croplands without raising the lands above the normal flood level. On the other hand over the period of time population has increased rapidly. Their wastewater accompanied with monsoon rain is being creating water logging inside the project from few years back. This situation has brought untold sufferings to the inhabitant living there. Some people has encroached internal khals and canals. Many new roads have been built without due passes of water. Innumerable homesteads have been built on croplands. All those unplanned activities have created impediment to water pass smoothly toward canals, khals and pumping stations. By the elapse of 38 years, the lone pump station become less efficient to pump out congested water from the project. All these accumulated factors contributed to water logging almost every year inside the project after '90's. Flood in August-September in 2004 into DND attracted considerable attention among the concern authorities, medias, and policy makers. Everybody concern realized that unplanned urbanization was mainly responsible for water logging that created manmade flood and brought immense suffering to the people living inside the project. Need for planned land use against water logging was envisaged. The present study is taken to suggest an alternate way of flood mitigation through planned land use.

1.2 Objectives

- A. To review existing land use with respect to settlement, industrialization, urbanization, agriculture production, retention area and pisciculture etc.
- B. Examine relevant law and policy of land use to find out scope for land use to reduce flood impact.

C. To recommend an alternate land use plan for DND in order to bring balance among model urbanization, healthy habitation, crops production and fisheries for sustainable development and to minimize disaster impact.

D. In search of finding out the underlying causes of water logging in the area-I and to suggest the remedial measures the present study is being taken.

1.3 Hypothesis

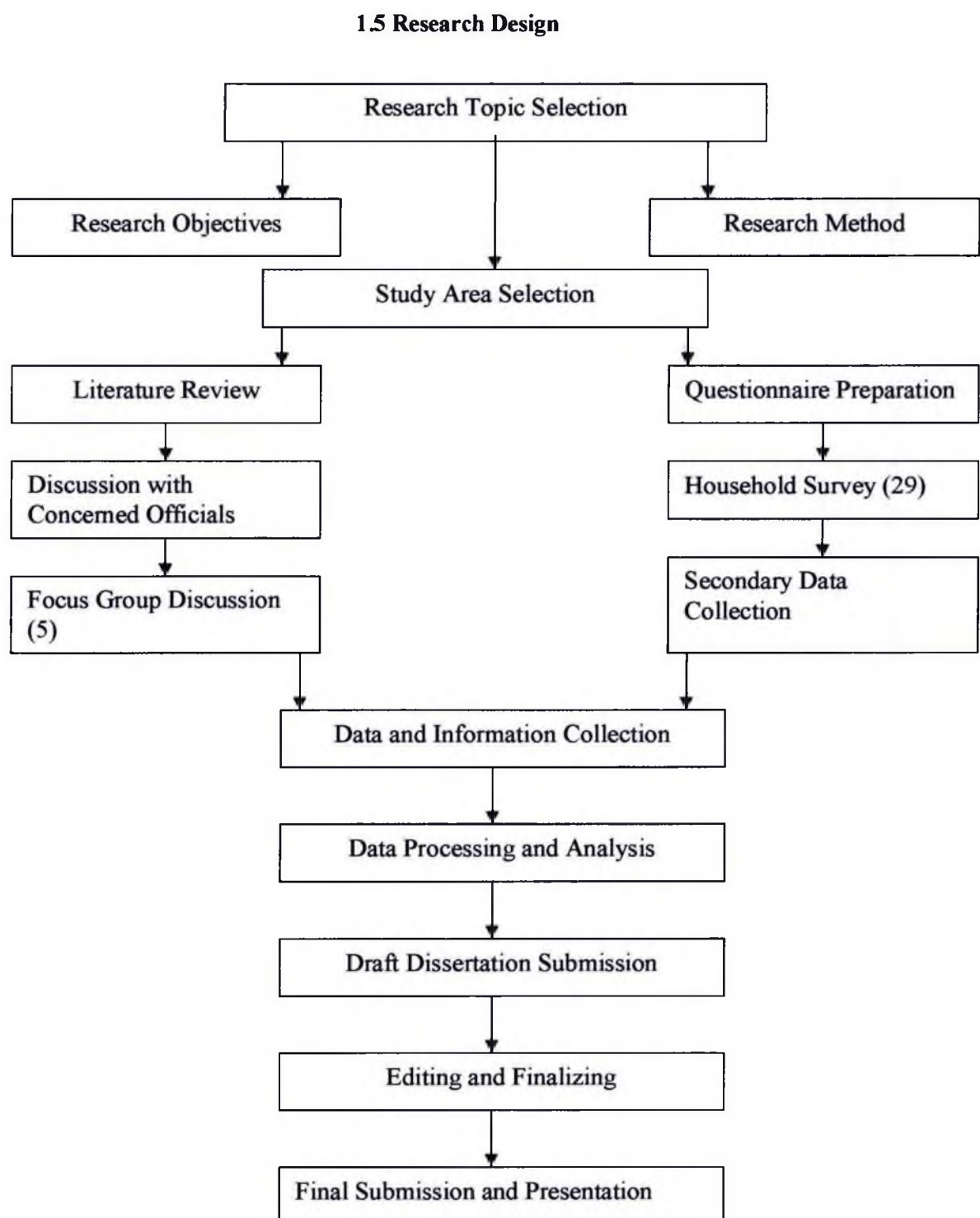
The area under DND embankment has been suffering from perennial flood and water logging from at least ten years back. This problem starts from June that continued up to November every year. The main cause of this situation is unplanned use of land for settlement, road construction, industrialization, urbanization etc. About 10 to 15 lac people have been suffering from this unfortunate phenomenon. But proper steps have not been taken to mitigate the problem so far. This situation will aggravate further if necessary measure is not immediately.

Lands are extremely limited resources. That should be use so judiciously that every inch of it can produce asset for the betterment of the people. Land use planning is essential for planned urbanization, viable industrialization, healthy habitation, road communication network, and make people resilient to disaster events. Proper land use can do vulnerability reduction of the people, their properties and elements that are expose to natural hazards. Land use planning will enhance resilience of all elements against all kinds of natural hazard including flood that often turns into disaster and will bring down the loss of lives and properties to an acceptable limit.

1.4 Rationale

Although Bangladesh is a land hungry country in respect to its population but land use planning is a neglected subject here. But it could have been a good and effective tool for development for such a densely populated disaster prone country. There are land laws and policies but before proclamation of these policies due consideration has not been given to the disaster reduction through well-planned land use. To bring up the importance of planned land use to policy makers, concern executive authorities and users, proper research on this matter is need of the hour. The present study is taken to shake the conscience of policy makers, civil society members, executives, landowners and other stakeholders who are concern with this subject. It is expected that concerned authorities would undertake the issue in their domains to bring it under broader light of mass consideration towards an effective and sustainable land use policy formulation.

Fig. 1.1: Flow Diagram of Data Collection and Study Method



1.6 Methodology

Primary data were collected through a model questionnaire devised by this author through trail and error process. Information was collected from wide range of people of different villages by field visits inside the DND project. There are three types of settlement inside the project; they are (1) densely populated cum industrialized roadside build up having typical urban characteristics, (2) moderate densely sub-urban habitation and (3) rural settlements. There are also some croplands and some few natural water bodies where water remained stagnant round the year. Due to limited excess and for the sake of proper result densely populated urban areas were excluded from data collection and data were collected from those areas where moderate habitations were existed. In order to obtain fair value of data from five villages were selected. Data were collected from the middle points of every village selected for the survey. Reconnaissance survey and transect walk were done throughout the project to compliment the gaps of questionnaire survey, if any. Gradual internal change over the years of the project scenario has been well known to the author for about at least 25 years. The author has many relatives who are living in the different villages inside the project. A series of discussions (FDG) as well as consultations were held with them about the causes of water logging and probable solutions of those. Analysis of pre-embankment situation with respect to present condition of the area was held with them. Some of them had sufficient lands in the past but by the ellipse of 4 decades they had lost many lands. The processes of gradual reduction of land ownerships were discussed. The author had obtained invaluable suggestions from them on prevention of floods inside the project.

Several visits were made to BWDB head office and pump house in Shimrail, Demra. Some visits were made to collect data & information from the offices of the Deputy Commissioner and XEN Roads & Highways, Narayanganj. Open discussions were held with officials and staff of above mention offices about the causes of water logging and probable solutions there off. Consultation about impact of internal roads on water logging and some other underlying causes of floods in the project were took place with Upazila Nirbahi Officer and Upazila Engineer, Narayanganj Sadar Upazila. Opinions were obtained over phone from some of the Technical Committee Members that was constitute in 2004 by the Ministry of Water resources to find out short term and long-term solution of flood inside the DND. Ongoing programs of concern departments against future water logging were scrutinized. The viability of the project as a crops production entity was examined time and again, which was initial objective of the project. The land use policy in Bangladesh, land laws, building codes, regulations and administrative orders are elaborately reviewed. The land use policies of some other countries were discussed in this research. A

number of books, reports, projects proposal were examined. “Unlocking the Potential”, National Strategy for Accelerated Poverty Reduction (PSRP) of the government of Bangladesh, relevant UN resolutions and some disaster management recommendations from National Workshop on “Option for flood risk and damage reduction in Bangladesh” were consulted too.

1.7 Data Collection

My first day experience of data collection was little bit amazing. On the day I approached to two gentlemen sitting in a shop together for information to fill in the questionnaire. Out of two, senior one ended with a comment that bring information from others than I could consider your request about furnishing information on DND project situation. Second one expressed his deep agitation on all governments after liberation and commented that we the people who are living inside the DND are no longer under any government; we are under Pakistan government who had built the embankment. We will declare independence from Bangladesh and will established a separate state here. No body had looked out our sorrow in the past and no body will see it in the future. So we need separate government in solving our problem. I realized that this type of outrage came from sufferings they have been facing year after year due to negligence of concern authorities to mitigate the problems and to allow the continuation of that type of endemic problems for indefinite time. I also noticed suspicion over their faces on me about the objectives of data collection. Then I discussed the aim and objectives of it with them and made them understand that that information would be used only for my academic purpose. Then they finally agreed to furnish information to me. To avoid such untoward situation in data and formation collection I picked up 5 young relatives of mine from 4 villages to assist myself in data collection. I trained them up and they had collected information for me.

1.8 Data Analysis

The data generated during household survey and literature review was rectified, processed and analyzed to draw conclusion at this stage. Data collected through the questionnaire survey and adopted from secondary sources was processed using statistical methods like percentage, mean, bar diagram, pie diagram, liner regression etc. The MS WORD is used to write the dissertation and MS EXCEL is used to present diagrams and liner regression. The GIS, ARC and Adobe Illustrator 10 were used to present maps and photos.

CHAPTER TWO

THE FCDI PROJECT AND THE SOCIO ECONOMIC PROFILE

2.1 The FCDI Project

The Dhaka-Narayanganj-Demra flood control drainage and irrigation (FCDI) project was commissioned in 1968 by the then EPWAPDB. The location of the project is in-between the southeast of Dhaka Metropolitan City and northwest of Narayanganj town. The Sitalakhya and Balu two local rivers have bound the area in the east, Buriganga in the west and Dholai khal in the north. The total gross area of this project is 56.79 km². The main engineering features of the project are as follows:

Gross area	8340 ha
Flood Control Area	5679 ha
Irrigable area in area-I(Original)	5064 ha
Irrigable area (present)	1300 ha
Flood embankment	31.25 km
Main irrigation canal	11.20 km
Lateral irrigation canal	34.15 km
Sub- lateral irrigation canal	9.63 km
Drainage canal	45.40 km
Intake canal	1.00 km
Pump house	1 Nos
Pumps	4 Nos
Irrigation structure	216 Nos
Floodwall	30 km

The project area is divided into two units. Area-I is the southern part of the project, provided with a well design embankment around the area for flood protection against seasonal flood. Irrigation and drainage facilities are provided as well. The project area is triangular in shape and encircled by Dhaka-Narayanganj road in the west, Dhaka-Demra road in the north and Demra-Narayanganj road in the east. After the embankment had been built total irrigable area in southern part, (area-I) was 5064 hectares. But over the period of about 4 decades indiscriminate private and public encroachments have been taken places and at present the area has been decreased by about 1300 hectares. All those lost lands are being used mainly for road construction, housing settlement, shops & markets, industries, railways, sewerage treatment project, stadium, hospitals, educational institutions and so on.

Fig. 2.1: Location of the Study Area

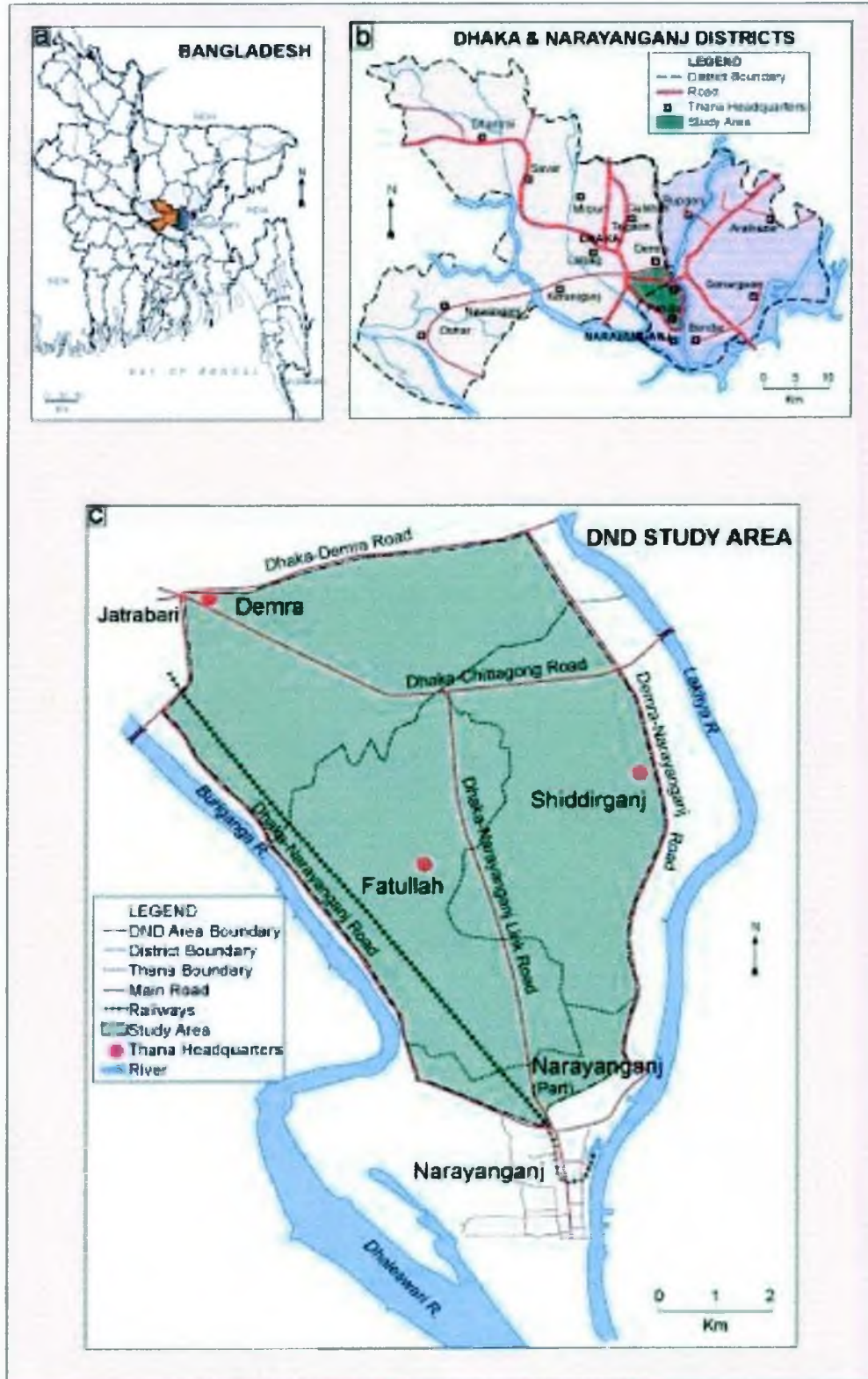


Fig. 2.2: DHD Project Area



Source: RWD, 2005

The study area, area-I of DND project has located at the south of Dhaka-Demra road. Total gross surface area of it is about 8340 hectares. After the embankment project had implemented, there was no more water logging inside it. Initially canals and drainage system were deep and wide enough to carry monsoon rainfall run-off to the Demra pump station. The pump station was new and efficient. It had needed capacity to pump out the rainwater beyond the polder. That ideal situation continued till the mid of 1990s. At present after about 4 decades of its implementation efficiency of pump house decreased much, canals and drainages have squeezed, unplanned urbanization took place, many roads and homesteads have built on the plain land without necessary pass out for rainwater and as a result water logging got started to some extent from few years back. In the year 2004 the area had unprecedented water logging for about 42 days. That brought about immense sufferings to the people living inside it. In the year 2005 the project again suffered water logging for a week in the monsoon season. After that the waterlogging problem inside Unit-I of DND project has become endemic. This situation had brought attention among politicians, civil society members, government officials, donors and other stakeholders. The humanitarian organizations, and development partners had shown their concern over the situation. Local as well as international medias had covered those unfortunate events with due seriousness. News and editorials were published to create awareness and bring about the attention of concern authorities for planned remedial measures.

The area-II, north of Dhaka-Demra road has a gross area of 2470 hectares. The area is nearest to the Dhaka City from the west and had been facing potentials threats too from unplanned urbanization. A good portion of land of this unit adjacent to Dhaka Metropolitan City had already gone under urbanization. This unit has not been given protection from seasonal flood in the rainy season. As a result the pace of withdrawal of lands from cultivation of this unit was less severe in the past but now it become inevitable owing to encroachment of land by settlement, industrialization and some big private real state companies for housing projects.

2.2 Scope of Study

The scope of study was immense. The project was commissioned in 1968 to increase food grain, especially vegetables and paddy production to meet the food deficit through flood protection and control irrigation. Till the middle of '90s the project's achievement was excellent in respect to paddy production. But by that time the project characteristics had been started to change gradually to the urbanization of a greater extent. Then the project had become suburbs of Dhaka city in the southwest and that of Narayanganj town in the northeast. The arable lands had been

used to implement development projects as well as homesteads, industries, shops and markets etc. Besides, huge arable lands were taken away from the cultivators for development of roads and highways. A large portion of productive agricultural land has been brought under urbanization. Valuable agricultural lands decreased day by day. Agricultural output had been gone down disproportionately too due to dual effect of shrinking of land and lack of fertility. Furthermore, water logging in the DND project has turned to a serious dimension. If planned steps are not taken immediately this problem will aggravate further in ahead. With this situation in reality and the amount needed every year to keep the project flood free, it is high time to inquire among beneficiaries, inhabitants, stakeholders and policy makers how water logging could be kept to a tolerable level and maximum benefit could be extracted from the project by keeping it flood free.

2.3 Topography and Soil

The project area lies within three main physiographic units: 1) Madupur tract; 2) Old Megna Estuarine Floodplain; and 3) Young Brahmaputra (Jamuna) Floodplain.

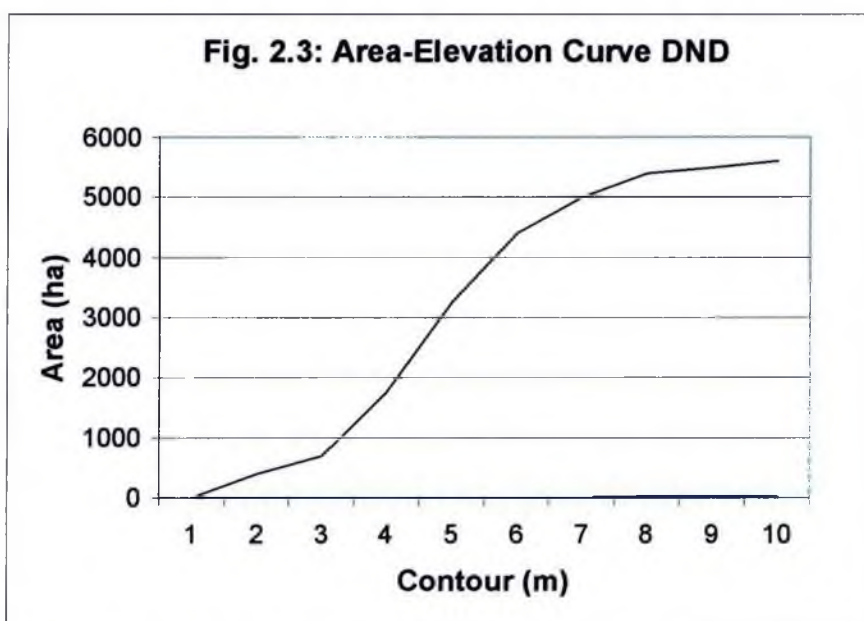
The outliers of the Madhupur tract in the northwest of the project area consist of down-warped, little weathered, Madhupur clay that has been shallowly dissected by board valleys. The terrace soils in this area are mainly grey, molted olive gray olive yellow, heavy clays. The soils in the valleys dissecting the terrace are mainly very dark grey, heavy clays. Local height differences are up to 3 feet.

The Old Megna Estuarine Flood plain occupies most of the project area. The soils of this unit occur in a pattern of board ridges and basins, with grey, molted yellowish brown silt loams or silty clay loams in the higher parts and grey to dark grey, molted yellowish brown silty clays and dark grey, very heavy clay in the basins the height differences between adjoining ridges and basins generally do not exceed 1.5-2 feet.

The low-lying Young Brahmaputra Floodplain deposits occur in a narrow strip along the western boundary. They include grey silty clay soils on smooth, low ridges, and grey and dark grey heavy clay in basins. Terrace hillock and high parts of flood plain ridges estimated at 8 percent of the gross area, roads, embankments and water bodies 3.5 percent, and homesteads 16 percents in 1968.

The soil of Madupur tract possesses complexity and diversity. The soil of the level area is deep friable clay loam to clay varying in color from red through yellow brown to gray. This soil type is acidic and crop production pattern is single or double in a year. The old Megna estuarine flood plain soils are almost friable silt loam on the ridges and clays in the basin. These soils are mid

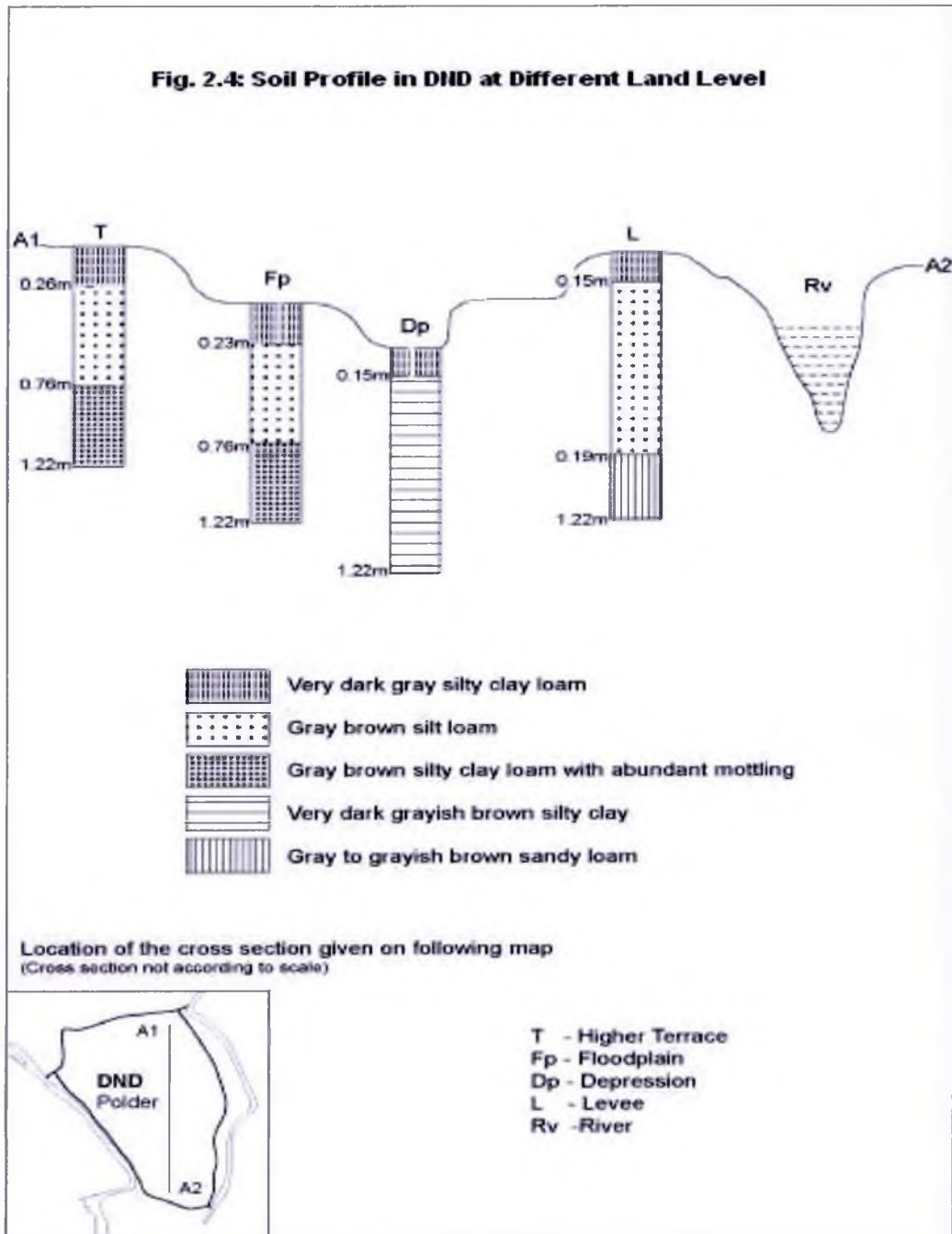
gray and finely molted yellow and brown. The young Brahmaputra floodplain soils are yellow brown or olive brown in color. Maximum part of the flood plain is neutral or moderately alkine below the topsoil and supportive to diversify crops production¹. Detailed soil information is summarized from the semi detailed soil survey of the project area by International Engineering Company Inc. in 1960 is presented next.



Source: IFCDR, 1988.

¹ Hugh Brammer, Land Use and Land Use Planning in Bangladesh, 2002, The University Press Limited.

Fig. 2.4: Soil Profile in DND at Different Land Level



Source : Chauthury, 1998

2.4 Hydrology

Bangladesh could be divided into seven hydrological regions considering rainfall run off over surface and major rivers flow (FPCO,1995). These regions are Northwest, North-Central, Northeast, Southwest, South-Central, Southeast and Chittagong hilly area. The Grater Dhaka including the DND area falls at the extreme south of the North-Central region. The region has been impacted by the river flows of Old Brahmaputra in the east. The Meghna and the Padma have tidal influence at the southeast corner of this region. The DND area is situated at the slightly above the southeast corner. The area has two types of hydrological scenarios these are external and internal. The external hydrology has been encompassed by river flow and embankment around it. On the other hand components of internal hydrology of the area are canals, khals, drainage systems, rainfall run off, urbanization, industrialization, homesteads, commercial centers, water bodies etc.

2.4.1 External Hydrology

At the east the river Sitalakhya is flowing, the Burhiganga is flowing in the west from Millbarak to Panchabati then meets with the Dhalessari. The Dholai khal connects Balu and Bhuriganga from north to west. The Balu is flowing at the east of the project and meets with Sitalakhya at Demra then flowing at the south. Before the embankment was built the DND area was submerged in the rainy season by overflowing the rivers and khals around it. At present the rivers sometimes in the rainy season, are flowing above the design elevation (5.79 m) of pump house. In that case discharge of the water from the project got stopped. Discharge of water was stopped from September 4th to 18th, a total of 11 days in 1998. Then external water level around the DND project at Narayanganj side was 65 cm above the road cum embankment and marginally saved it from the over toppled by the flood fighting measures such as palisading¹ and reinforcing the embankment by sand bags. During the flood in 1998 the project faced severe breaching threat from the external river flow and was damaged by leakage, seepage and piping developed in the road cum embankment.

2.4.2 Internal Hydrology

The internal hydrology consists of embankments, khals, canals, pump house, rainfall, wastewater, depression etc. The average rainfall in the months of June, July and August are 398mm, 391mm and 328mm respectively. Local rainfall has caused water logging and flood almost every year

from some years back. Water has remained stagnant round the year in some low-lying areas. Urbanization induced industries and households produce wastewater that falls in the khals and channels through paddy field. There are eighteen major khals with a total length of 34.7 km. These khals collect surplus water from paddy field through the connected secondary and tertiary canals. These canals pull that water up to the demra pumping station. Now a day the drainage systems of the project cannot function properly owing to encroachment, natural silt, earth filling and many other abstractions that caused polluted water logging.

2.5 The Climate

The DND area as a part of greater Dhaka is characterized by tropical monsoon climate and heavy rainfall in the months from June-September associated with seasonal variations, high temperature up to the 43°C (extreme case) in April and gradual decreased down to the 4.5°C in January/February. Sometimes excessive humidity and evaporation prevailed then. The climate of the area can be divided into four main seasons:

Hot summer (March-May): This is pre-monsoon period with the highest temperature and maximum evaporation rate. Nor'-wester, accompanied with thunderstorms, rainfall, hail and few tornadoes are being natural calamities of this season.

Monsoon (June-September): The season of highest rainfall and humidity. The sky remains cloudy throughout the season excepting sporadic few days. High intensity rainfall for some consecutive days may cause local flooding inside the project.

Post-monsoon (October-November): The period is hot and humid but temperature gradually goes down and rainfall is decreasing. Days are almost sunny but heavy dew at night.

Winter (December- February): The weather is cool, dry and sunny in the daytime, cooler and foggy in the night. Average temperature and humidity is minimum from the remaining part of the year. There is no or minimum rainfall throughout the winter.

2.5.1 Temperature

Mean annual temperature is about 25°C. Extreme temperatures range between about 4.5°C in winter and 43°C in the hot summer. Mean monthly temperature varies from 18°C in winter and 29°C in pre-monsoon season. The average annual rainfall is 2037mm but there is a significant variation both in total amount and in the time of rainfall in different years. In general about 85-90 percent of annual total rainfall occurs between April to September. From 1981 till 1995 the highest rainfall was recorded in 1984 (3222mm), and the lowest in 1992 (1169mm).

Humidity is high throughout the year excepting in the winter. Rainfall exceeds evapo-transpiration rates in the monsoon season. On the contrary evapo-transpiration rates exceeds rainfall in the winter. Evapo-transpiration rates also exceed rainfall significantly during the pre monsoon season. Ground water recharging through rainfall is also low due to over consolidation of the less permeable on the top and water logging on the low-lying areas throughout the year. Most of the rainwater drains out to the Sitalakha River by pump house in Shimryl, Demra. Some climatological parameters of DND area are summarized below:

Table 2.1: Climatological Indicators

Month/Tem °C	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
High (extreme)	34.2	36.6	40.6	42.3	40.6	38.4	35.2	35.9	35.3	38.8	33.3	31.2
Low (extreme)	5.6	4.5	10.4	15.6	18.4	20.4	21.7	22.0	22.0	10.4	10.6	6.7
Average	18.8	21.5	26.1	28.7	28.9	28.7	28.7	28.7	24.7	27.4	23.6	19.8
Relative Humidity, %	70	66	63	71	79	86	87	86	86	81	75	74
Evaporation (mm)	104	79	81	77	78	83	87	130	118	106	75	105
Rainy days, per month	1	2	4	8	14	19	22	22	16	9	2	1
Average rainfall (mm)	6.5	20.2	52.3	124.0	283.0	398.2	391.4	328.0	264.0	160.0	25.3	7.4

Data: 1) Bangladesh Metrological Department (1953-1985)

2) Evaporation, H. R Laboratory (Dhaka) No. E-10 (1978-1979)

Source: JICA; Study on Storm Water Drainage System Improvement Project in Dhaka City, 1987

2.6 Population Increase

A feasibility study was conducted by JICA in 1992 to suggest a comprehensive development for the DND area. Then total population in 1990 was calculated at about 0.45 million. The same study was forecasted on population for the year 2000 as 0.88 million, 196% increase from 1990 and for the year 2010 as 1.314 million, which is almost 150% above than 2000. But RAJUK's

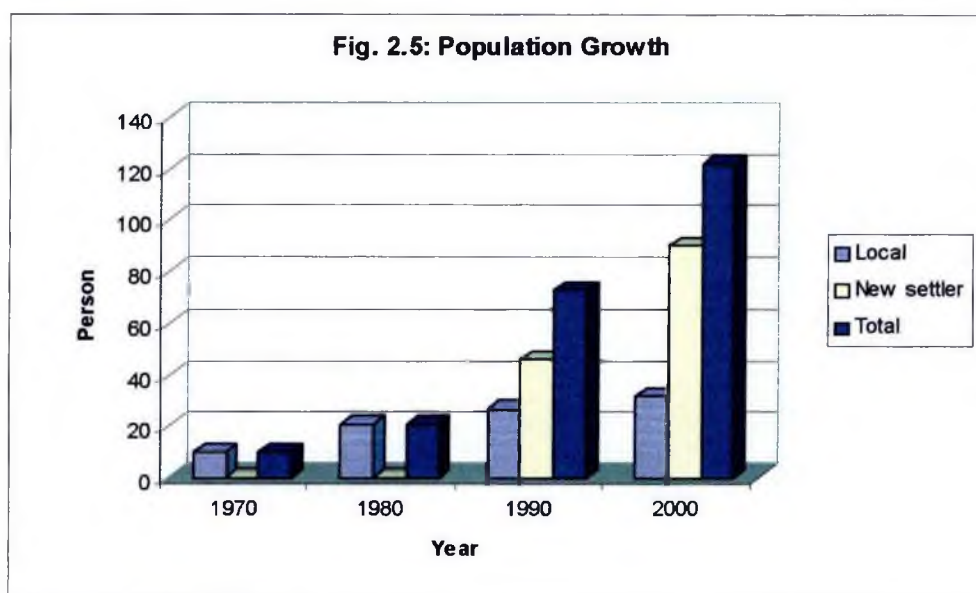
study in 2006 has estimated the present population in DND is 1.3 million and some newspapers have estimated it as 1.3-1.5 million.

In order to find out the trend of population growth 29 families were consulted at the present survey. Population increasing trend of the DND project (unit 1) is summarized in the following:

Table 2.2: Population Growth

Year	1970	1980	1990	2000
Local (human)	10	21	27	32
New settler (human)	00	00	46	90
Total	10	21	73	122
Growth rate	0%	110%	247.62%	53.42%

Source: Field Survey, 2006

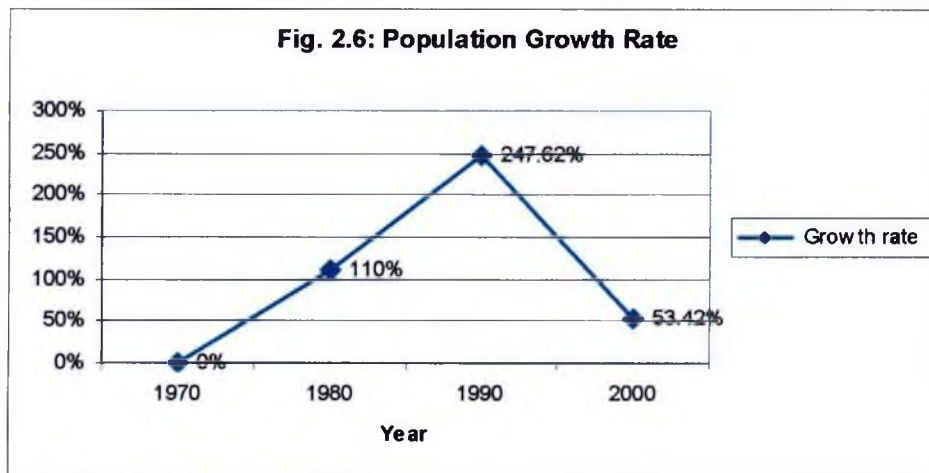


Source: Field Survey, 2006

It is evident from the survey that the rate of increase of population in DND from 1970 to 1980 was 110%, from 1981 to 1990 was 247.62% and from 1991 to 2000 was 53.42%.

Particular attention must be given to the fact that out of 29 families surveyed, only 8 families (27.59%) had been living in DND before the embankment, rest 21 families (72.41%) came from the outside after the embankment. It is evident from the survey findings that the trend of

population increase in the DND from the year 1980 -2000 was much higher than that of earlier. The present study finding on population growth is supportive to the estimate of RAJUK.



Source: Field Survey, 2006.

The survey further revealed that the population growth in the DND happened mainly in two ways, those are, natural growth and settlement from the outside. The DND project is situated at the vicinity of Dhaka city and Narayanganj town. People are being coming from all over the country in these two towns in search of livelihood at a higher rate. Many of them are being found their address cheaply in the DND. The present survey shows that 11 families from 1980-1990 and more 9 families in the next 10 years had been settled inside the project. Outside rush for settlement in the project has caused population increase many folds.

The population of DND will increase rapidly ahead than before. And to cater the need of augmented population new homesteads will be built, more roads will be constructed, additional business centers will be setup, hospitals, educational institutions and many other utility services will be needed. Wastewater from these and rainfall run-off will create serious overloads on the drainage systems if planned steps are not taken beforehand.

2.7 Land Ownership

The Dhaka-Narayanganj-Demra embankment and drainage project was completed in 1968. Land holding within the project has been changing from then. But the fundamental change had taken place fast and radically after 1980s. Per family land holding in 1972 was 2.73 acres, but presently

it comes down to 0.071 acres. During present survey 29 families were consulted, of them 13 families owned 0.01-0.05 acre, 8 families owned 0.06-0.10 acre, and 5 families owned 0.11-0.15 acre, one family owned-0.16-0.20 acre and 2 families have no land ownership, they lived in the rented houses. Below is a list of land ownership of 29 families as found at the present survey:

Table 2. 3: Present Land Holding

Serial Number	Name	Land Own	Use	Classification
1.	Habibur Rhaman	No land		
2.	Md. Montu	No land	-	-
3.	Md. Arif Hossian	0.0375	Homestea	Very High
4.	Md. Abdul Karim	0.06	Homestead	Medium High
5.	Md. Mosleuddin	a) 0.045 b) 0.105	Homestead Crop Land	Medium High Medium Low
6.	Md. Abu Taher	0.0375	Homestead	Very High
7.	Akram Ali	0.0330	Homestead	Low Land
8.	Md. Khalil Khan	a) 0.09 b) 0.03	Homestead Pond	Medium Low
9.	Md. Rafiqul Islam	a) 0.075 b) 0.03	Homestead	
10.	Md. Fazlul Haq	0.075	Homestead	Medium Low
11.	Md. Abdul Malek	0.075	Homestead	Low Land
12.	Md. Fazar Ali	0.03 0.045	Homestead	
13.	Md. Abul Hossian	0.09	Homestead	Medium Low
14.	Md. Selim Mollah	0.0375	Homestead	
15.	Md. Pappu Mian	a) 0.0225 b) 0.0375	Homestead Pond	Low Land Fisheries
16.	Md. Aatur Rahman	0.0375 0.0225	Homestead Pond	Medium Low
17.	Mrs. Imama Begum	a) 0.04 b) 0.03	Homestead Pond	Fisheries
18.	Habib Miah	a) 0.09	Homestead	Fisheries Medium

		b) 0.045	Pond	Low
19.	Md. Kaium Khan	a) 0.015 b) 0.015	Homestead Pond	Medium Low Fisheries
20.	Md. Hasem Sarif	0.045	Homestead	Medium Low
21.	Md. Sattar Mollah	0.045 0.025	Homestead	Medium Low
22.	Md. Amanullah	0.08	Homestead	High Land
23.	Md. Altaf Hossian Mian	0.10	Homestead	High Land
24.	Md. Sahid	a) 0.15 b) 0.05	Homestead Fellow Land	High Land Medium Land
25.	Md. Minal Hossian	0.0375	Homestead	Low Land
26.	Md. Abdul Awal	0.03 0.06	Homestead	Very High Land
27.	Md. Selim Reza	a) 0.105 b) 0.045	Homestead Crop Land	
28.	Md. Bakul Hossian Chowdhury	0.03	Homestead	High Land
29.	Md. Based	0.03	Homestead	High Land
	Total	1.9175 acres		

Source: Field Survey, 2006.

Total land owned by 29 families is 1.9175 acres. On average, each family owned measuring 0.071 acre of land whereas per capita present land holding is 0.14 acre. Maximum size of land ownership by a family is 0.20 acre and minimum land owned by a family is 0.03 acre. It is notable that per capita land holding in 1973 was 0.29 acres (Agro-Economic evaluation report of DND, second edition, 1984) on the contrary now it comes down to 0.071 acres per family. This shrinking in land holding is a result of continued division and sub-divisions of land holdings induced by high pressure of population on it. The study revealed that the holdings are excessively divided and sub divided into pieces. The operation of law of inheritance and fragmented wholesale sale of holdings are responsible for this situation. This trend of land division will go ahead in future and the area will be farther fragmented into smaller plots in the years to come. The situation in the coming years will be more complex if necessary steps are not taken immediately to stop the fragmentation of land holdings.

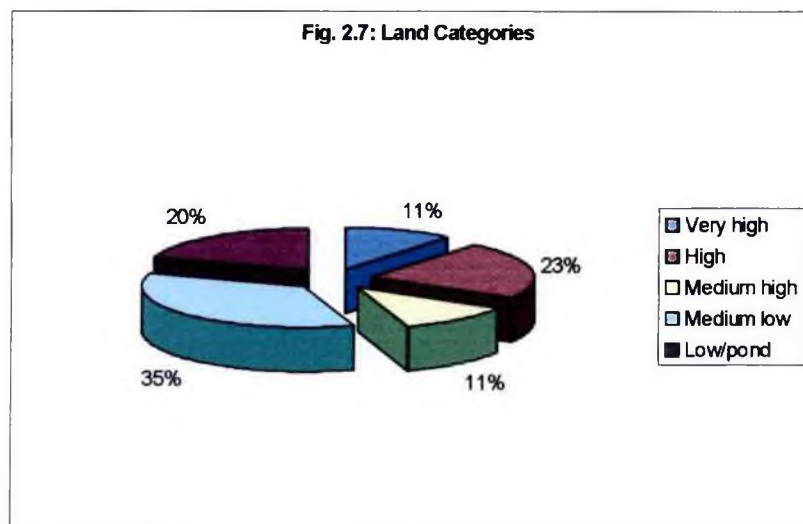
2.8 Land Category

There are five categories of lands are identified as very high, high, medium high, medium low and low. The study revealed that out of total 1.9175 acre, the very high land is 0.21 acre, the high land is 0.435 acre, medium highland is 0.2175 acre, medium low land is 0.6725 acre and low land including pond fisheries occupied 0.3825 acre.

Table 2.4:Land Categories

Very high	High	Medium high	Medium low	Low/pond
0.21	0.435	0.2175	0.6725	0.3825
10.95%	22.69%	11.34%	35.07%	19.95%

Source: Field survey, 2006.



Source: Field Survey, 2006.

Fig. 2.8: Land Level in DID and its Surrounding Area



Source: JICA, 1987

2.9 Sources of Income

The heads of the 29 families are inquired about their primary as well as secondary sources of income, the results are presented below,

Table 2.5: Sources of Income

A. Primary Sources	NO. of Families
Business	17
Service	10
P. Service	01
CNG driver	01
Total	29
B. Secondary Sources	
Business	02
Service	02
Labors	02
F. Remittance	02
House rent	02
Carpentry	01
Carpentry	01
P.Service	01
Total	13

Source: Field Survey, 2006.

Out of 29 families 18 families depend on single income source, 11 families have mentioned their single secondary income source and 2 families have dual secondary income sources. It is worthy mentionable that from the aforesaid families consulted none of those families has any primary income from the agriculture sector. Not even a single head of the families has cited agriculture as the secondary source of income.

CHAPTER THREE

LAND USE

3.1 Land Use in Bangladesh

Land and water are the two important natural resources of Bangladesh without substitutions. Land means all lands either dry or wet or water bodies within the national boundary of this country. The land use is of great importance for this country, which is densely populated and mostly based on agricultural production. Land covers the physical attributes of lands, while land use is a pattern of human activities undertaken within a socio-economic context. Natural land cover is changed by the use of it in meeting crop production, settlement, industrialization or other necessities

About 29% of Bangladesh's territory is classified as high land and is above normal seasonal inundation. Next category Medium High land occupies near 12% of surface area. These types of lands are inundated to a depth of 30cm in the rainy seasons. These lands are most valuable in respect to agricultural production. The next category is slightly lower level than the previous and known as Lower Medium Highland, where normal inundation is between 30cm to 90cm. This type of land occupies 23% of total land in the country. These lands are very important for crop production too. Medium Lowland forms 12% of the territory and is gone under water in the rainy seasons up to 90cm to 120cm deep. This category of lands is also useful for agriculture. The last as well as deeper land categorized as Lowland and this occupies 9% of total land. These lands are inundated between 180cm and 300cm in every year in the wet period of the year. Haors, baors and beels and other natural water bodies excepting rivers are included in this category. The rest 15% of the lands are either deepwater (rivers) bodies in excess of 300cm or urban buildup and rural settlement.

Bangladesh bureau of statistics had published a land utilization statistics in the year 2005 (latest). In its publication land use classifications are as follows; net cropped area, current fallow, current waste, forest, and area not available for cultivation. This classification of land use is ambiguous and is not helpful to this study.

Land use pattern in this country is basically determined by physiography, climate and land heights in relation to inundation in the rainy season. Mainly the monsoon climate and seasonal flooding which affects the greater part of the country determines land use in Bangladesh. This physical determinants are reinforced by settlement due to high population pressure, industrialization, rapid urbanization, compartmentalization, road and railway network and, increasingly, by alteration to the natural environment through flood protection, drainage and irrigation intervention. But in relation to disaster mitigation land use means regulating use of land

in order to reduce vulnerability of people, their crops and property, infrastructures, public utilities development initiatives etc. from flood damage or loss. It can also be used to modeling land use that might interfere with the passage of rainfall run off or floodwater in rivers, its tributaries and distributaries, channels, canals, between embankments or along recognized flood spillways.

It is evident that it is not possible to stop indiscriminate sprawl of settlements, setting up of industrial and commercial enterprises, of field fisheries and other non agriculture uses of land onto flood protected land inside the DND embankment area as because no land use regulation exist till now by which such unhealthy practice could be prevented. In absence of law and its enforcement measures, the only means to prevent such land use would seem to be through popular involvement in project management through local government institutions. It is the local people who would benefit most from the functioning of planned land use and efficient drainage system in the long run. So local people should be involved to design the long-term solution of this problem. This could be achieved through raising awareness among people to generate public demand for regulation to be made and enforced to protect life, livelihood and property from natural disaster.

3.2 Land Use in DND

The DND embankment and irrigation project was completed in 1968. Before the project was completed the area was inundated under 5-15 ft water in the months from July-September every year. After completion of this embankment project the area got full protection from monsoon inundation. The primary objective of this project was to increase agriculture production by ensuring flood control in the rainy season and by providing irrigation in the dry season and drainage facilities to croplands. At the initial stage the project was moving toward fast to fulfill its objective smoothly but from 90's this project has been suffering serious setback for various reasons.

The DND area is near to Dhaka city in the northwest and it is close to Narayanganj town in the southeast. The project area is embanked with metal roads by the three sides, carrying of raw materials to industries from other places are easy and marketing facilities of industrial goods in the two nearby cities are available. Having these advantages many small and medium scale industries have been setup along the three roads cum embankments. There are enormous new homesteads, industries, markets, and shops. There are number of brickfields, institutions, filling stations, cinema halls etc. inside the project. There are some real state companies operating in the

embankment area. They are functioning by purchasing medium low lands at large scale and selling that on a piecemeal basis. These lands are basically fertile croplands. Other than those, many service providing installations were established there on the croplands.

Some government departments had encroached mentionable agricultural land to implement their development projects. Initially the project area was reduced by about 2400 acres for development purpose by DIT, WASA and Roads & Highways department. Again R & H department had eaten up huge agricultural land in 90's to implement a link road from Narayanganj (Chasarsa) to middle of the Jatrabari-Kanchpur (signboard) road. These are the classic examples of encroachment of agricultural lands for development purposes. The WASA established a sewerage treatment plant near Pagla by eaten up 240 acres agricultural land from the project. Local Government Engineering Department (LGED) has been making many roads encroaching agricultural lands inside the embankment. The Bangladesh Cricket Board had made a stadium at Fatullah on huge agricultural lands. Deputy Commissioner's office, District Jail, Zila Parishad and Upazila Parishad all of Narayanganj had set up inside the embankment on valuable agricultural lands. Besides, Ministry of Health and Family Welfare established a Mother and Child health institute at Matuail. Department of Youth has set up a youth training center at Jalkuri and PDB had set number of power sub stations inside the project. All these establishments had been established on agriculture lands without due planning. By the elapse of a period of 38 years the agricultural land has reduced drastically. Now it is a mater of some years ahead when the entire area of this project would be used other than agricultural crop production. A picture of land use other than agriculture and non-agriculture in the past, at present and prediction use for coming future is shown below:

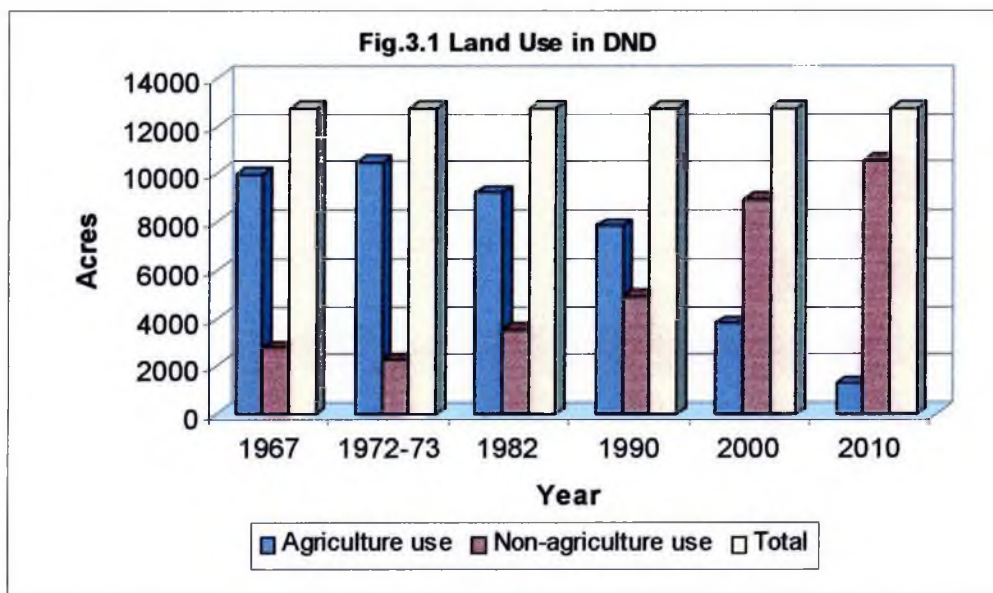
Table 3.1: Land Use in DND; past, present and future

Year	1967	1972-73	1982	1990	2000	2010
Agriculture use (acres)	10000	10477	9215	7840	3810	1314.6
Percentage	78.5%	82.24%	72.33%	61.53%	29%	10.32%
Non-agriculture use (acres)	2740	2263	3525	4900	8930	10550
Percentage	21.5%	17.76%	27.67%	38.47%	71%	89.68%
Total	12740	12740	12740	12740	12740	12740

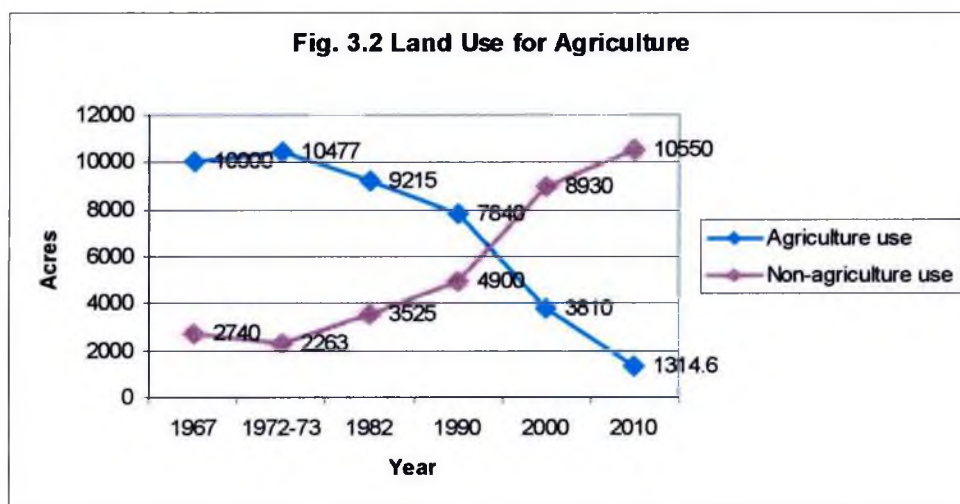
Sources: 1. *Agro-Economic Survey, 1973, BWDB.*

2. *Study report, FAP 8A JICA, 1992.*

The above table shows that out of total 12740 acres, land under agricultural use was 10000 acres in 1967 (before embankment) and had increased from 10000 acres to 10477 acres in 1972-73.



Sources: 1. Agro-Economic Survey, 1973, BWDB.
 2. Study report, FAP 8A JICA, 1992.



Sources: 1. Agro-Economic Survey, 1973, BWDB.
 2. Study report, FAP 8A JICA, 1992.

That expansion of agricultural land was happened due to provision of irrigation and drainage facilities and flood control measure. Before those facilities some high lands were kept as fellow due to dryness and some low lands were beyond cultivation owing to inundation round the year. After the project was commissioned in 1968, both types of aforesaid unproductive lands were brought under cultivation. Thus land for agriculture use had gone up, from 78.5% in 1967 to 82.24% in 1972-73. But lands under agricultural use were being decreasing from 1975.

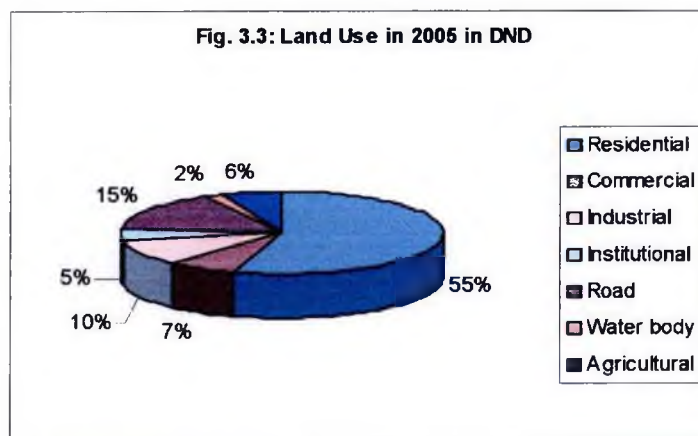
Withdrawal of lands from agriculture is being gradually increasing over the years. The cropland decreased to 72.33% in 1982, to 61.53% in 1990 and to 29% in 2000. The JICA's study on land use in DND had given a doom picture in respect to agricultural use of land from 1990 to 2000 and forecasted that it would be minimized upto 10.32% by the year 2010.

A recent survey (2005) by RAJUK had revealed that the build up area in the project has already been exceeded the projected land use in the year 2010 by JICA. Land use in DND project as found in that survey is as follows;

Table 3.2: Land Use in DND in 2005

Type of land use	Percent
Residential	55
Commercial	7
Industrial	10
Institutional	5
Road	15
Water body	2
Agricultural	6
Total	100

Source: RAJUK, 2005.



Source: RAJUK, 2005.

It is evident from various studies that if present trend continue which is almost certain most of the project area will go under non-agricultural use in near future.

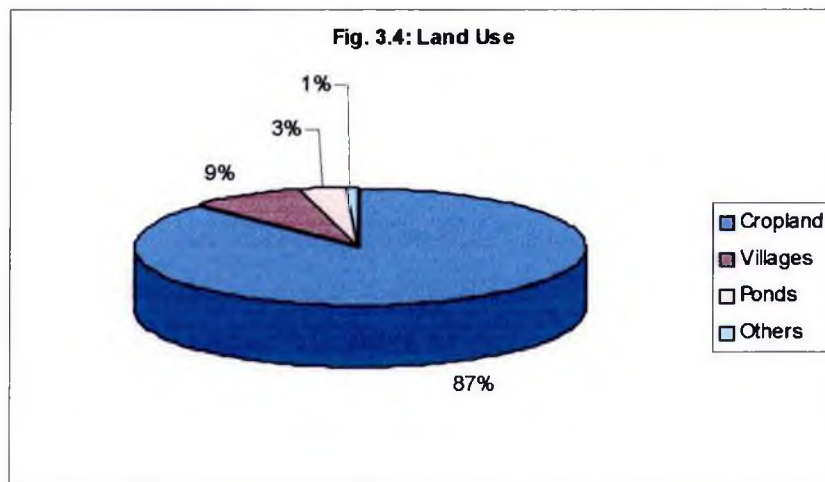
3.2.1 Pre Embankment Time

Before execution of the embankment project the entire area was a depressed contour. Almost 90% lands in the project area were low and used to be flooded by 5-15 feet deep during monsoon. Houses in the villages were built after raising the lands by the earth filling. Homestead building was much costly, as it had needed huge labor force to raise the land above seasonal flood level. There were mud houses almost all the villages inside the embankment Apart from villages which were mostly sporadic there were no houses elsewhere. People of that area were grown vegetables, jute, aush paddy and low yielding long aman sparingly in the kharif-I (March to June) & kharif-II (July to mid October) and mustered, wheat, lintel, pulses, and vegetables in the winter (mid October to early March). Most of the year winter crops were uncertain because of dryness in the field and absence of irrigation facilities and rainy season paddy crops were damaged due to flood. There were ponds connected with almost every household where fishes were produced for family consumption. Economic activities were almost agriculture based. There were some fisheries in the natural depression, and fellow or posture land round the year. Then croplands had not been widely used for homesteads or any other development purpose such as roads, industries, brickfields, institutions etc. There were no built up markets or supermarkets but small village hats or bazzars. There could have some small shops or industries but those were not mentionable. Lands were not taken away from the cultivators for development purpose or for urbanization. There might have some earthen village roads those were used as walkway. Road communication in the dry season was on foot and in the rainy season it was on local boats. Then total lands under the project were used as below:

Table 3.3: Land Use

Categories	Percentage
Cropland	87.37
Villages	8.51
Ponds	3.41
Others	0.71
Total	100

Source: Agro-Economic evaluation, of DND, 1972-73, p-24, second edition, 1984



Source: Agro-Economic evaluation, of DND, 1972-73, p-24, second edition, 1984

3.2.2 Land Use till '80s

At the outset of the project dwelling houses had not been erected on the low land rather those were built on the high land or medium high land by earth rising as before. New homesteads were accommodated within existing villages at about the first 5-7 years of the embankment project. At that time internal population was limited, outside influx was absent and internal family breaking was not prominent. So people of the area were not pushed to the agriculture land for habitation.

Bangladesh had experienced a major flood that brought severe famine to the whole country in 1974. After that flood and famine, people from different parts of the country had started to come into the cities and towns including Dhaka and Narayanganj in search of livelihood. The new coming people had needed shelters to live, and then new homesteads erections were started along the embankment cum roads of the project. These people were mostly belong to lower income group and had lived a very hard life. Day by day they search for cheap shelter and many of them found their haven inside the DND. Those low-income groups were not financially capable of purchase a piece of land or raise the earth and so they had made their homesteads on the slope of embankment without raising the earth. These had unfolded a new dimension of housing inside the DND project. By this time local people's sense of ensured security against floods augmented and they had started to erect dwelling houses in the low lands inside the embankment area without raising the earth. Housing in the croplands was gradually expanding due to the proximity of the two urban centers, livelihoods opportunities in the two cities, law of inheritance and due to the breaking up of joint family system.

The Dhaka-Narayanganj-Demra embankment project was implemented to solve food grain deficit in 1960s. The objective of the project was to increase crops and vegetables production by ensuring irrigation and flood control facilities. At the planning stage productions of local varieties was taken into account, and production of HYV were not considered then. But within five years of the project implementation high yielding varieties (HYV) especially paddy had started to replace that of local varieties. With the help of agriculture extension field workers and utilizing favorable situation of flood control and irrigation the peasants of the project area had been introduced HYV (IRRI) instead of local varieties. At 80's agricultural production especially paddy production boomed beyond the projection. Irrigation facilities and flood free environment had encouraged cultivators toward extensive crop production. Economic upliftment of local people started to flourish at the pace with the agricultural surplus. The embankment had been saving their crops, homesteads and other household assets from attrition by seasonal floods especially every year. Flood in 1974 had devastated major parts of this country. The loss of crops (especially aush paddy) and other assets were huge throughout the country but DND and other cordoned areas. Famine had engulfed the whole country and many people died of starvation. But a reverse event took place inside the DND embankment. The area was flood free so the farmer in DND had not lost their crops they produced similarly they did not faced any flood damage as outside embankments. As a result the people did not suffer from famine and the local inhabitants of DND did not face starvation. On the contrary they had produced enough food grain that was surplus to them. That year they were even gained much by sailing their surplus food grain in the market. That event their economic gain in 1974 had suppressed previous many years. Some big firm owners had accumulated necessary capital to start business or small-scale industries.

From 1975 people had started to set up shops and markets inside the embankment along with homesteads. They also started to establish small industries, workshops and brick cleans at a large scale. A number of new internal roads had begun to develop to facilitate road communication. The rickshaws, bicycles and other motorized vehicles had been introduced. Economic activities had increased manifolds, income and spending augmented. Different government agencies whose were working in the DND had started to spend more funds to cater essentials services. The WASA had set up a large sewerage treatment plant inside (Pagla) the project

Many new roads were built and new transport systems were introduced in the area. In the past, the means of transportation and communication in the dry seasons were on foot and in the rainy seasons were by country boats but in the flood free situation bicycles, rickshaws and automobiles had replaced those. Canals ridges were being used as roads and walkways round the years. Those

new communication systems had expanded movement of commuters living there. The flood free environment and improved communication systems had attracted locals as well as outside people to built houses inside the embankment on the lowland. Furthermore low price of lands at the vicinity of the two urban centers allured people to settle. All these factors contributed to agricultural land shrinking every year to meet up the growing demands of land for erecting dwelling houses, roads, business centers, industries, educational institutions etc.

3.2.3 Land Use in '90s

The DND area is near to Dhaka city in the North- West and it is close to Narayanganj town in the South- East. The project area was encircled with embankment cum metal roads by the three sides. Carrying of raw materials inside the project from other places was easier and marketing facilities in the two nearby cities were available. Having these advantages many small and medium scale industries had set along the three embankments cum roads. There are enormous homesteads, shops, markets and bazaars, a number of supermarkets, cinema halls and fuel filling stations inside the project. There are also some real state companies operating in the embankment area. They are functioning by purchasing low and medium low lands at large scale and selling out those on piecemeal basis. These were basically fertile croplands.

In '90s a part of Asian highway from Jatrabari to Kanchpur and a linking road from about middle (signboard) of it to Chashara were built inside the project. These two roads have converted the project into virtual three compartments and a new era has been ushered there in the communication and transport systems. Many interconnecting roads were built to cater the needs of inhabitants living inside the project. Local Government Engineering Department has been making many roads encroaching agricultural land inside the embankment. New communication facilities expanded movement of commuters living in the area. Again affordable price of land, repaid urbanization, vicinity of the two big cities and protection against flood had contributed to attract people from inside and outside to built houses inside the embankment on low land.

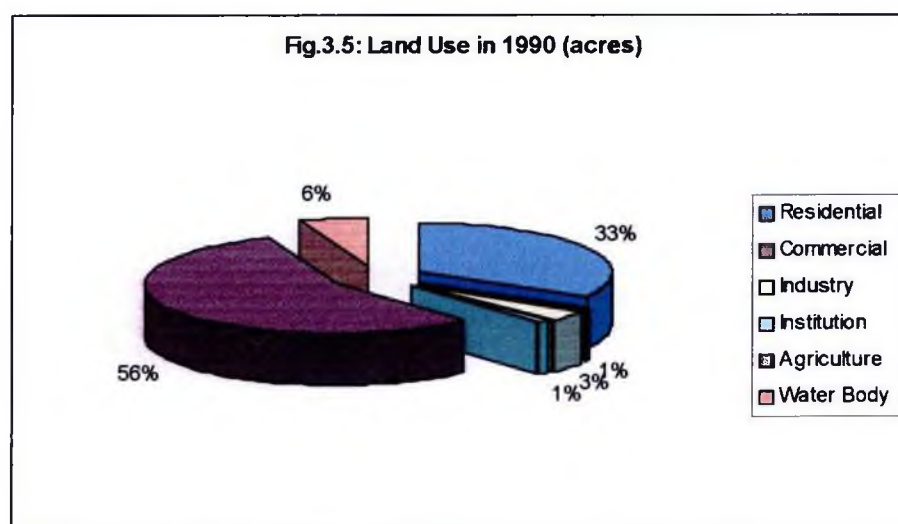
Some government departments have been encroached mentionable agricultural lands by acquisition to implement their development projects. Among those the Roads & Highways department had eaten up huge agricultural lands to implement their two projects namely Jatrabari to Kanchpur (a part of Asian highway) road and a link road from Narayanganj (Chasarsa) to middle of the Jatrabari-Kanchpur (signboard) road. These are the classic examples of encroachment of agricultural lands for development purposes. The Bangladesh Cricket Board had

made a stadium at Fatullah on huge agricultural land. Many govt. offices including offices of the Deputy Commissioner, District Judge, Superintendent of Police, Civil Surgeon, District Jail, Upazila Parishad all of Narayanganj had established offices inside the embankment on the valuable agricultural lands. Beside those, the Ministry of Health and Family Welfare has established a Mother and Child Health Care Institute at Matuail. The Department of Youth has set up a youth training center at Jalkuri and PDB had set up a number of power sub-stations inside the project. All these establishments have been setting up on agriculture lands defying the primary objectives of this project, and without land use planning. A land use table is presented below:

Table 3.4: Land use in 1990

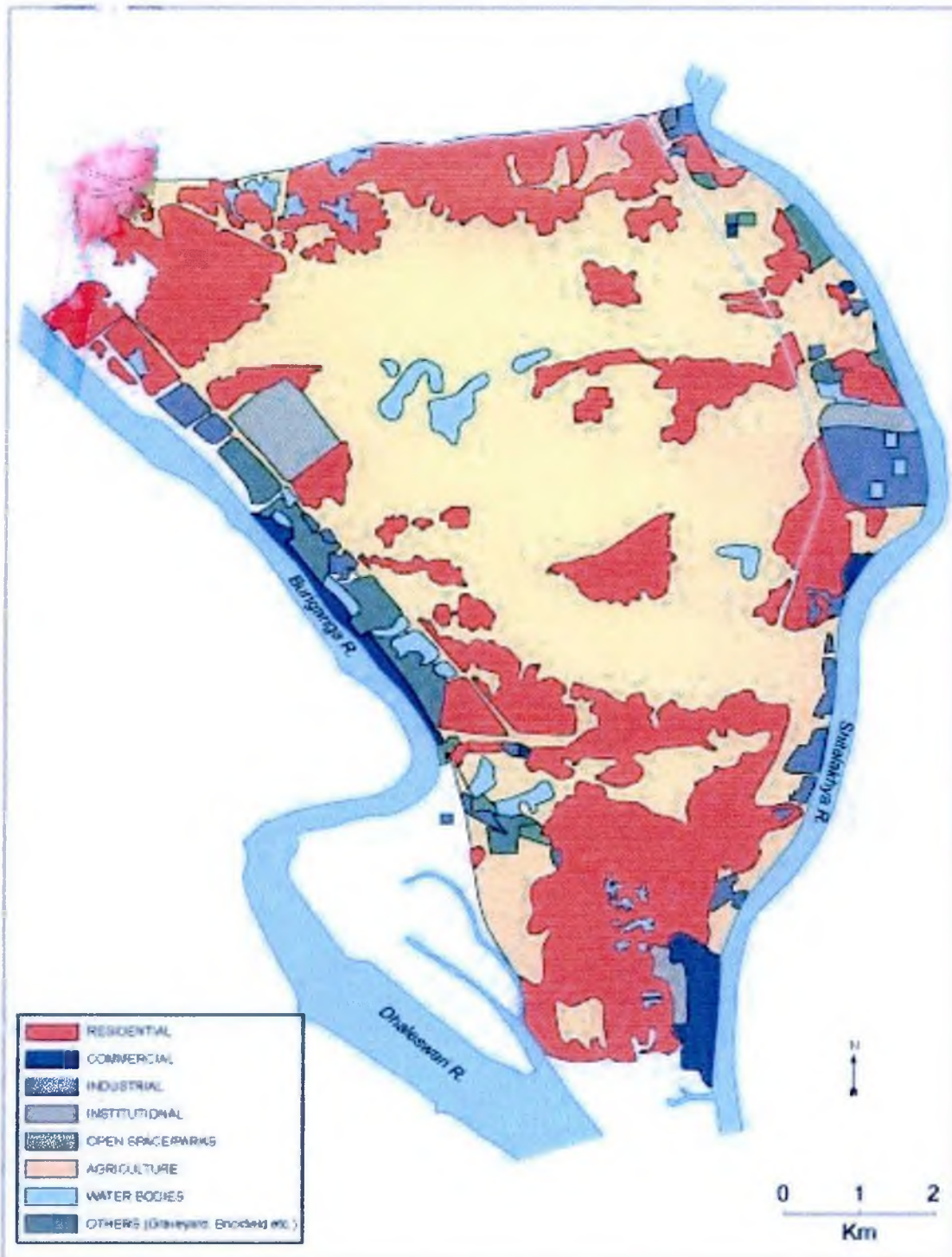
Use	Residential	Commercial	Industry	Institution	Agriculture	Water Body	Total	Build up area
Area (acres)	4606.0	138.37	484.3	145.7	7751.6	820.38	14035.3	5305.3
Percentage	33%	1%	3%	1%	56%	6%	100%	38%

Source: Study report, JICA, 1990.



Source: Study report, JICA, 1990.

Fig. 3.6: Land Use in DID and its Surrounding Area, 1990



Source: Modified from JICA, 1992

3.2.4 Present Situation

At present land use patterns in DND have turned into a very complex phenomenon. Floods in 1988 and 1998 had exceeded the complexities of land use inside the project. It is evident from the field survey that homesteads are spreading very fast. It was observed at the time of reconnaissance survey that homesteads were built on all the categories of lands including high, medium high/medium low and low excepting deep contour. Setting up of industries, business centers, hospitals, offices, institutions etc are going on without any hindrance. Many development projects are implemented by different govt. organizations. All these are being established mainly on agriculture lands letting down the objectives of the project. This trend will continue ahead due to absent of land use regulation/plan for the project.

3.2.4.1 Settlement

Earth filling and homestead building onto the medium low land or low land was started after the flood in 1974 and that got pace after the flood of 1988. Population pressures from outside the DND embankment project and breaking of joint families inside it has been contributed much in building new homesteads on valuable crops lands. Much area had been filled up by this process resulting transformation of many lands from medium low and low to high and medium high. This process is being running from about 1975 and is increasing over the years. Hundreds and thousands tones of earth had filled into the project from outside to accomplish this task. So, the land of the project is being gradually raising and transforming to higher categories. Apart from that presently more than 25 real state companies are functioning inside the project. These companies are being purchasing many plots of land of medium low or low categories (mainly agriculture) and converting those into high or medium high lands by earth filing. They also have been fragmenting those lands into smaller plots and sale those out to people for housing settlement. One of those real state companies is the Rupayan Housing, a well-known real state and housing company is establishing a satellite town namely 'Rupayan Model City' at Bhuighar, Fatulla. Some others big real state companies are:

- a. Navana Bhuian city
- b. Jubak Housing
- c. Asa co-operative society
- d. Deputy Commissioners' Housing project
- e. Madaninagar housing project

- f. Aftabnagar housing
- g. Shantidhara housing state
- h. Relince city
- i. Al-Islam nagar housing
- j. Amulia model town, etc.

Apart from those there are many private housing initiatives facilitating housing settlement in the project. All these factors pushed the agriculture project into a sub-urban housing settlement.

3.2.4.2 Industry & Commerce

Few small scale and cottage industries, some workshops, small hats & bazaars, and sporadic shops were there at the beginning of the project. From 1975 more small to medium scale industries were set up. The DIT had established an industrial state at Postagala- Shampur to facilitate industrial enterprise. At present many industrial units, large, medium, small as well as cottage are running there. Many industries have been functioning along the highways, road cum embankments and also on different sporadic locations inside the project. There are many commercial centers, super markets and innumerable shops inside the project. The DCC has established a wholesale market for vegetables, fish, fruit etc near Jatrabari. There are many kitchen markets inside the project to meet the daily necessities of local people. There are number of steel re-rolling mills, saw mills, cinema halls, pump stations, hospitals, clinics, warehouses, medicine stores and many other business houses & trading centers to cater the need of urban life.

3.2.4.3 Road Communication

At present entire DND project area is criss-crossed by the road communication. The development of road communication has contributed mainly toward urbanization as well as a major cause of water logging for this area. Apart from encircled embankment cum road of 31.25 km, a portion of Dhaka-Chittagong highway (Jatrabari to Katchpur) and a part of inter district highway (Chasara, Narayanganj to Jatrabari- Katchpur road) constructed by the R & H department have ushered a new era of road communication and urbanization. Besides, DCC, Zila Parishads and LGED Dhaka and Narayanganj, Upazila Parishad, Sadar and Siddirganj Municipality, Narayanganj and Union Parishads of Dhaka/Narayanganj district located inside the project have made innumerable inter connecting roads. Other than those, local communities made many roads by their own initiatives. Total length of internal roads is more than 5000 km at present.

Photo 3.1: Dhaka – Chittagong Road

The Jatrabari-Katchpur highway and Chasara to Jatrabari- Katchpur roads are centrally planned but without sufficient water passes and other local roads are unplanned and defective, those have been put impediment to water discharge and contributed to flooding.

3.2.4.4 Other Establishments

Emerging town ships are evident in and around the project. Many people are coming from different parts of the country to settle there and density of population is increasing day by day. To meet the growing demands for various services a number of new service offices were set up inside the project. Some of those are offices of the Deputy Commissioner, District Judge, Superintendent of Police, District Jail, Zila Parishad, Upazila Parishad, XEN LGED, XEN R& H, Civil Surgeon etc. There are some govt. and private hospitals/clinics, schools, colleges, madrasas, training centers providing respective services. The WASA had a large sewerage treatment plant and PBD had constructed few power sub stations. The gas distribution company, the BTTB and

many other public as well as private service provider have made number of establishments in the project area.

3.2.4.5 Fisheries

There are six natural depressions inside the project. They are located at Adamjee nagar, Siddirganj, Dagair, Godnail, Matuail(Mridhabari), and Julkuri. Other than those, there are many small ponds in the project. Those are natural fisheries and hold water round the years. Besides many people use their crop fields for fish cultivation instead of crops. They create artificial shallow pond fisheries on the cropland by fencing around it with fish garth, mosquito net, brick wall or erecting earth. They hold a pool of rainwater inside the fence. They use these types of artificial ponds for pisciculture. This ponding water aggravated flood during rainy season when torrential rain falls for several days continuously. Most of the area is flood plain inside DND from the very beginning of the project. Only five months from June to November all these flood plains remain under water. These floodplains had contained natural plankton that made congenial breeding ground of native fishes even after the embankment has built. That were the sources of fishes and that was sufficient to meet local demand. At present those flood plains remain under water round the years but do not produce fishes as before. Industrial filthy wastewater combined with household disposal spreading over that wetland and polluted water on floodplains. Polluted water is being standing on the wetlands that destroyed bed of natural plankton and breeding grounds of native fishes. So natural fish production reduced substantially as a result croplands fisheries are gradually spreading over.

3.2.4.6 Agriculture

Day by day agriculture lands are decreasing. Land use for crops production is not viable economically. Agriculture lands are transforming to non- agricultural land in the one hand and polluted water damaged the soil nutrient and fertility in the other hand. These dual effects bring down the average production capacity of lands drastically. The agricultural production from that wetland started to reduce gradually from mid of '90s and within 10-15 years it becomes almost null. Now the project is suffering from its identity crises as the agriculture hub.

3.2.4.7 Retention Pond

From 2000 onward floodplains in DND has become perennial water body with huge water on that. There are some deep parts inside the embankment as retention water body. These are silted gradually by soil erosion from ridges and upper riparian. This process got momentum after '90s from when earth filling from outside was started into the project. It could be worth mentionable that from the mid of '80s some brickfields were being functioned in DND. After 1990 many new brickfields were set up inside the project. Brickfields had used local earth as raw material. They collected that by digging earths from the land inside the project. Land digging was continued at least 15-20 years up to mid of 2000s. Average depth of those dug lands was five feet. Tanks created by lands digging could contain substantial volume of water and worked then as retention ponds throughout the years. From the middle of 2000's this process started to reverse. Brick making by collecting earth from inside the project become costly and scarce day by day. Brickfields' running costs had gone up disproportionately and many brickfields were winded up. Earth filling started into the aforesaid tanks carrying earth from the out side. Many tanks had filled up by this process that squeezed retarding capacity of water inside the embankment.

These filled up earth are not been consolidated enough to make strong bound together. Some of these soils washed away during rainfall and moved to deep flood plains over the low lands. Height of low land has been raised day-by-day and deep wetlands become sallow gradually. This process has been continuing till now and the height of wetlands is rising that resulted into water logging in the project round the year.

3.3 Future Trend

Future land use in the DND project will be more complex. The Jatrabari-Kanchpur portion of the Dhaka-Chittagong highway and Dhaka-Narayanganj link road divided the project into three compartments. The LGED has built number of roads connected with these roads and highways. The whole area of the project is now criss-crossed by many inter connecting roads, streets and pathways. On the sides of the connecting roads innumerable homesteads, shops and many markets were established. There are number of industries, fuel pump stations, sawmills, multistoried markets, shops and business centers along the highways. The Dhaka City Corporation has established a wholesale vegetables market, fish market and a fruits market near Jatrabari. Apart from this there are innumerable kitchen markets, shops and establishments throughout the project.

Most of the area specially Jutrabari east, Kajla, Kutubpur Rayar bagh, Sanir Akhra, Dania, Shyampur, Pagla, Fatulla, Matuil, Godnail, Siddirganj, Simulpara, Anyatnagar, Ward no 31,32,33 of Dhaka City Corporation and Ward no 1,2,3 of Narayanganj Municipality have become build up areas. A major portion of aforementioned areas has densely populated. There are many industries located in those localities along with habitation, institutions, workshops, super markets and shops. All these are standing haphazardly in absence of planning.

There are several real estate companies functioning inside the embankment. They are purchasing medium low land to low land and developed those by earth filling. They have fragmented those purchased lands into smaller plots and offered for sale. They allure people to purchase plots from them for house building. Apart from that people who holds large plots are been divided and sub-divided their lands into small plots in order to sale those to the prospective buyers inside the embankment for settlement. Fragmentation of land holding inside embankment is prominent due to intrusion of outside people for settlement by purchasing land in one hand and due to operation of law of inheritance in the other hand. New settlers are making their homesteads, build roads, establish shops and markets, educational institutions, mosques, graveyards etc to cater needs on crops lands. All these have changed land use pattern inside the project dramatically and made the area densely populated day by day. By the elapse of a period of 38 years the agricultural lands has reduced drastically. Now it is a mater of some years ahead when the entire area of DND will be used other than agricultural crop production. All these have changed land use pattern inside the project dramatically and made the area densely populated day by day.

Table 3.5: Existing Land Use in DND

Land use	Percent
Residential	79.79
Agri or fellow	10.43
Pond	9.78
Total	100.00

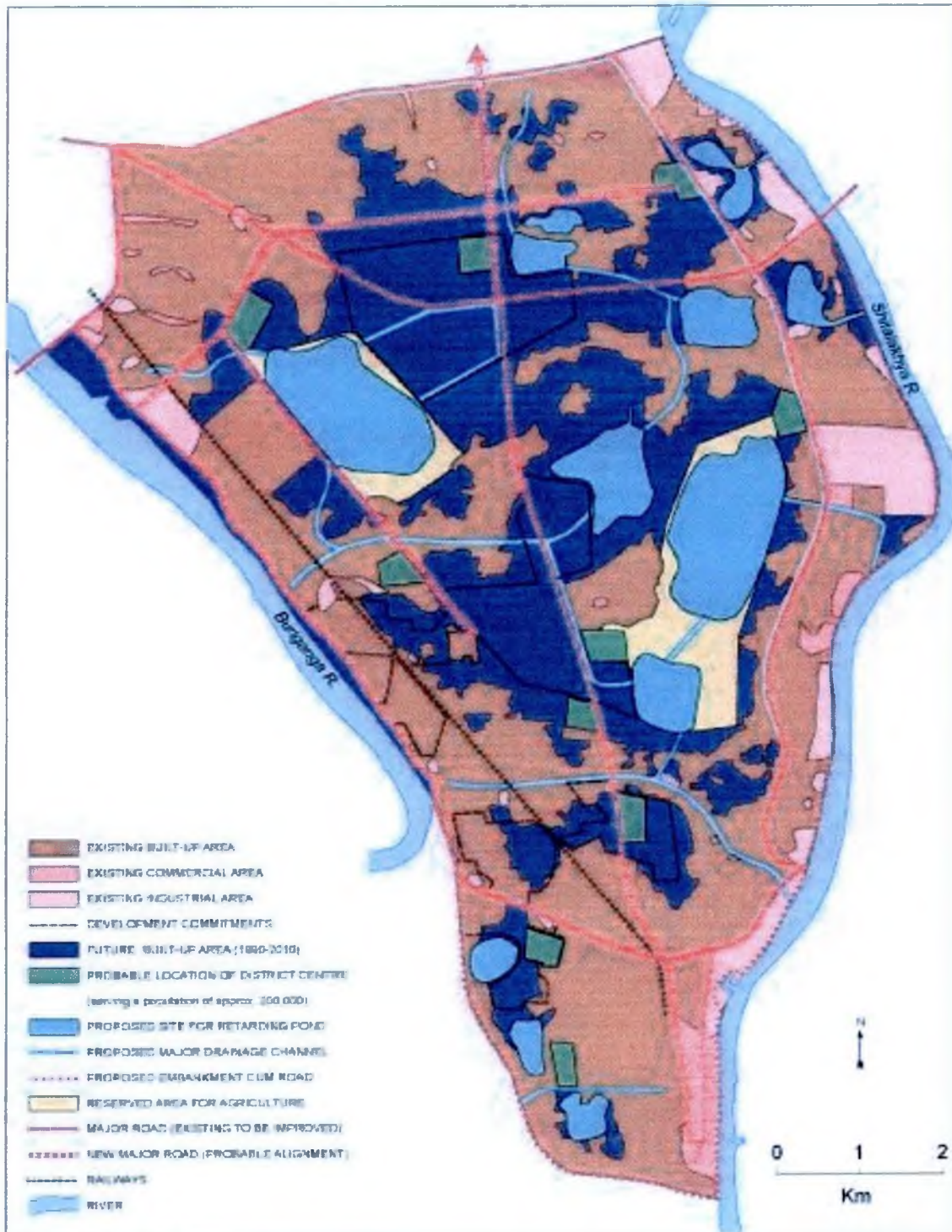
Source: Field survey, 2006.

During present survey it was found that the land owned by the 29 families is 1.9175 acres, of that, 1.53 acres (79.79%) used as homesteads, 0.29 acres (10.43%) comprised as croplands and fellow lands, 0.1875 acres (9.78%) as ponds. It is evident that homesteads are spreading very fast. All though the present study does not depict all categories of land use due to limited scope but a

rational assumption could be drawn from the survey that the area is speedily moving toward urbanization. It was observed at the time of reconnaissance survey that many homesteads have been built on medium low and low lands excepting deep contour or waterbeds.

The DND area is situated near Dhaka city and land inside it are comparatively cheaper than that of Dhaka city, so people are aggressively purchasing lands there mainly for settlement. All these settlements go unhindered on the croplands haphazardly and creates obstacle to smooth passing of storm water to the canals and drainage systems. This caused water logging on floodplain during rainy season. As population has been increasing by leaps and bounds, so use of water is increasing to keep pace with increasing demand of water for industrial and household use. Households as well as industrial wastewater increases manifold. These waste water increases pressure on canals and drainage systems. It contributed to water pollution and land degradation, fertility loss and production decrease of crops, fishes etc. Many species and flora and fauna of that area were extinct for this. That ultimately polluted the total environment of the area. This polluted environment has created health problems and much health related alignment, such as diarrhea, dysentery, typhoid etc. are being developing.

Fig. 3.7: Land Use in DID and its Surrounding Area, 2010



Source: Modified from: JICA, 1992

CHAPTER FOUR

POLICY AND LAWS RELATING TO LAND USE

4.1 National Land Use Policy-2001

On 13th June 2001, Ministry of Land has issued a National Land Use Policy for Bangladesh. The objectives of land use policy are,

1. Minimize the trend of reducing agricultural land to maintain food grain production increase to meet the demand of food for growing population.
2. Control unplanned expansions of homesteads, industries, commercial enterprises and institutions through land zoning.
3. Ensure eco friendly land use to reduce land pollution and to prevent environmental degradation etc.

The land use policy, 2001 has given maximum emphasis on land zoning. It is stated in that policy that the use of land on suitability such as, homesteads/industries/commercials/ institutional and other purpose is an important step to maximize the productivity of land. Describing present situation it is stated that there may have some control on land use in the cities and towns but it is totally absent in the villages all over the country. Taking this advantage the villagers, the industrialists, the entrepreneurs and other land users have been expanded their homesteads, industries, commercial establishments etc on valuable and productive agricultural lands. Many industries have been set up near homesteads lying vacant industrial plots in the industrial estates established by various government departments. To control such sprawl of homesteads, industries as well as commercial centers and other non firm use of land a“ Village Improvement Act” is suggested. Change of natural phenomenon of land and ecosystem such as hills, forests, and depression is prohibited through human intervention.

Introduction of land zoning system has given stress in the policy. Enactment of land zoning law at the national level is proposed. It is suggested that the local government institutions such as Union parisad, Upazila parisad and Zila parisad in the villages, Municipality and City Corporation in the urban areas will act under that zoning law in their respective fields. Transformation of any land beyond the law will be strictly prohibited; if any change is inevitable in land use there should be a rigorous process to do it. The aim of such process is to discourage the change in the character of lands.

Public representatives and employees of local government institutions will be trained up to upgrade their efficiencies about land zoning and in preparation of zoning maps.

4.2 Land Zoning

- A. Earmarking of different location/area for different purposes such as habitation, industrialization, fisheries, forestry, grassing, orchard, commercial purposes etc.
- B. At present the Town Improvement Act, 1953 is at force, but homesteads; business centers and industries were not built on proper place. Besides, there are many offices, hotels, shops, supermarkets and hospitals/clinics located in the residential areas.
- C. There are somewhat restrictions and planning in the land uses in the cities and towns but it is totally absent in the villages. A Village Improvement Act is need to control misuse or wrong use of valuable agricultural land. Provision of easy term loan to construct high-rise building in the village might be considered to protect valuable and productive cropland from shrinking.
- D. The City Corporations and Municipalities will demarcate and map its area for residential, commercial, institutional, industrial and other uses to foster sustainable economic development keeping environment healthy and habitable.
- E. Each Zila/Upazila/Union parisad will prepare zoning maps for its own use to preserve valuable productive agricultural land from encroachments or use of other purposes.
- F. National zoning law will be enacted under which local government institutions will prepare their own zoning maps. There should be a limited scope, if needed, for change in the zoning map following rigorous procedure.
- G. Trainings of central as well as local level officials and public representatives would be ensured on relevant laws, regulations and procedures to ascertain the selection of lands having comparative advantages of different uses.

4.3 Sectors of Land Use in Bangladesh

1. Agriculture
2. Residence
3. Forest
4. Rivers, canals, fisheries and ponds.
5. Roads and Highways
6. Railways
7. Commerce and Industry
8. Tea, robber garden and horticulture
9. Costal belt forest

10. Alluvial land

11. Others

4.4 Agricultural Production

Agricultural land is shrinking day by day throughout the country. More people are moving toward crops land for various reasons other than agriculture purpose due to population pressure. Urbanization, industrialization, homestead, institution, road and other infrastructure contributed to reduction of agricultural land. Within the '80s build up area and homesteads had occupied the area up to 15% now it has risen up 30%. On the other hand fertility of land is diminishing mainly due to indiscriminate use of it and over use of chemical fertilizer. Food grain production in future will certainly decrease and import of that will increase if this trend continues.

Although land is personal property but its use should be confirm with national and social needs. Present trend of reducing agriculture land should be restricted immediately for food grain production to meet the demand of growing population.

4.5 Habitation

Last decades urbanization had taken place rapidly and migration of population from villages to towns and cities created tremendous pressure on urban areas. On the other hand to meet the growing demands of habitation for increase population more lands are used as homesteads. Day by day agricultural land has been reduced to meet the growing demands of homesteads for growing population. To control the situation house building regulation in respect to land use should be imposed strictly in the cities and towns. The land use for habitation in village should be kept as minimum as possible. Local administration should be active to retain productive agriculture lands as they are.

4.6 Industrialization

Considerable factors for private industrialization are easy communication for bringing in raw materials to the factories and marketing facilities of finished goods, uninterrupted gas and electricity supply, etc. These factors are available by the side of roads & highways. It is evident that the sides of the roads & highways establish the industries and commercial enterprises. In the coming future these trends will continue. On the other hand industrial plots are lying vacant in the

in the government' industrial estates. Proper steps are needed to stop this practice. Where industries could be accommodated in the government industrial estates there should be strict restriction on setting up of industries within the 20 km of industrial estates.

4.7 Other Uses of Lands

Economic and social development needs homesteads, educational institutions, playgrounds, hospitals, public centers, offices, establishments, dairies and poultries etc. Day by day pressure has been mounted on crops lands for establishing such facilities. The sprawl expansion of brick cleans and use of earth as the raw materials for making bricks is being altering the lands permanently to nonuse. This also degrades the environment. To avoid such unhealthy practice use of hollow blocks, those are made of stone dust, sand and cement in construction works would be encouraged.

4.8 Stop Misuse of Acquired Land

Many lands have been acquired in the past to implement intuitional and development projects. At least one-fourth of those lands is being kept as fellow lands in many projects. These unused fellow lands are being lying without any productive use for years together. These lands could be resume to the government. To facilitate multipurpose use of acquired lands relevant law could be amended. The fellow lands of different projects could be used for crop production, tree plantation, fisheries and livestock rearing etc. to poverty reduction. Acquisition of irrigable agriculture land where two or more crops could be produce in a year would be restricted for agriculture production only.

4.9 Land Data Bank

Land data bank would be maintained to the use of lands. Preferences would be given on use of governments' *khas* lands in implementing development projects. If *khas* lands are not available for project implementation due care would be given at the time of land acquisition that proposed land is not irrigable or fertile for crop production, and acquired land is minimal.

4.10 Main Features of Future Land Use

The agriculture lands would be used only for agricultural production. Others uses of productive croplands and change of its classification would not be allowed without due approval from the

competent authority. Divisions and sub divisions of lands would be limited up to a rational size to stop excessive fragmentation and to create smaller plots.

All city corporations, municipalities and upazila parisads will earmark the lands for specific use under its territories into different zones to minimize misuse. Land zoning maps will be prepared and published by the concerned authorities. District administration revenue offices will help local authorities to prepare the land use zoning maps. Zoning maps would be approved at appropriate level. Approved maps would not be changed generally but if needed to fulfill grater interest that could be done complying rigorous process after duly scrutinized. There will be a zoning law for the whole country and every body would be bound to comply the zonal maps as per law.

Encourage would be ensured for the people living in the villages to make planned vertical expanded model houses in the villages. Soft term loan facilities need to be ensured to maximize the utilization of lands in homestead buildings. Multistoried buildings would be built instead of one storied in the cities, towns as well as in the villages.

Floods protection embankments would be used as roads and highways if possible. Due attentions would be given that the flood protection embankments could not cause water logging. National highways, regional and inter district roads, district-upazila-unionparishad-growth center-village connecting roads would be built with proper planning keeping necessary water pass. Where lands acquisitions are unavoidable, no lands would be acquired unless those are necessary for grater national interest. Care should be given that acquisitions do not cause damage to homesteads or productive agriculture land.

Industry would be built in the earmark zone for it. Sub zone would be created in the industrial zone for similar type of industries. Industrial wastage will be disposed of scientifically that it does not cause damage to the lands or does not degrade to the environment. In general all industrial enterprise would be set up in the industrial estates. Industries within 10 km from the estates will be discouraged.

4.11 Awareness Rising

Campaign, rallies, dramas, seminars, workshops, talk show etc would be arranged to create public awareness about proper land use. Electronic and print media would be used in this regard. Editorials sub-editorials and articles would be published in the dailies and periodicals that concern people can realize the importance of cost effective rational use of their valuable

agriculture lands for crop production over other uses. Once awareness will create among them, then general people will be interested to safeguard their lands from misuse.

4.12 National Committees on Land Use

To implement, monitor and proper guidance in this regard The National Land Use Committee has been formed headed by the Honorable Prime Minister. To help the national committee, a land use implementation committee has been formed headed by Honorable Minister for land as the convener of it. This committee will provide secretarial support to the National Committee. Secretary, Ministry of land will act as the member secretary for both the committees. Both the committees can co-opt any person in the committee and can invite in the committee meetings.

4.13 Relevant Laws on Land

From time immemorial Bangladesh has experienced many disasters. The foreigners depict sometimes this country as a “delta of disaster”. In 1988 and 1998 this biggest delta faced unprecedented floods that engulfed two-third of the country. People lost their lives, crops, cattle heads, homesteads and other assets in the affected areas. To cope with that untold situation many farmers were forced to sell their croplands to the non-farmers. To prevent the transfer of agriculture lands by sailing to the non-farmers government had issued a circular at that time citing concerned section of The East Bengal State Acquisition and Tenancy act 1950.

4.13.1 The State Acquisition and Tenancy Act 1950(Act xxviii of 1951).

90. Limitation of Transfer of Holding-(1) Notwithstanding any other thing contained in any other law for the time being in force, no person shall after the commencement of this Part be entitle to purchase or otherwise acquire, except in accordance with the provisions of this Part, any quantity of land which added to the total quantity of land(375 standard bigas) already held by him for himself and his family exceeds.

(2) Not withstanding anything contained in any other law for the time being in force, the holding of a raiyat or a share or portion thereof shall not be transferred whether by sale in execution of a decree or of a certificate signed under the Bengal public Demand Recovery Act, 1913 (Bengal Act iii of 1913) except to a bona fide cultivator.....

(3) Notwithstanding anything continued in sub section (1) or (2), a person who is not a bona fide cultivator, may, with the previous written permission of the prescribed Revenue Authority,

purchase or otherwise acquire, such quantity of land as may be specified in such permission, for occupation and use of commercial, or industrial purpose or for charitable or religious purpose.

(4) Notwithstanding anything continued in sub section (1) or (2), a person who is not a bona fide cultivator, may, with the previous written permission of the prescribed Revenue Authority, purchase or otherwise acquire, such quantity of land as may be specified in such permission, for the purpose of constructing a dwelling house for himself and his family-----.

Provided that no such person shall be allowed to hold any area of land in excess of the limit imposed in sub section (1).

Provided further that, in case of land acquired by the such person for the purpose of constructing a dwelling for himself of his family, if no dwelling house is constructed on the land within five year S from the date of such acquisition, the right of such person in such land shall be extinguished and the land shall vest in the Government.

(5) Any transfer of holding or tenancy or of a share or portion there of made in contravention of the provision of this section shall be void and land comprised in the holding or tenancy or share or proportion thereof so transferred shall vest absolutely in the Government free from all encumbrances.

4.13.2 The Bangladesh Land Holding (limitation) Order, 1972(P.O. No. 98 of 1972).

3. Notwithstanding any other thing contrary in any other law for the time being in force,- (a) no family or body shall be entitled to retain any land held by it in excess of one hundred standard bighas in the aggregate and all lands held by it in excess of that quantity shall be surrendered to the Government.

(b) No family or body shall be entitled to acquire any land by purchase, inheritance, gift, heba or otherwise which, added to the land already held by it exceeds one hundred standard bighas in the aggregate-----.

.....
2. All lands acquired by any family or body in excess of one hundred standard bighas after the date of commencement of this Order, or where a family or body has submitted the statement under Article 7, after the date of submission of such statement, otherwise than by inheritance, shall stand forfeited to the Government free from all encumbrances.

4.13.3 The Land Reform Ordinance, 1984(Ordinance No. X of 1984).

4. Limitation on Acquisition of Agricultural Land- (1) No malik who or whose family owns more than sixty standard bighas agricultural land shall not acquire any new agricultural land by transfer, inheritance, gift or any other means.

(2) A malik who or whose family owns less than sixty standard bigahs of agricultural land may acquire new agricultural land by any means, but such new land, altogether with the agricultural land owned by him, shall not exceed sixty standard bigahs.

(3) If any malik acquires any new agricultural land in contravention of the provisions of this section, the area of land which is in excess of sixty standard bigahs shall vest in the Government and no compensation shall be payable to him for the land so vested, except in the case where the excess land is acquired by inheritance, gift or will.

4.13.4 The Bangladesh (East Bengal) Embankment and Drainage Act of 1953.

Powers of Engineers (in charge of irrigation Division)

7(3) That any embankment, or any obstruction of any kind, which endanger the stability of a public embankment or safety of any town or village, or which is likely to cause loss of property by interfering with any water course or with the general drainage or the flood drainage of any tract of land, should be removed or altered.

7(5) That any sluice or watercourse should be made, or that any watercourse should be altered for the improvement of the public health, or for the protection of any village or cultivable land;

7(6) That any road which interferes with the drainage of any tract of land should be the altered, or that any watercourses under or through such road should be constructed.

14.(1) Whenever as order shall have been passed in cases falling under clause (6) of section 7 directing that any road owned by the local authority, which interferes the drainage of any tract of land, be altered or that any watercourse be constructed under or through such road. The engineer may require such authority to make such alternation or construct such watercourses and in the events of failing to comply with such requisition in such manner and within such time as the engineer may prescribe. The engineer may cause the road to be altered or the watercourses to be constructed by the officers of the government.

14(2) Expense of such alternation or construction shall be borne by the local authority concerned so far as the same shall have been incurredand the remainder of the expense, if any shall be charged upon and recovered from the owners of the lands benefited.....

56(a) Who, without the previous permission of the engineer (Superintending)..... or obstructs or diverts or causes or willfully permits to be constructed or diverted, any water course, if such act interfere with, counteract or impede any public embankment or any public watercourse:

(b) or obstructs or diverts, or causes or willfully permits to be constructed or diverted any watercourse; and

(e) Who abets any such act as is mentioned in classes (a) and (b) shall be liable, on conviction, to fine, which may extend to five hundred takas or in default of payment to imprisonment of either description for a period not exceeding six months.

57.Whoever, without due authority or opens or shut or obstructs any or any public watercourse, shall be liable to imprisonment of either description for a term which may extend to one month or to fine which may extend to two hundreds takas.

4.14 Miscellaneous Laws and Regulations on Land Use

Some other relevant Acts and Rules, currently enforced are The Building Construction Act of 1952(E.B. Act II of 1953), The Building Construction Rules 1996, The Town Improvement Act 1953(E.B. Act XIII of 1953), The Land Development Rules of Private Housing Estate, 2004, The National Housing Policy(Amended in 1999),1993, The Bangladesh National Building Code, 1993, The Environment conservation Act of 1995, The Wetland Protection Act 2000, (Act XXXVI of 2000) The Building Construction Act of 2006, and Private Housing Land Development Rules of 2004 and The Dhaka City Building Construction Rules, 2007 etc.

Note: Concerned portion of relevant laws are excerpted in this chapter.

CHAPTER FIVE

FLOOD AND WATER LOGGING

5.1 Introduction

Prior to the completion of the embankment project the whole area used to submerge by floodwater in the monsoon season by the 5-15 feet deep. After the rainy season the flood- water had been recessed by gravity drainage. There were sporadic water bodies, where water remained stagnant round the year. Those were natural fisheries. The question of water logging within the area was not relevant then. The embankment was completed in 1968 and then, the Area-I of the DND project got full proof external flood protection. On the other hand the pumping house pumped out internal rain fed water in rainy season. The pumping station was efficient and khals, canals were wide and deep enough to carry internal rainwater to the pump house. At that time there was no water logging inside the project. Then the project was a model one in both respects as flood control and agriculture production.

Photo 5.1: Water Logging in South Matuail.



On the way of 38 years the embankment project has been faced threats of breaching and over topping by external floods several times. Those threats had been created when external floods

were abnormal and water level went as high as or above the crest level of embankment. Internal water logging has become endemic for the last 8-10 years and getting worse almost every year in the monsoon season. So the project is facing threats from external floods and internal water logging at present and this situation will aggravate in future if appropriate measures are not taken now.

5.2 External Flood

The DND project Area-I is supposed to free from external floods and virtually it is so in the years of normal flood in the rivers surrounding it. But abnormal floods in the past had posed severe threats to the embankment. The embankment faced number of structural problems at the time of flood in 1974. Some of those were longitudinal cracks in the Dhaka- Demra section on the crest, toe erosion, piping failure, seepage, small-scale landslides etc. along several sections of the embankment in the Dhaka –Narayanganj section. Flood in 1988 posed a great threat to the embankment. During that flood the water level was exceeded partly the top of the embankment. In 1988 the area was marginally safe from the external flood by the flood fighting measures such as reinforcing the embankment by palisade, earth filling and raising height of the embankment by sand bags. The most severe external threat to the embankment was experienced during the flood in 1998. In that year in between July-September exceptional high water levels threaten to over top several sections. One segment of embankment from Chashara to I.T School was over-topped by 65cm on its crest. The highest flood level recorded on 10 and 11 September 1998 at the Sitalakhya riverside was 6.49m PWD. On the other hand designed upper pump limit is 5.79m PWD. During the flood sliding, leakage, seepage and piping were developed in the different parts of the embankment. One old culvert at Ranimahal cinema hall had washed away during peak flood time and intrusions of external floodwater inside the area took place. Another aspect of the flood in 1998 was its duration. The high water level above pump limit continued for 44 days at the riverside. A study by Saleh and et al. (1998) revealed that in terms of both duration and magnitude, flood in 1998 was unprecedented compared to the pervious highest floods. However the cordoned area was marginally saved by flood fighting measures such as reinforcing and raising the heights of embankment. The effect of such prolong high floodwater exposed the risk and vulnerability of DND embankment from external floods. After the flood in 1998, floodwalls about 2ft high were constructed on the road-cum-embankment. But there are logical doubts about the effectiveness of floodwalls among the stakeholders and the general public living inside the area.

5.3 Internal Water Logging

The internal normal flood area is estimated at 410 ha that is 7% of the DND area. The average flood depth and duration are 0.13m and 2 days, respectively (JICA, 1992). The aforementioned scenario was revealed by the JICA in its study FAP 8A in 1992, which cannot depict the present position. The present condition of DND in respect to water logging in the monsoon season is worse. Only two days non-stop rainfall can create water logging inside the project. Acute drainage congestion and consequent water logging problem is practically endemic and becomes worse during monsoon. The problem has become acute in recent years as existing pump drainage system often fails to drain out the rain fall run off resulting prolong water logging, causing immense sufferings to the inhabitants of the area. The water logging problem in DND has attracted the attention of the medias, the policy makers and the planners alike. A quick improvement of the dire situation has now become a loud demand from all corners.

Photo 5.2: Water Logging in Built-up Area in DND.



The DND Area-I was cordoned during the late 60s of the last century. This water bound and largely un-inhabited area was developed to create a high value agricultural zone with a well laid out system of canals to serve the dual purpose of irrigation and drainage channels. A pump house was set up to draw water from Sitalakhya River in the dry season and remove excess water from within during the rainy season. By the elapse of 38 years unplanned conversion of agricultural land to residential, industrial and other developmental use started, and the original purpose of the project faced total defeat. The large influx of people and quick pace of construction damaged drainage system, thereby protracted water logging.

Till 1985 the project did not experienced any major internal water logging. In 1986 the project faced a major setback of internal flood in the rainy season due to heavy rainfall in a limited period of time but that situation was remained for not more than a week. After that the project suffered moderate water logging in some years.

In 1998 this project experienced a major internal flood. The flooded area was estimated at 1863 ha in lieu of normal 410 ha. Of that the build up area was 1312 ha, which is whole of the build up area. Maximum flood depth and duration was 1.63 m and 40.0 days respectively in 1998 flood. Flood depth around settlement was estimated at 0.8 m to 2.6 m (FAP 8A, JICA).

The DND project area had experienced prolonged water logging due to excessive rainfall during the September in 2004. The situation had turned worse as almost the entire area become inundated and remained impassable for one and half months. The accumulated congested water inside the project stood at 37 million cum only by 7 days of rain and the severity of drainage congestion was the highest since the implementation of the project. Water logging inside the project area surrounded with the road- cum-embankment could not be mitigated by existing pump and drainage systems. The capacity of existing 4 pumps drainage discharge now stands at 0.877 million cum and it took 42 days to discharge inside congested water of the area by continuously using 4 nos. pumps.

After that every occasion of usual rainfall brought untold miseries to the people trapped in the triangle.

Photo 5.3: Water logging in front of Mannan High School, Matuail.



5.3.1 Printing Media Reports on Water Logging

The Daily Star, 26 September 2004

After the heavy downpour that began on September 11 and continued for more than a week, the entire DND embankment area was swamped with knee to waist-deep water causing distress to over 10 lakh people.



সেইসময়ে দু'টি—এক মেয়ে হাতীক লম্বাফল হাটকা করতু পিচ হাটকা হাটকা৷ গিহেলগি হাটকা হাটকা গিহেলগি

BD News, Narayanganj, Monday 04 Jul 2005

Heavy rainfall during the last few days has flooded the areas inside the Dhaka-Narayanganj-Demra (DND) dam in the district causing immense sufferings to the people of the area.

Tens of thousands of people were marooned due to water clogging. Houses, schools, colleges, mosques and madrashes of low-lying areas went under water. Water entered into some mills and factories although temporary walls are being erected in a bid to protect them.

The pump house sources said water level in the DND canal rose by nearly four feet. Usually, the height of water remains nearly six feet in the canal but the continuous rain increased the water level to around ten feet, sources added.

The Daily Star, Wed, August 16, 2006

Water logging: Unplanned urbanization threatens permanent stagnation in DND area
Morshed Ali Khan



কোকাশ বাংলা ৯ জলাভঙতার কারণে তিনশতটি বীথ সংলগ্ন দেলাপাড়া এলাকার জনসাধারণের দুর্ভোগ এখন চরমে



According to officials, one of the biggest blows to the area came with the construction of Jatrabari-Kanchpur Road and Narayanganj Diversion Road, which instantly created three sub-divisions within the DND area, cutting off drainage in one third of the area.

The Water Development Board (WDB) has now proposed to immediately restore some drainage system by recovering the canals and by setting up a pump with a capacity of jetting out 50 cubic meters of water a second.

"Each of the canals has been filled with rubbish, and roads have been paved on natural canals vital for draining water up to the pump's retention point," said an engineer. The engineer however said there is still times to recover the canals as there are not that many concrete structures on those lands yet.

In 2004, heavy rainfall caused unprecedented water logging in the DND area that lasted for over 24 days with local people, WASA officials and the army personnel working frantically day and night to pump out the water. The rise in the level of water in the river nearby also threatened to breach the dyke, as thousands of people worked day and night to protect the dyke and avert a catastrophe.

5.4.1 Rajuk's Study Report

Before the embankment the area was used for mostly single-phase agricultural crop production and a limited portion was under settlements in the shape of small-island in a vast watery area in the rainy season. As a result rainfall run off used to be distributed over the large area and the rise of water level would be of no major cause of serious inconvenience. With a growth of settlements at a rapid rate, the retention area of water continued to shrink at a faster rate and soon water level is rising that has been exceeding the average land level. On the other hand with the increasing scale of urbanization the laid out drainage system encroached upon or completely destroyed blocking excess water reaching the pump house. As a result the accumulated run off continued causing water logging. The causes of water logging in the area may be summarized as follows:

- a. Unplanned conversion of low lying agricultural land to settlements, industrial, institutional and other purpose that made the traditional drainage systems unworkable.
- b. Unplanned development by different public departments and private initiatives caused serious obstacle on run off in absence of development control by RAJUK or BWDB.
- c. Due to absence of any authority to provide municipal services, people are forced to use existing canals and water bodies as dumping ground of solid waste resulting in reduction of drainage and original retention capacity of the particular segment of khal.
- d. Construction of roads and high ways without any consideration of due drainage pass that prevented natural flow of water.
- e. Discharge of household and industrial waste substantially increasing additional drainage need.
- f. The local practice of pisciculture is responsible for closure of many canals by constructing earthen dam across canals.

5.4.2 Technical Committee's Report

In September 2004 the DND project area experienced severe drainage congestion and water logging that was highest since the implementation of the project. In order to find out the causes of water logging and to suggest the mitigation options, the Ministry of Water Resources had constituted a Technical Committee headed by the Chief Engineer, Central Zone, BWDB. The Technical Committee identified that the drainage khals in the area has been blocked either by encroachment or crossroads at several points of their channels that cause substantial reduction in the drainage capacity. Present drainage facilities are not enough to drain out standing water in the

face of monsoon rainfall. The Committee's recommendations were, (a) removing of all illegal encroachments of drainage channels, (b) Construction of necessary drainage system, (c) Setting up of new pump houses in the selected locations with additional pumping out capacity, (d) preservation of retention area as recommended in the JICA (1992) study and suspension of granting of development permission till the preparation of Detailed Area Plan for the area by RAJUK.

5.4.3 Present Study Findings

The present study has identified that major causes of water logging are (a) heavy downpour in a short period of time that is climate change and (b) pumping out of less rainwater against rainfall run off in the monsoon, (c) silting up of khals, canals and drainages, (d) illegal squeezing of khals and canals by encroaching those, (e) unplanned roads that are criss-crossed the whole area without sufficient outlet for water pass, (f) sprawl of homesteads haphazardly those create hindrances on water movement, (g) setting up of industries, markets, fuel pump stations etc. along the highways and roads-cum-embankments that created blockage on water passes, (e) field fisheries on crop lands by erecting ails, walls, nets and (f) illegal fisheries in the khals and canals by blocking those.

5.4.4 People Perception

The comments on the causes of floods depend on respondents conscious and perceptions. Among the respondents every one cited two major causes of floods these are (1) heavy downpour in a short period of time and (2) disproportionate pumping out of rainwater against downpour. Other causes of floods as they mentioned are squeezing and silting up of khals, canals and drainages, unplanned roads without sufficient outlet, sprawl of homesteads, industries, markets, fuel pump stations, field fisheries, hindrances such as erecting ails, walls, nets on water paths, and illegal fisheries in the khals and canals etc.

Among the respondents somebody hints that among others one of the major causes of water logging in 2004 was unholy alliance of influential political personalities and their local followers. Besides, there were numbers of fisheries on cropland inside the project. These illegal fisheries retained water round the year. Torrential rain in between 11-17 September 2004 had added huge water on those fisheries. That submerged almost whole area including those fisheries. All fishes

tried to get out from the fisheries but owners of those tried their best to block fish and water pass that linger water logging in the project.

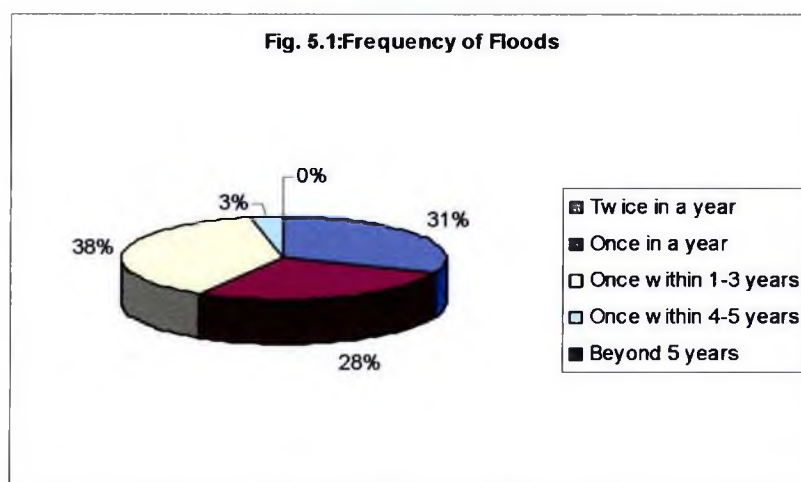
5.4.5 Frequency of Floods

The land elevation inside the project is different for various land types and locations. So floods times, events and depths are not similar for all lands. People lived on different parts in the DND area have their different types of experiences on floods. Occurrences of floods are less frequent in higher elevated areas but it is more frequent in the low-lying areas. It is in between for the medium high lands. The responses about the flood events depend on experiences of happening in the localities where the respondents lived in. A table of responses on the flood events is given below:

Table 5.1: Frequency of Floods

Intervals	Twice in a year	Once in a year	Once within 1-3 years	Once within 4-5 years	Beyond 5 years
No. Of respondents	09	08	11	1	00
Percentage	31%	27.5%	38%	3.5%	00%

Source: Field Survey, 2006.



Source: Field Survey, 2006.

Total twenty-nine persons from different families and localities were consulted for their opinions about the frequency of flood. Have them nine families lived in the low-lying areas and they confronted floods every year at least twice in a year. Eight families lived in the medium low land and they faced flood once in a year. Aforementioned two categories constitutes 58.5% inhabitants

whose is largest group living on flood plains. People lived in the medium high land (comparatively densely populated area) experienced floods once in 01-03 year. Number of respondents in this category is 11. One family who lived in the high land had answered that flood could happen in 4-5 years and no body agreed that it could took place after 5 year interval.

5.4.6 Water Level

During the survey 29 families' data were collected, of those 20 families faced inundation to their homesteads at the time of flood in 2004. Their homesteads were gone under water from 1 foot to 7 feet high. The rest 9 families have been living on the high lands before the embankment was built. It is revealed that 6 families have pond fisheries, those were gone under water up to 12 feet high. Only 3 families have agriculture lands, those lands were inundated beneath 7 feet deep water during the flood in 2004. Besides, some families who are being living in the low-lying areas have been facing floods all most every year in the rainy season from some years back. Flood depth on the low-lying area is 5 to 15 feet high depends on rainfall and pumping out situation.

5.4.7 Time of Occurrence

In Bangladesh Asher & Shraban, two months of Bangla calendar is considered as rainy season but in fact the rainy season starts from Asher and continued to the month of Bhadra. Those bangla months are parallel with 14 June to 15 September of Georgian calendar. During the present study some respondents replied that they had faced floods in the months of Asher, Shraban and Bhadra. Some of them cited July, August and September as floods occurrence time. In the deeper parts of the embankment, pools of water remain throughout the year. Sometimes, torrential rain falls starts in the rainy seasons. Rains add additional water with logged water causing water level rise that creates flood in wetlands and lowlands. In these situations homesteads in low-lying areas had to face floods several times throughout the season. At the beginning of the rainy seasons these types of floods create moderate suffering to the inhabitants. As the rainy seasons proceeds so the rainfall and the water logging. But rainwater cannot run smoothly through the khals and canals to the pumping out station due to impediments on its ways. On the other hand day-by-day, pump house has lost its efficiency due to old aging and cannot pump out excess water proportionately with the rainfall. The ultimate result is huge quantity of water accumulated everywhere in DND excepting very high or high lands. So the settlements on those lands experienced severe floods. Intensity of floods is different for different land categories. Duration of floods also varies on the

elevation of lands. Some families living on the low lands have been facing floods more than once in a season. Floods on such lands start early in the rainy seasons and continued till the last of the seasons.

5.4.8 Duration of Floods

In the present study 29 families were consulted. They had mixed experiences about the duration of floods. As they stated minimum duration is 7 days and maximum is 60 days. People living on the high lands face floods less in time, on the medium elevated lands experience moderate duration and on the low lands suffered long time then others.

CHAPTER SIX



AGRICULTURE

6.1 Cropping Patterns

6.1.1 Before Embankment: Cropping pattern includes single, multiple, mixed and strip (Shaner et.al.1982). Before the embankment almost whole area was single cropped except some highland such as terrace and ridges. On terrace and on some higher ridges dry land rabi crops such as mustered, pulses, khesari were grown using residual moisture stored in the soils after rainy season. In the deep basins local varieties long-stemmed broadcast deep water aman paddy were cultivated. These varieties can grow maintaining the pace of raising floodwater in the normal flood situation. On the Medium Lowland broadcast aman mixed with aus or either jute or single aman were produced. However the overall cropping intensity was low as 110-120 percent.

6.1.2 After Embankment: After the completion of the irrigation and flood protection project in 1967 the cropping pattern had changed substantially. The cultivators of the area quickly adjusted their cropping patterns with irrigation facilities and high yielding varieties (HYV). They had been started to grow t.aman followed by IRRI boro paddy to a larger extend. On the other hand aus were grown to a lesser extend on the medium high lands. That had emerged as the main cropping pattern in Area-I from 1970s to mid of the1980s. Lands under the pattern were generally provided with irrigation and drainage facilities. The lands of higher topography, which were beyond the irrigation facilities, broadcast aman or jute followed by t.aman was cultivated then.

Photo 6.1: Crop Production in DND Area.



It was supposed in the feasibility report in 1960 that after the completion of the polder project there would be triple crop in Area-I and the cropping intensity would be 270%. But that assumption was not based on realistic land elevation. In 1972 cropping intensity of the area was 171% and in 1982 the cropping intensity has risen to 248% and that was the highest against the estimated cropping intensity of 270% in the project feasibility report prepared by Engineering Incorporation, U.S.A. in 1961.

The cropping pattern has further changed with the introduction of advance farm technology. In 1982-83 some part of the Area-I was remain under one or two High Yielding crops round the year. Major part of the project area went under double crops cultivation system and some lands produces triple (even four) crops. HYV t. aman and HYV boro became major crops and average yields were gone up. Average production of HYV t.aman was 43.25 maunds, those of HYV boro was 41.25 and of HYV t.aus 37.50 maunds per acre respectively, whereas average yield of HYV paddy was 25.61 maunds per acre respectively in 1972. But till then the project area was below the presumed (270%) intensity. and was approaching full achievement. The projects had shown encouraging potential to reach the projected benefit in full in terms of irrigated acreage and production per acre. There was scope for further incremental benefit of the farmers if the still remaining constrains were minimized. There was scope for land leveling and readjustment of irrigation canals for better irrigation efficiency. Adequate O&M work would increase irrigation and drainage efficiency of the canal systems and more intensified efforts of the extension personnel could attribute higher production.

6.2 Major Crops

6.2.1 From Pre-project to 1982

Before the embankment varieties of crops were produced in two seasons. During dry season rabi crops such as wheat, mustered, pulses, khesari, potato, tomato, vegetables etc. were mainly grown. Local broadcast aus (b. aus) had been produced on the ridges and on the medium high flood plains in the in the kharif season. Local varieties long-stemmed broadcast deep-water floating amans were being cultivated in the deep basin. Broadcast aman (b. aman) mixed with aus or either jute was produced in the medium lowland. Average cropping intensity was 110-120 percent approximately and average yield of crops were low as b. aman 15 md/ac, b aus 12md/ac and jute 12 md/ac.

After the embankment irrigation water became available in 1967 and crops were grown round the year. The overall cropping intensity was estimated at 160 percent in 1970 and was increasing

thereafter. The peasants of the DND project started to grow transplant boro paddy to a larger extent and, to a lesser extent, b. aus. In another development, HYV became available from 1966-67, and were gradually adopted by the farmers. In 1982, about 90% of the all boro and most of aus paddy grown in the area was HYVs. On average, the HYV paddy was produced 45-50 md/ac with modest application of fertilizer. In the Rabi season HYV/ local boro, mustard, pulses, wheat, winter vegetables and potato were grown. HYV/local t. aus, HYV/local b. aus, jute and some summer vegetables were grown in the kharif-I and HYV/local t. aman in the kharif-II were major crops. Among all cereal crops paddy occupies the highest position. Farmers were very much inclined to paddy production because the agriculture of the project area was run on subsistence ground. They preferred paddy (IRRI) due to its high yielding capacity to other crops. Jute production was not encouraging to the farmers due to its less productivity and price fall. Due to higher productivity and good price of paddy more monetary benefit was ensured by its production. So paddy cultivation was more encouraging than the jute. Production figures of various crops including paddy from pre-project to 1982 are summarized below:

Table 6.1: Crop Production

Crops/ Year	Pre-project yield, md/ac	Projected yield md/ac	Yield in 1972 md/ac	Yield in 1982 md/ac
B. aush	12.00	20.00	13.33	20.00
T. aush	12.00	20.00	17.99	27.00
Boro(local)	12.00	25.00	20.56	22.00
B. aman	14.70	-	15.58	-
IRRI(aush)	-	-	23.81	37.50
IRRI(aman)	-	-	27.52	43.25
IRRI(boro)	-	-	25.52	41.25
T. aman	-	25.00	19.17	27.50
Jute	12.00	20.00	13.18	17.00
Potato	75.00	-	120.00	95.00
Mustard	-	-	4.56	11.00
Lentil	8.00	-	3.60	13.00
Wheat	-	16.00	-	20.00

Source: *Ago-economic evaluation, BWDB, 1984.*

6.2.2 Present Situation

At present paddy is the main crop in the project area. Local varieties of paddy were almost replaced by HYV. The production of vegetables, wheat and other winter crops are not significant except mustard. There are still some medium high lands inside the project where mustarded are grown without irrigation. Owing to high price and demand of rice, the peasants of the project are concerned with meeting of their families staple food requirement. Average production of paddy and mastered from 1973- 74 to 2004-05 is summarized below:

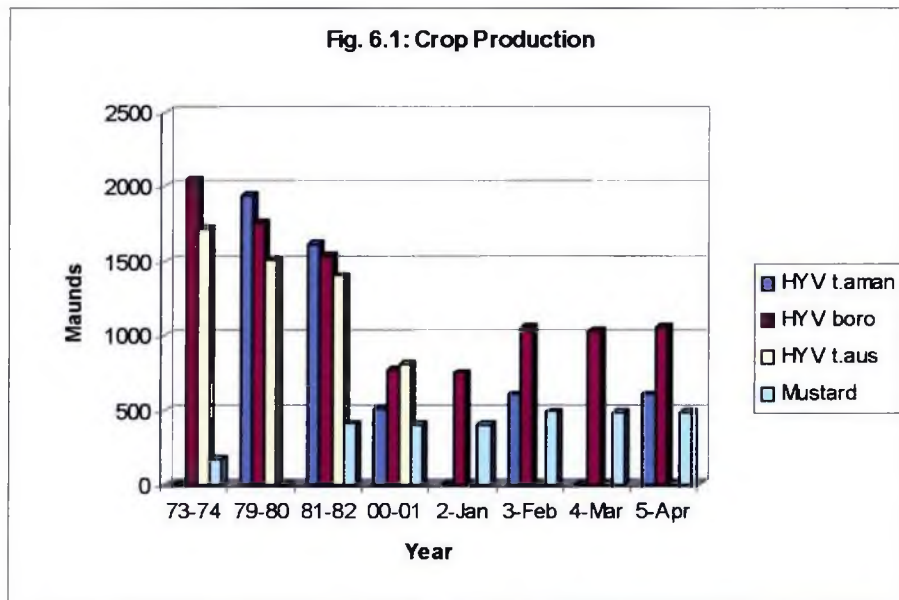
Table 6.2: Crop Production; past and present.

Name of the crop	73-74	79-80	81-82	00-01	01-02	02-03	03-04	04-05
HYV t.aman (mds)	*	1941	1614.5	506	Flood	603	Flood	607
HYV boro (mds)	2053	1754.5	1540	765	749	1053	1032	1053
HYV t. aus (mds)	1717	1502.5	1400	809	0	0	0	0
Mustard (mds)	170	*	410	405	405	486	478	478

Source: 1. Agro-economic evaluation, BWDB, 1984.

2. Agriculture extension department, 2006.

* Data are not available.



Source: 1. *Agro-economic evaluation, BWDB, 1984.*
 2. *Agriculture extension department, 2006.*

The table pictured that HYV (t. aman, t. boro and t.aush) production were high when those were introduced at the beginning. From the year 2000, productions were decreasing gradually. Soil experts Mr. Ahamed Ali Chudhory, Upazila agriculture extension officer, Narayanganj Sadar has opined that under present project condition apart from different non-agriculture use of land, much larger amount of plant nutrients are being removed every year from the soil. Excessive use of chemical fertilizers, high population pressure, homestead wastage, industrial pollutants accompanied with rain induce flood water that remain standing up to 7-8 months onto the agricultural lands has been polluting and eroding top soils from croplands that contributed to soil infertility and low crops production.

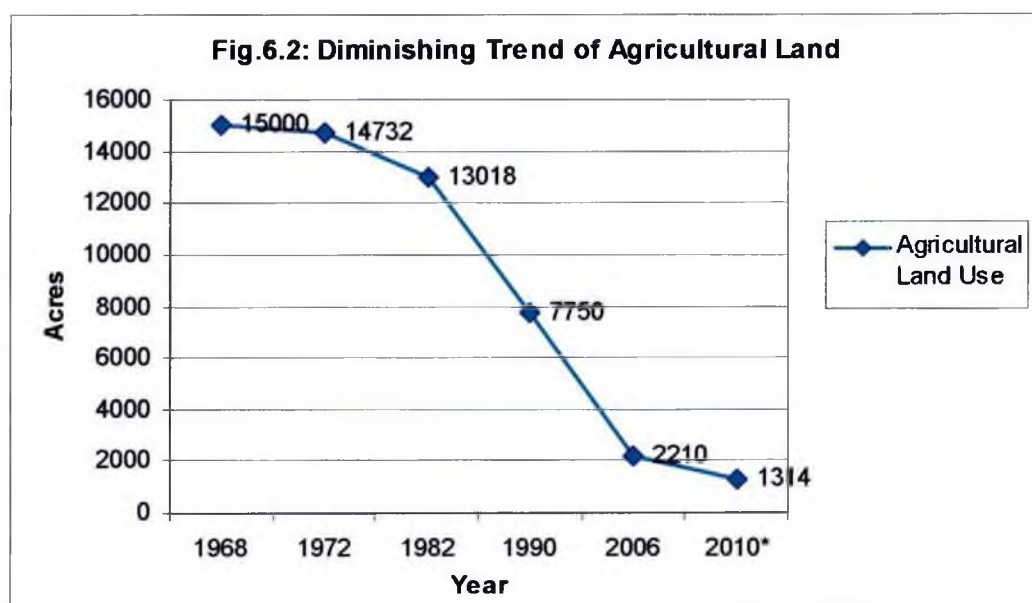
6.4 Land Available for Agriculture

Because for the particular location of the project considerable change in land use has took place at post- project era. This project was implemented as a model agriculture entity but its croplands are being shrinking every year to meet the demand of non-agriculture uses by the people from inside and outside. Homestead building is one of the major causes of this situation. Development pressure has contributed significantly to this process. Initially the command area was reduced by 2400 acres for development purpose by RAJUK (DIT), WASA and R & H department. Industrial, commercial and institutional uses of agriculture land are significant among other non-agriculture use. A statistics of gradual shrinking of agriculture land is flowing:

Table 6.3: Diminishing Trend in Agricultural Land

Year	1968	1972	1982	1990	2006	2010*
Agricultural use (acre)	15000	14732	13018	7750	2210	1314

Source: * Projected by JICA, FAP8A report, 1992.



Source: * Projected by JICA, FAP8A report, 1992.

Agricultural lands are aggressively taken away out of crops production in one hand and the average yields of produces are decreasing day by day. These dual effect has pushed the project now at the verge of failure. At present the project turned into a sub-urban residential cum industrial and commercial hub.

CHAPTER SEVEN

IRRIGATION, DRAINAGE SYSTEMS AND FLOOD CONTROL

7.1 Existing Flood Control Embankment

The DND project area is bounded and protected from flood by embankment- cum-asphalt roads. A small portion of it, from Haziganj to Chasara is embankment-cum- railway line. A floodwall was constructed after colossal flood in 1988 along the road that surrounded the most part of the DND project area. The top elevation of the floodwall from Buriganga Bridge to Fatulla ranges from 8.0 to 7.6 m with its road elevation being about 7.0 m. While the design top levels at Mill Barak and Hariharpara gauging stations are 8.4m and 7.8m respectively. From Sayedabad to Demra, the top elevation of the floodwall ranges from 7.8m to 8.0m with the road elevation being about 7.2m. Tentative design top level at Demra is 8.0m. From Demra to Hajigong along the Sitalakya River, the top of the floodwall ranges from 8.1 to 7.5m with the road elevation is being about 7.0m. Design top levels at Demra and Hajiganj are being 8.0m and 7.7m respectively. The existing top levels of the floodwalls are not sufficient to meet the design criteria of 50/100 years' return period of external flood. So the present floodwall be rehabilitated and certain parts of the wall will have to be raised to give the floodwall equal height in all parts. Furthermore, the wall strength is not sufficient to withstand the impact of trucks or other heavy weight vehicles and there are many gaps along the floodwall to facilitate movement of vehicles, goods and people to and from the rivers.

7.2 The Pumping Station, Demra

The pumping station was commissioned in 1968 by BWDB with a dual proposes of draining out of storm water in the rainy session from the project and providing irrigation facilities in the dry season from the same pumping plant. The specification of the pumping station is as flowing:

Total design discharge:	3.63-cusec/ units.
Design H.W.L (suction side):	1.8m PWD
Design L.W.L (suction side):	1.0m PWD
Design H.W.L (discharge side):	5.94m PWD
Pump head:	4.9m
Pump type:	Vertical axial flow
Pump diameter:	1300mm
Number of pumps:	04
Total discharge capacity:	14.52-cusec
The DND project area	56.79 sqr.km.

Photo 7.1: Existing Pump Station of DND Area, Shiddirgonj, Demra.



The pump station has been serving both the purposes efficiently till 90s but the project area is being suffering from water logging in the rainy session from some years back.

During the winter season three pumps are sufficient to meet the demand of irrigation at the early years and one pump has been kept as stand by. But in the rainy season the situation from last couple of years were different, the existing pumps and the drainage systems have proved as inefficient as well as inadequate to drain out even normal rain water accompanied with access domestic and industrial waste water.

In the last few years, due to climate change heavy rainfall have been occurred within a short span of time that caused water logging and emerged as recurring disasters within the project area. In September 2004, 37 million mm rain fell within 7 days and it took 42 days to remove excess congested water from the project area. Existing pumps and drainage system failed to mitigate the

water logging as the capacity of 4 pumps drainage discharge now stands at 0.877 cusec and the drainage canals have been silted up and encroached by local people.

Then operations of additional pumps become inevitable to face the water logging. In 2004 additional 12 pumps were set to pump out the storm water in the rainy season that necessitates balancing, modernizing, rehabilitation and expansion (BMRE) of existing pumps house as well as setting up of more pumps houses.

7.3 Irrigation Facilities

The Dhaka–Narayanganj-Demra embankment cum irrigation project was commissioned near the Dhaka city as a showpiece of higher agriculture production entity through ensuring flood control in the rainy season and providing irrigation facilities in the dry season. The systems are consists of a dual-purpose (water in and out) pump house and a network of two main canals, six lateral canals (secondary) and a number of sub-lateral (tertiary) canals. Some hydraulic structures like farm pipe turnouts (outlets), check structures, division boxes, siphons, aqueduct flumes etc are parts of the irrigation systems.

The Sitalakhya River is flowing at the east of the DND embankment, water pumped into the project from the river in the dry seasons. Pumped in water used to release in two main canals from where that flowed into six lateral canals. Operating turnout gates regulates the water supply from main canals to lateral canals. Sub-lateral canals receive water from the lateral canals through farm pipe turnouts. From these laterals water for irrigation is drawn under gravity by operating the side gates of the outlets to different plots within the command area of each lateral.

Demand of water for irrigation was higher at the out set of the project. But due to gradual withdrawal of land from agricultural use the demand for irrigated water were being come down to minimum. The irrigation demand was incrementally decreasing from 1981 and it decrease sharply from 2000. The above figure depicts a dim picture about the future of the project as agriculture hub rather it strongly indicate that the viability of the project as agriculture production entity is no more exist.

A statistics in this regard is the flowing:

Table 7.1: Irrigation Demand of water from 1981-2004

Year	Operating Hours	Amount of water pumped in (crore gallons)
1981	3026	1044
1982	3404	1174
1983	2428	838
1984	3168	1093
1985	2560	883
1986	3483	1201
1987	2325	802
1988	1923	663
1989	1980	683
1990	1957	675
1991	1829	631
1992	1564	540
1993	1921	663
1994	1583	546
1995	2109	728
1996	1988	686
1997	1629	562
1998	1219	420
1999	1979	683
2000	2450	845
2001	716	247
2002	198	63
2003	468	161
2004	221	76

Source: BWDB, 2005.

7.4 Drainage Systems and Discharge

The area is encircled around by embankment cum roads keeping one opening at the pump house point at Shimrail, Demra. The project allowed the excess rainwater from all sides to flow to the pump house. Then the water is being pumped out to the main river. To facilitate this, two main drainage canals and six secondary drainage canals received rainwater from inside the project and convey that to the pump house by gravity. The water at the pump house thereafter is pumped out to the nearest Sitalakhya River. From 2001 the project is suffering from water logging in the rainy seasons. This is being happened due to inefficiency of pumps, silting up of canals, unplanned construction of roads, sprawl of settlement, haphazard urbanization etc. Besides, due to population boom, wastewater has increased manifolds and dumping solid waste in the canals hinder the water flow toward the pump house through canals. High water level in the surrounding rivers sometimes made the draining out of inside water impossible. Excessive rainfall within a short period of time, and encroachment of drainage *Khals* and canals aggravates the situation further.

Photo 7.2: Encroachment of Drainage *Khals* in DND Area.



This phenomenon contributed to the flood in the project. Operation hours of pumping station are being increasing to cope with water logging in recent years but sometimes it failed to control the situation. That had caused immeasurable sufferings to the people living inside the project and that had brought attention of people, of medias, of policy makers and of planners at national and international levels. Operation hours of pumps from 1981 to 2004 are as following:

Table 7.2: Draining out Hour of Water (1981-2004)

Year	Operation Hours	Amount of water drained out (crore gallons)
1981	4887	1686
1982	3231	1115
1983	6358	2194
1984	8253	2847
1985	4178	1441
1986	5453	1881
1987	6818	2352
1988	7252	2502
1989	4010	1383
1990	3191	1101
1991	8487	2928
1992	3884	1340
1993	8769	3025
1994	2841	980
1995	6210	2142
1996	6511	2246
1997	6052	2088
1998	8961	3091
1999	8661	2988
2000	7445	2568
2001	9849	3398
2002	7938	2738

2003	7687	2652
2004	9549	3294

Source: BWBD, 2005.

The above table has shown that operation hour as well as amount of water drained out is increasing on the passes of time. It also satisfies that the demand of pump operation will increase in the future. And immediate steps are essentials in this regard otherwise the situation might turn into all out disaster.

Fig. 7.1: Present Drainage System in DND Area



Source: BWBD, 2005.

7.5 Flood Control Measures

7.5.1 Retention Pond

The idea of retention pond was not foreseen at the project execution, because some parts of the project area were natural water bodies whose had been served as retention ponds.

Photo 7.3: Retention Pond on Crop Land in DND Area.



It was a model agriculture entity to increase food grain production through providing irrigation and flood control facilities. The area was mainly cropland excepting some settlements on traces and higher ridges along the rivers and few sporadic villages in the project area.

The drainage systems were efficient, deep enough to carry on the storm water to the pumps station without hindrance. Over the period of 4 decades most of the project area went through rapid change by settlement, industrialization, roads as well as many others infrastructures developments. Similarly the drainage systems were went through encroachments and silting up that resulted inadequate and inefficient to carry storm water by and large. Recently the project is suffering from endemic disaster of storm water flood on the one hand and the pumps house is suffering from inadequate water flow toward it on the other hand. These dual effects bring forward the idea of retention ponds inside the project.

7.5.1.1 JICA's Proposal in 1992

The FAP 8A suggested that large tracts of low lands would have to be maintained as retention ponds, which will hold the excess water in time of need. They calculated that approximately 12.5 percent gross area would be required for these retention ponds. The study suggested six retarding areas in two zones. Three of 266 hectares in the northern drainage zone another three of 377.5 hectares in the southern zone. The location and sizes of those could be determined considering land contours, existing settlement trend, RAJUK's urban development scheme, future population growth projection and forecasting drainage requirements.

7.5.1.2 Technical Committee's Suggestion in 2005

After the internal flood in September, 2004 a technical committee was formed to suggest mitigation measures to get rid of water logging. The committee submitted the report suggesting among others:

- a) Eviction of unauthorized encroachment of drainage systems and deepening of khals & canals,
- b) Construction of escape structure for drainage water of the main irrigation canals and pumping out excess storm water by installation and operation of sufficient number of surface pumps during monsoon,
- c) Setting up new pump house and acquisition of lands for new ponding areas, and
- d) Protection and alignments of retarding ponds to preserve excess storm water.

7.5.1.3 RAJUK's Proposals in 2005

Detail Area Planning (DAP) Team of Dhaka Metropolitan Development Plan (DMDP) proposed a different approaches, which includes (Firdos, 1995):

- All existing Water Development Board (BWDB) khals be maintained to its original width increasing the depth by one meter.
- A retention pond along Demra-Narayanganj road (approximately 2.5 kms) over the existing 255 meter long khals be constructed to a width of 140 meters (most of the proposed retention khals runs through agricultural lands, hence the problem of acquisition would be reduced to minimum)

CHAPTER EIGHT

FINDINGS, RECOMMENDATIONS AND FUTURE RESEARCH

8.1 Findings

During the 70s of last century the Dhaka- Demra-Narayanganj embankment project was implemented to create a high value agricultural zone with a well laid out systems of canals to serve the dual purpose of irrigation and drainage facilities. A pump house was set to draw water from the Sitalakhya River in the dry season for irrigation to crop lands and remove out storm water within during the rainy season. After about 40 years unplanned conversion of agricultural land to residential, industrial, road network and development initiatives has pushed the project out of its original purpose of establishing a model agricultural zone. Now the project is at the verge of failure in respect to agriculture production.

Most of the land under the project has gone to residential use followed by road network. Industrial, commercial, administrative, institutional and other development use have eaten up much land. So the project has created lots of alternative use of lands that are more viable as well as productive than the agriculture.

Construction of Jatrabari-Kanchpur highway and Chasara to Jatrabari- Kanchpur link road has divided the project into virtual three compartments. These two roads were constructed without due water pass that blocked the storm water inside the compartments and hindered water movement towards pump house and contributed mainly to water logging. Increasing scale of urbanization has eaten up a substantial portion of the laid out drainage systems.

Absence of regulatory authority and zoning law, lands of the project has been used through process of laissez faire. Intense fragmentation of lands and multiple transfers of those by the owners and vendors contributed to the unplanned sprawl of homesteads. Moreover various process of development by different govt. departments and private initiatives gave rise to haphazard use of land in the project. Ownership of tiny plots precludes the owner to encroach upon canals and drainage adjacent to his/her lands that create obstacle to water movement.

Lands are withdrawn from agricultural use are faster than JICA's projection. So crops production are decreasing day by day and there is zero possibility for the project that it will succeed as an agriculture hub in future. A major portion of land has been used for developmental and administrative purpose and the trend is continuing.

All the above causes are inter-related and contributed negatively to the waterlogging phenomenon. Water logging is therefore a major problem. The solution of this problem lies in

coordinated action of concern public sectors, political leaders and above all awareness about the problem among inhabitants.

8.2 Recommendations

1. The Dhaka-Narayanganj-Demra flood control, irrigation and drainage project was implemented in order to protect the area from seasonal flood every year and to increase agricultural production. The above dual objectives were going to fulfill up to 1990s. But after that the project has been facing severe obstacles on its way to achieve 270% crop intensity. Unplanned development work, sprawl settlement and urbanization collectively create this unwanted situation. Considering high population due to outside influx the goal of targeted food grain production would never be achieved. The conflict between need for agricultural production and need for ever more land for settlement and other non-agricultural purpose will become increasingly serious. So the minimum possible amount of land should be taken out of productive agricultural use for conversion to urbanization. One or more of the following could achieve this:

- a) Enacting zoning law to protect the high value agricultural land for agriculture production and to restrict the spread of settlement and industry to land of lower agricultural value, so that flood protection does not lead to a rapid expansion of settlement onto valuable agricultural land.
- b) Free khals & canals from all sort of encroachments and re-excavate those maintaining proper width and depth.
- c) Designing roadside borrow pits in such a way that, wherever possible, they can be used as irrigation canals or water reservoirs. Moreover water retarding ponds is necessary to meet the demand of water be pumped out.
- d) Restricting land acquisitions to the smallest area actually needed for the particular purpose. Preference should be given to vertical rather than horizontal expansion (as practiced, for example, in Egypt). This could be made easier by way of zoning regulation.
- e) Land of higher elevation may be marked up for settlement and industry. Floodplain and land of lower elevation should be preserved for agriculture production. And natural water body may be kept as retention pond, if, the authority wants retain the project as flood free agriculture hub.

2. Present study have revealed that the area is virtually divided into three compartments by the Dhaka- Chittagong highway and Dhaka- Narayanganj connecting roads, these are as flows:

Area 1: The area lies in-between Jatrabari- Demra, Demra- Kanchpur roads and Kanchpur- Jatrabari portion of Dhaka-Chittagong highway. Approximate area of this part is 13.90 sqkm. This area could be linked with Demra Pumping station.

Area 2: The area is identified as Jatrabari- Postagola-Fatullah- Chasara, Chasara- Singboard (on Dhaka- Chittagong highway) and Singboard- Jatrabari roads. The area of this portion is 21.85 sqkm. This area could be linked with a new pump station at Shampur Khal towards Buruganga.

Area 3: The area is consists of Chasara- Singboard, Singboard- Kanchpur and Kanchpur- Chasara roads. Total area of this part is 21.04 sqkm and could be connected with Pagla/ Fatulla khal by setting another new pump station.

Beside those DCC, Siddirganj Municipality and LGED had made about 5000 k.m. road in the different parts of the project whose had crisscrossed the whole area and created innumerable tiny compartments. Those pocket compartments could hold enough water to bring about huge suffering to local people during monsoon. Steps are needed to pull the water out of mini compartment into three above-mentioned large compartments and developed a pump drainage system with additional two (total three) pumping stations for area 2 &3.

8.3. Future Research Direction

Present study incorporates some common aspects those are existing drainage systems, pump operation, causes and impacts of flood in DND and unplanned land use in order to find out sustainable mitigation measure. Due to limited opportunity and fund constraint a full-length study toward that end had not been done but there is still ample opportunity to developed it professionally. In fact, a professional study will be able to identify the multidimensional causes, effects and remedial measures to maintain it sustainable residential cum industrial area. Although the DND embankment project was implemented in 1962-68 as an agricultural hub but at present it has lost its basic character. At present it has become a sub-urban residential cum industrial/commercial center. In some parts rural characteristics are still evident but these characteristics are diminishing day by day. So it is high time to undertake various research programs on land zoning, urban planning, flood control and road communication etc. Instead of BWDB and other government department feasibility for an independent development authority for DND me be taken immediately.

CHAPTER NINE

CONCLUSION

Conclusion

The Dhaka-Narayanganj-Demra embankment project was implemented as a model cordoned approach with a vision of higher agriculture production that it can contribute toward self-sufficiency in food grain production. The project was moving fast to its goal within first 10 years of implementation. In fact agriculture production was boom beyond projection in 80's. In 90's agriculture lands were getting squeezed rapidly. So agriculture production had gone down beating the projection. At present the project has turned into an urban conurbation and after about four decades the primary vision has become dim. More than half of its area had gone to housing settlement. Other major uses are road development, industrialization, institutional development etc. The govt. own action is mainly responsible for the change of its characteristics. By constructing roads and highways govt. has been alluring people toward different use of its land other than crops production. Some other govt. departments such as WASA, BWDB, BPDB, BTTB, Department of health, National Sports Council etc. have encroached a good amount of land for different purposes. Private owners also used land for industrial and commercial purposes. All those accumulated affect has lead to urbanization but not in a proper manner rather it is urbanized in a haphazard way.

Such large-scale project is not without its own problems. This type of project is costly to provide and operate. It has allowed settlements to sprawl wastefully over good crops land after deep-flooding constraint is removed. Unplanned urbanization has caused drainage congestion, surface water pollution and environmental deterioration. Indiscriminate land use has brought down the production of agriculture and of fisheries. Intensive agriculture and pisciculture is essential to compensate the loss.

Drainage condition inside the project area deteriorated considerably. People suffer a lot during the monsoon period due to improper drainage system. Development of road communication network and without necessary water pass has contributed much to water logging. Water logging problem and water pollution worsen the living condition of the people and squeezed the employment opportunity. Due to proximity of two cities most of the dweller of DND area depend for their livelihood either Dhaka or Narayanganj. The commuters living in the project has suffered much in respect to road communication due to waterlogging in the rainy season.

Despite many adverse impacts on life and livelihood there are a lot of positive changes in the life of settlers in DND. Industrialization creates huge opportunity of employment. The project area is near to main commercial and business center i.e. Motijheel. As a result the importance of DND area as the residence of employees should not be ignored. The landscape of the project has

changed to urbanization and the value of land has increased manifold. The flood free condition allows people to settle there. The area is well connected by road and railway with the other parts of the country. The socio-economic condition of the area is good. Peoples' living standard is good and they earn relatively better income. They are now relatively educated than earlier. The area has access to electricity and gas supply facilities. Medical facility and commercial centers increased considerably. Mother and Child Health Care Institute at Matuail have created good facilities of health care.

Considering the overall situation the objectives of the project should be re-written. At present the project is no longer viable as an agriculture project. A small piece of land may create huge opportunity of job through industrialization that is quite impossible in agriculture sector. Besides importance of an economical and well communicable residential hub should not be ignored. By ensuring all civil amenities the Dhaka-Narayanganj-Demra embankment area could be an ideal urban center in 21 century.

BIBLIOGRAPHY

Bibliography

Ahmad, Q.K. (ed) (2000), *Bangladesh Water Vision 2025: Towards A Sustainable Water World*, Dhaka: Masro Printing and Packaging Ltd.

Alexander, D. (1993), *Natural Disasters*, London: UCL Press Ltd.

Asian Development Bank, Manila, 1991, *Disaster Mitigation in Asia and the Pacific*.

Bangladesh Bureau of Statistics (2003), *Population Census 2001, National Report*. (Provisional), Vol. 1, Planning Division, Ministry of Planning, Government of People's Republic of Bangladesh.

Bangladesh Bureau of Statistics (2002), *Statistical Pocket Book of Bangladesh 2001*, Ministry of Planning, Government of People's Republic of Bangladesh.

Bangladesh Bureau of Statistics (2006), *Monthly Statistical Bulletin-Bangladesh*, Bangladesh

Bureau of Statistics (2007), *Population Census 2001, Community Series, Zila: Dhaka and Narayanganj*, BBS, Planning Division, Ministry of Planning, Government of People's Republic of Bangladesh.

Bangladesh Centre for Advanced Studies (1994), *Socio-Economic Project of Meghna-Dhonogoda Irrigation Project*, Draft Final Report, September 2004.

Bangladesh Engineering and Technological Services (1990), *An Investment into the Drainage Problem of Metropolitan Dhaka and Its Solution*, BETS R&D Publication No. 4, Dhaka, December.

Brammer, H. (1990), *Floods in Bangladesh II. Flood Mitigation and Environmental Aspects*, *The Geographical Journal*, Vol.156, No. 2, pp. 158-165.

Brammer, H. (1996), *The Geography of Soils of Bangladesh*, Dhaka: University Press Ltd.

Brammer, H. (2002), *The Land Use and Land Use Planning in Bangladesh*, Dhaka: University Press Ltd.

Bibliography

BWDB (1968), Proforma for Development Project, Dhaka-Narayanganj-Demra (DND) Irrigation Project, Bangladesh Water Development Board, Dhaka, August.

BWDB (1984), Agro-economic Evaluation: Dhaka-Narayanganj-Demra (DND) Irrigation and Flood Protection Project, Second Edition, Bangladesh Water Development Board, Dhaka.

Choudhury, N.Y. (1998), Impact Study and Economic Assessment of Flood Control Measures and Flood Risk Modeling Using Integrated GIS and Remote Sensing Techniques, Unpublished M.Sc. Thesis, International Institute for Aerospace Survey and Earth Sciences (ITC), Enschede, The Netherlands.

Choudhury, N.Y. (2000), Evaluation of DND Embankment in Flood Protection, *Oriental Geographer*, Vol. 44, No.2, pp.1-8.

French Engineering Consortium and BWDB (1989), Prefeasibility Study For Flood Control in Bangladesh, Vol. 1, Executive Summary, Government of the People's Republic of French.

IFCDR (1992), Pilot Program to Improve Management of Flood Control, Drainage and Irrigation Projects, Final Report (Phase-I), Institute of Flood Control and Drainage Research, BUET, May.

International Engineering Company Inc. (1960), Dhaka-Narayanganj-Demra Project, Feasibility Report, East Pakistan Water and Power Development Authority, May.

International Engineering Company Inc. (1961), Dhaka-Narayanganj-Demra Project, East Pakistan Water and Power Development Authority, January.

International Engineering Company Inc. (1968), Dhaka-Narayanganj-Demra Project, Operation and Maintenance Manual, East Pakistan Water and Power Development Authority.

Islam M.A. (1995), *Environmental Land Use and Natural Hazards in Bangladesh*, Dhaka University, Dhaka.

Islam M.N. (2003), Environmental Impact Assessment due to the Urbanization of Dhaka-Narayanganj-Demra Project Area, Unpublished M.Eng. Thesis, Department of Civil Engineering, BUET.

Islam N (1998), Alternative Approach to Flood Control: The Case of Bangladesh, Unpublished Research Report, Department of Economics, Emory University, Atlanta.

Islam N (2005a), *Natural Hazards in Bangladesh: Studies in Perception, Impact and Coping Strategies*. Dhaka: DRTMC, Department of Geography and Environment, University of Dhaka.

Jahan S.S. (2002), Performance Evaluation of Dhaka-Narayanganj-Demra (DND) Project, Unpublished Research Report, Water Resource Engineering Department, BUET.

Japan International Cooperation Agency (1987), Study on Storm Water Drainage System Improvement Project in Dhaka City, Main Report, The People's Republic of Bangladesh, Department of Public Health Engineering, Ministry of Local Government Rural Development and Co-operatives, Local Government Division, October, 1987.

Japan International Cooperation Agency (1991), Master Plan on Greater Dhaka Protection Project (Study in Dhaka Metropolitan Area) of Bangladesh Food Action Plan No.8A, Supporting Report-I, Flood Plan Coordination Organization, Government of the People's Republic of Bangladesh, June, 1991.

Japan International Cooperation Agency (1991), Master Plan on Greater Dhaka Protection Project (Study in Dhaka Metropolitan Area) of Bangladesh Food Action Plan No.8A, Supporting Report-II, Flood Plan Coordination Organization, Government of the People's Republic of Bangladesh, June, 1991.

Japan International Cooperation Agency (1992), Feasibility Study on Greater Dhaka Protection Project (Study in Dhaka Metropolitan Area) of Bangladesh Food Action Plan No.8A, Main Report, Dhaka, June, 1992.

Khandakar M.A.T. (1998), Dhaka-Narayanganj-Demra Irrigation Project, Brief Report on 1998 Flood Rehabilitation Program, Bangladesh Water Development Board, Dhaka.

Bibliography

Ministry of Water Resource (2005), Technical Committee Report on Identifying the Water Logging Problem in Dhaka-Narayanganj-Demra (DND) Project Area with Mitigation Measures, Ministry of Water Resource, Government of the People's Republic of Bangladesh.

Master Plan Organization (1995), National Water Plan Project, Draft Final Report, Vol. I & 2, Ministry of Irrigation, Water Development and Flood Control, Government of the People's Republic of Bangladesh.

Nazrul Islam, 2005, Natural Hazards in Bangladesh, studies in perception, impact and coping strategies, Disaster Research Training and Management Centre, Department of Geography and Environment, University of Dhaka.

Nizamuddin K. ed. (2001), Disaster in Bangladesh, Disaster Research Training and Management Centre, Department of Geography and Environment, University of Dhaka.

RAJUK (1995), Manual for Preparation of Detailed Area Plans for Dhaka Metropolitan Development Planning (DMDP) Area, Final Drafts, Dhaka.

RAJUK (1997), Dhaka Metropolitan Development Plan (1995-2015), Vol. I & II, RAJUK, Dhaka.

RAJUK (2004), Preparation of Detailed Area Plans for Dhaka Metropolitan Development Planning (DMDP) Area, Group-B, Inception Report, Dhaka, September, 2004.

RAJUK (2006), Preparation of Detailed Area Plans for Dhaka Metropolitan Development Planning (DMDP) Area, Group-B, Survey Report-II, Dhaka, August, 2006.

Saleh A. F.M. et al. (1998), Performance Evaluation of FCD/FCDI Projects during 1998 Flood, Institute of Flood Control and Drainage Research, BUET, Dhaka.

Task Force Report (1991), The Flood Action Plan, In Report of the Task Forces on Bangladesh Development Strategies for the 1990's, Developing the Infrastructure, Vol. 3, The University Press Limited, Dhaka.

Bibliography

Kader A. (2007), Two million marooned in DND area: Unplanned urbanization blamed, *New Age*, 17 June, 2007.

Khan M.A. (2007), Unplanned Urbanization and Water Logging: The place is called DND, *The Daily Star*, 18 June, 2007.

Narayanganj Correspondent (2004), DND Bandh Upche Pani Vitore Dhoker Asanka (in Bengali), *The Daily Prothom Alo*, 22 July, 2004.

Rahman M.K. (2004), DND Bashir durvog Komsena (in Bengali), *The Daily Janakantho*, 17 October, 2004.

Shiddirganj Correspondent (2006), DND'r Jalabodhota: Atonke Roeche 15 Lakh Pani Bondhi (in Bengali), *The Daily Jugantor*, 11 June, 2006.

Shiddirganj Correspondent (2006), DND'r Jalabodhota: Atonke Roeche 15 Lakh Pani Bondhi (in Bengali), *The Daily Jugantor*, 11 June, 2006.

Shiddirganj Correspondent (2006), Borshai DND'te Krittim Banna, Kayak Lakh Pani Bondhi (in Bengali), *The Daily Ajker Kagoj*, 28 May, 2006.

APPENDIX

**Post Graduate Program for Disaster Management (PPDM)
BRAC University**

**Questionnaire for Household (H H) Survey
A study on land use planning to Disaster Mitigation
(Only use for academic purpose)**

A. General Information

- 1) Name of the respondent -----
- 2) Address-----
- 3) Year of settlement in DND -----
- 4) Settlement land owned by ---- -----
- 5) Residence owned/rented -----
- 6) Ideographic information of respondent household

Name	Occupation	Relation with the head	Sex M/F	Age	Education	Martial status

B. Sources of Income

1. Primary
2. Secondary

C 1. Land Owned by the Family

1. Very high/ High land
2. Medium high/ Low land
3. Low land

Total

C 2. Land Used by the HH

Cause	Area (decimal)	Classification	Percentage

D. Disaster Related Information

D 1. Frequency of flood

- Twice in a year
- Once in a year
- 1-3 year interval
- 4-5 year interval
- More than 5 year interval

D 2. Causes of Flood

D 3. Water Levels at

- Homestead
- Agri-land
- Farm/ business center
- Industry
- Pond fisheries

D 4. (a) Occurrence time of flood -----

(b) Duration of flood ----- days

E. Damaged by Flood Disaster

1. Number of death toll -----
2. Number of injuries-----
3. Income loss ----- Taka
4. Properties and infrastructure damaged (briefly describe)

F. Preventive Measure Against Disaster Loss

1. Structural Measures

2. Non- structural Measures

G. Effectiveness of Preventing Measure(s)

1. Structural

2. Non- structural

H. Do you have any suggestion of land use against flood disaster?

Thank you

Name of the surveyor

Date:

