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ISSN 1019-9624

RDA JOURNAL

বাংলাদেশ পল্লী উন্নয়ন সমীক্ষা
Bangladesh Rural Development Studies

খন্ড ১৩ | ১৪১৭ | সংখ্যা ১
Volume XIII | 2010 | Number 1

প্রবন্ধ । Article

Rural Development Academy (RDA), Bogra
Bangladesh

Bangladesh Rural Development Studies ● Volume XIII Number 1 2010

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প্রকাশক : মহাপরিচালক
পল্লী উন্নয়ন একাডেমী
বগুড়া-৫৮৪২, বাংলাদেশ

Published by : **Director General**
Rural Development Academy (RDA)
Bogra-5842, Bangladesh
Phone: 88-051-51001, 88-051-78602
88-051-78603
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মূল্য : টাকা ২০০.০০ (প্রতিষ্ঠানের জন্য)
টাকা ১০০.০০ (ব্যক্তিগত ক্রয়ের জন্য)
মার্কিন ডলার ৪.০০

Price: : Tk. 200.00 (For Institution)
Tk. 100.00 (For Individual)
US $ 4.00

Cover Design : **AKM Zakaria**
Md. Kamrul Islam

Computer Getup and Makeup : **Md. Ahsan Ullah Khan**

Printed by : **Bimurto Prokasoni & Procharoni**
Bogra, Bangladesh

সূচী

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ISSN 1019-9624
The Bangladesh Rural Development Studies Vol. XIII No. 1 (2010)

Current Situation and Strategies of Solid Waste Management in Bangladesh

M A Matin[1]
Md. Abid Hossain Mridha[2]

Abstract

At present, solid waste management is a vital issue of urban local bodies in Bangladesh. There are 522 urban centers in the country including 254 municipalities and 06 City Corporation. Solid waste generation has increased in urban areas during 1991-2001 census years, due to over 3.3% growth of urban population. In the perspective year 1991, 2001 and 2004, total waste generation rate were 9,873.50, 11,695.00 and 16,382.00 ton per day respectively and waste generation rate will be increased 47,064.00 ton per day in the year of 2025.The institutional arrangement of solid waste management was organized by six steps from chief conservancy officer to cleaners and sweepers under the city corporation. There are two policies was used under legal framework - national level framework and local level legal framework. The local authorities spent 5-20% of their total annual budget to collect, transport and dispose waste. Approximately 50% of this budget is being collected as revenue and the rest comes as grant from the national government. The waste is generated from domestic, commercial, industrial, street sweeping, health care facilities etc. Three systems of waste management co-exist side by side in Bangladesh such as Formal System, Community Initiatives and Informal System.

Introduction

Solid Waste Management is an important obligatory function of urban local bodies in Bangladesh. At present, there are 522 urban centers in the country including 254 municipalities and 06 City Corporation (BBS 1997 and NILG 2002). With over 3.3% annual growth in urban population in Bangladesh during 1991-2001 census year, solid waste generation has increased proportionately. Solid waste management includes all

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activities that seek to minimize the health, environmental and aesthetic impacts of solid wastes. Solid waste can be defined as material that no longer has any value to the person who is responsible for it, and is not intended to be discharged through a pipe. It does not normally include human excreta. It is generated by domestic, commercial, industrial, healthcare, agricultural and mineral extraction activities and accumulates in streets and public places. The words "garbage", "trash", "refuses" and "rubbish" is used to refer to some forms of solid waste.

Objectives of the Study

- To assess the current situation of solid waste management;
- To analyze the strategies of solid waste management in various urban centers;
- To estimate the recycle processed and existing practice of solid waste management; and
- To evaluate the problems of solid waste management

Methodology

The study considered to review overall current situation and strategies of solid waste management and its impact on different Pourashava, City Corporation and Urban centers in Bangladesh. For the study, data were collected from secondary source both qualitative and quantitative. Researchers made a review on solid waste management of various urban centers and consulted BBS report, newspaper and relevant reports.

Findings of the Study

Current Situation of Solid Waste Management

Solid Waste Generation from Urban Areas

Comprehensive waste characterization studies have not been conducted in Bangladesh. In addition none of waste disposal sites in the country is equipped with weighbridge. However, recently Dhaka City Corporation (DCC) at its waste disposal site has installed a weighbridge to measure the amount of waste being disposed. Consequently, there is limited source of reliable information related to quantity of wastes generated in the urban areas of Bangladesh. Due to lack of information, estimates were made of the amount of waste generated. The estimates were based on the information available from other countries and cities having similar socio-economic condition to those prevalent in Bangladesh. Solid waste generation in Bangladesh is growing proportionately with the

growth of urban population. The following table shows volume of solid waste generation over the years.

Table-1: Total Urban Solid Waste Generation in Bangladesh

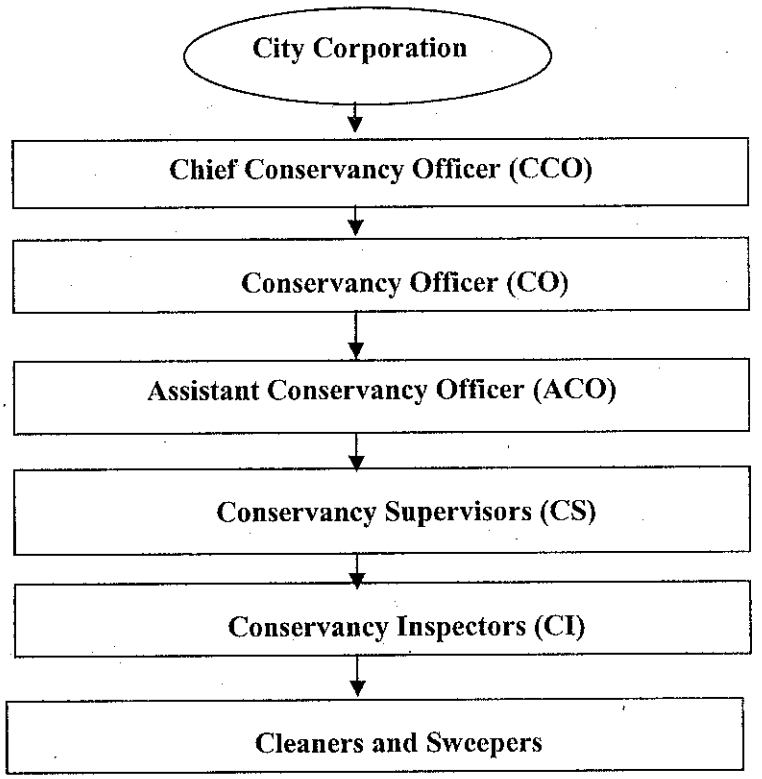
Year	Total Urban Population	Total Urban Population (% Total)	Waste Generation Rate (kg/cp/day)	Total Waste Generation (Tone/day)
1991	20872204	20.15	0.49	9873.50
2001	28808477	23.39	0.50	11695.00
2004	32765152	25.08	0.50	16382.00
2025	78440000	40.00	0.60	47064.00

Source: *ADBI & ADB, 2000 and Zurbrugg 2002.*

Institutional Arrangement for Solid Waste Management

Presently, the solid waste management system in Bangladesh is not well organized. However, efforts are under taken to improve the organizational structure for solid waste management in different cities/towns. For instance, Dhaka City Corporation has recently established a Solid Waste Management Cell to improve the waste management services in its jurisdiction. In most of the city corporations and municipalities there is no separate department for solid waste management. Solid waste management is organized and run by conservancy section of the urban local bodies, whose prime responsibility is entrusted with the maintenance of the sanitation system represented by the following diagram.

Diagram-1: The organizational structure of conservancy section



Legal Framework for Solid Waste Management

At present, there is no separate policy or handling rules for solid waste management in Bangladesh. The existing legal aspects relating to solid waste management can be classified into two groups, which are given below:

National Level Framework

- National Environmental Management Action Plan (NEMAP)
- Urban Management Policy Statement, 1998
- National policy for Water Supply and Sanitation, 1998
- Local Government Bodies (City Corporation and Municipalities)
- Feasible collection, removal and management of solid waste to the private sector

- Measures to be taken to recycle the waste as much as possible and promote use of organic materials for compost and bio-gas production
- Private sector including NGO participation in sanitation is encouraged by National Clean Development Mechanism (CDM) Strategy, 2004.

Local Level Legal Framework

The responsibility of removal and disposal of municipal solid waste lies with the city corporations and municipalities. The six City Corporation Ordinances and Pourashava Ordinance 1977 give some idea about disposal of municipal waste.

Strategies for Solid Waste Management

- The present solid waste management practice being followed is based on the end-of-pipe approach, i.e. collect-transport-dispose. This approach is neither sustainable nor cost-effective.
- The strategy for solid waste management is based on 4 R's principle i.e. reduce, reuse, recycle and recovery of the waste.

Out Reach of the Strategies are:

- Prioritizing waste avoidance over recycling and recycling over the other forms of environmentally sound disposal methods;
- Reuse non-avoidable waste as far as possible;
- Maintain the content of hazardous substances in waste at the lowest possible level;
- Guarantee an environmentally sound waste collection, transportation, resource recovery and disposal system; and
- Promotion of Public-Private-Community Partnerships in solid waste management.

Technologies Used for Waste Recycling, Treatment and Disposal

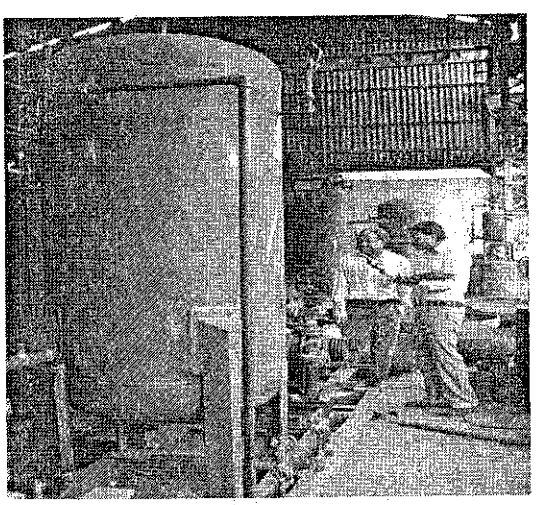
Waste disposal is an emerging problem in almost all urban areas of Bangladesh. The increase in waste generation can be primarily attributed to factors such as rapid rate of urbanization, rural- urban migration, changing consumption pattern and high population

growth rate. While the magnitude of the problem is relatively small and manageable in rural areas, it appears to be growing significantly in urban areas in recent times. Among the major environmental concerns confronted today in the urban areas of Bangladesh are problems relating to proper management of solid waste.

There is no single solution to improve solid waste management system in any city. It must be based on integrated systems with a combination of different methods. There should not be any contradiction between different methods; instead they should be complimenting each other. Sophisticated technologies are beyond the capacity of small and medium towns of Bangladesh. The local authorities spend 5-20% of their total annual budget to collect, transport and dispose waste. Approximately 50% of this budget is being collected as revenue and the rest comes as grant from the national government. Presently, a number of commendable steps have been under taken by the government to promote low cost, appropriate decentralized community based composting technology based on socio-economic and climatic condition of the country. RDA's experience on bio-gas technology is presented as a case study.

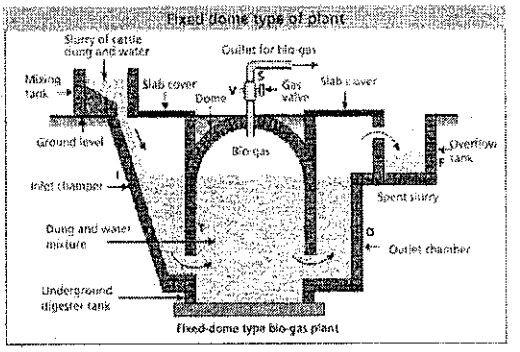
A Case Study of RDA Bio-gas Plant

RDA has successfully carried out five numbers of fixed cover digester of bio-gas plant having capacity of 130 m^3 in each. Those are installed in various locations at RDA campus such as power station, demonstration farm, Agro-product processing and marketing unit, CIWM office building and senior faculty quarter area. In these five plants, two plants are operated by using human excreta, one plant is operated by kitchen by-product, one plant is operated by using cow dung and rest one is operated by waste of agro product. There are twenty six households, guest house and DG's banglo are covering in the campus by production gas through the plants. After production of bio-gas, slurry is processed by sun drying (moisture continent about 12-20



A renowned bio-gas processing industry at Haldiram, India was visited by Mr. M A Matin

percent) as organic fertilizer entitled "Palli Joibo Sar". RDA is being carrying to successfully marketing of Palli Joiba Sar costing about Tk. 8000.00 per ton. On the basis of these experiences, RDA is going to be installed 112 nos. community based bio-gas plant having capacity of 120-150 m^3 each in different parts of the country through ***Action Research Project on Poverty Alleviation through Livestock Management and Bio-Gas Bottling*** *based on 376 ton per day cow dung produce in milk vita areas. It can obtain raw bio-gas about 1200 m^3 per day by using 5 ton raw inputs from a plant. After processing of this amount of gas by compressed up to 200 bar pressure, It would be produced final purified gas about 600 m3 per day per plant with the presence of 96% methane. The neighboring peoples will be used the bio-gas fruitfully for their cooking purpose and also protected environment pollution. Besides, it could be run CNG operated vehicles and gas generator as well as reduce pressure on energy and power sector.*

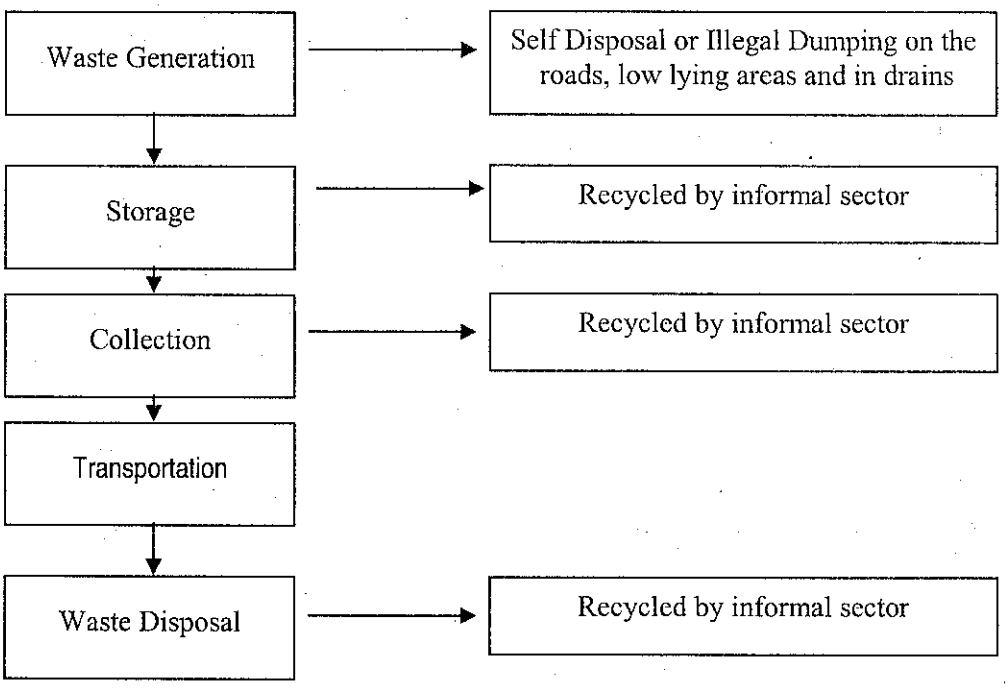


Existing Practice of Solid Waste Management in Bangladesh

Approximately 16,382 of tons of waste are generated in the urban areas of Bangladesh in the year 2004. The waste is generated from different source (domestic, commercial, industrial, street sweeping, health care facilities etc. 3 (three) 'systems' of waste management are coexisting side by side in Bangladesh. One is the 'Formal System', where municipalities/city corporations are responsible for Solid Waste Management (SWM). This is based on the conventional system of collection transportation- disposal of waste carried out by the local authorities. In this system the concept of transfer stations, resource recovery, minimization and recycling are absent. Secondly 'Community Initiative' that is based on primary solid waste collection by CBOs and NGOs, 'Community Initiatives' of house-to-house waste collection in neighborhood started due to lack of satisfaction with solid waste management service. Finally, 'Informal System' represented by the large informal labor force involved in the solid waste recycling trade chain. Diagram-2 shows the existing system of solid waste management in the urban areas of Bangladesh.

Partnership between these three systems is needed to promote effective solid waste management system in the country.

Diagram-2: Flow Chart of Waste Management in Informal Sector



Problems of Solid Waste Management in Bangladesh

The main problems and drawback of solid waste management in the urban areas of Bangladesh are as follows:

- Absence of national policy to encourage recycling practice;
- Lack of proper handling rules and standard;
- Lack of proper institutional setup in the local bodies to manage solid waste properly;
- Lack of finance, and inefficient tax collection;
- Lack of manpower and infrastructure;
- Incomplete and inefficient waste collection practice;
- Lack of access to municipal solid waste service by huge population;
- Shortage of lands for final disposal of solid waste;

- Lack of public awareness about the health and environmental problems associated with the solid wastes; and
- Lack of partnership between the public sector, Private sectors, community people and NGOs and CBOs.

Conclusion and Recommendations

Solid waste management is an important issue in present situation and immediate enhancing to initiative by the government as well as non-government official in the country. It is one of the best ways to decompose for production of gas by installing bio-gas plant. As a result, it can contribute to minimize load shedding and thus additional power can be put away in our national grid. Solid waste management can also improved sanitation where available used as bio-gas plant system and avoid various harmful diseases for sustainable environment in the country. It would be provided to getting urban advantages through solid waste management in rural areas. In order to improve solid waste management in the urban areas of Bangladesh following issues should be considered:

1) Promotion of source-separation of waste;
2) Tax incentive for use and production of recycled waste product;
3) Promotion of public-private-community partnerships;
4) Promotion of recycling/composting/no-burn technology and less filling of waste; and
5) Promotion of more waste related projects using Clean Development Mechanism (CDM) opportunity.

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ISSN 1019-9624
The Bangladesh Rural Development Studies Vol. XIII No. 1 (2010)

Variety Screening and Sweetness Measurement of Grape

Dr. Ranajit C. Adhikary[1]

Abstract

A fruit like grape (Vitis vinifera L.) is a rare food item in Bangladesh but it is popular food item throughout the world. Since there is no grape cultivation and popular variety in Banglades, RDA started experimentation in 2000. A number of samples were collected from different nurseries of Bangladesh containing native and exotics varieties. The varieties were tested from 1999 to 2003 in Nursery-2 and transferred to Nursery-1 in 2004 which were found promising. About 10 varieties were identified through various sizes and shapes of leaves, leaf colour and vine differentiation. Up to last year (2009) eight varieties gave flowers and fruits namely- RDA1, RDA2, RDA4, RDA5, RDA7, RDA8, RDA9 and RDA10. RDA8 and RDA9 yielded 4.40 and 3.60 Kg berries per plant where as RDA1 and RDA10 yielded 510 and 250 g berries per plant. The sugar percentages of RDA1, RDA5, RDA7, RDA8, RDA9 and RDA10 were19- 20%, 12-14%, 17-18%, 18-19%, 12-13% and 18-19% respectively. The variety RDA8 and RDA1 found promising in respect of yield and sweetness.

Introduction

Commercially grapes are by far the most important fruit crop accounting for about one-quarter of the fruit production of the world. On a world basis, they are listed as having the highest monetary value of all fruits and undoubtedly rank higher in amount produced and number of people they feed. About 78% of the world's grape is pressed into wine, 14% is dried and 8% is consumed fresh (Jancis, 1986). Specific cultivars are usually grown for each purpose. The European grape *vitis vinifera (vitaceae)* is grown for wine, fresh fruit and raisins.

There is no hearsay about grape cultivation in Bangladesh on experimental basis though some households reportedly cultivated grape in their kitchen gardens or on fallow lands

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just as hobby. Technological ignorance and varietal unsuitability are mostly known as major factors impeding grape production and extension in this country. "Grape is not an adaptable crop to Bangladesh climate" is a generalized opinion but this conception may be arguably wrong since this lacks supportive experimental evidences (Nurujjaman, 1994). Reversely, grape may be termed as a prospective crop under sub-tropical Bangladesh climate especially when we look at the other tropical countries like Philippines, Taiwan and Thailand which are successfully growing sweet grapes on commercial basis under similar climatic conditions. Due to ignorance of intercultural operations and follow-up nursing after plantation, in most of the cases, desirable production is hampered in terms of taste and yield of produce. Therefore, constant endeavour supported by constant research works on technology development and varietal suitability under Bangladesh agro-climatic context is strongly imperative. So, keeping these in view, Rural Development Academy, Bogra took initiative to conduct a research on grape in 1999-2000.

Objectives of the trial were three fold:

- To collect germplasm of grapes;
- To screen out high yielding varieties of grapes through adaptive trial; and
- To work out sweetness of grape through TSS values.

Varieties/ Lines Collection

Some unknown varieties of grapes spread all over the country were collected after going through the grape articles time to time published in the National and Regional Dailies from 1999 to 2003. The indigenous and exotic varieties of grapes were collected from inland particularly from distant places like- Khulna, Bagerhat, Jessore, Bogra, Gaibanda, Natore, Rajshahi, Chapai Nawabgonj, Dinajpur, Thakurgaon and Dhaka. The varieties named after the name of collected locations are- Padmabila, Mollahati, Keshabpuri, Demajani, Gaibandha, Kanaikhali, Rajshahi, Nawabganji, Dinajpuri and Thakurgaon. Jakkaw and Blackruby were collected From Dhaka – Kashempur and Krishibid Nursery at Manikmia Avenue. Oisharja and Kalmaria, so called two Nepalese and Australian varieties were also collected. One grape seedling developed from seed of marketed variety exported from Australia and at the age of six months transplanted in the main field on 25 December, 2002. Most of the collected indigenous varieties were sown in

June- October, 2000; Kanaikhali in March, 2001; Kalmaria and Oisharja in June- August, 2002. Among them Kanaikhali did not survive lastly. Other than those, two so called seedless oblong varieties (Lalpur and Banglaband) were also sown in December, 2003 in Nursery-2. Seven varieties of twenty three saplings were collected from Benapole, Jessore in January, 2004 (twenty three saplings contained seven varieties were proved through various sizes and shapes of leaves, leaf colour and vine differentiation). After short verification from 1999 to 2003, a total of 55 saplings were re-transplanted in Nursery-1 in RDA Demonstration farm from 24 -27 May, 2004. The 10 varieties (exotic 7, indigenous 2 and 1 seedling developed from seed) were re-named as RDA-1, RDA-2, RDA-3, RDA-4, RDA-5, RDA-6, RDA-7, RDA-8, RDA-9 and RDA-10. As per confirmation, Jakkaw and Blackruby covered almost all the areas of Bangladesh identified at Nursery-2 from 1999 to 2003 which were collected in the name of Padmabila, Mollahati, Keshabpuri, Demajani, Gaibandha, Rajshahi, Nawabganji, Dinajpuri, Thakurgaon, Oisharja and Kalmaria.

Design of the Experiment and Fertilizer Use

The experiment was laid out in filling soil of RDA Farm following design and replication. Replication was made as per availability of the sapling numbers. Sapling numbers were different from variety to variety. Fertilizer dose for all plants were the same. Sugarcane compost, Urea, TSP, SOP, Gypsum, Magnesium sulphate, Borax were applied 20 Kg, 450 g, 800 g, 500 g, 100 g, 100 g and 50 g respectively. Except sugarcane compost all fertilizers were applied in two installments, first half in the month of November and last half in the month of February. Ripcord for insects and cupravit for fungus diseases control were sprayed after every 10 days @ 5 ml /g medicine with 10 Litres of water. Most of the time 30 Litres of pesticide mixture of water sprayed 55 plants. Pruning was done in the month of February. From November to February irrigation was given after every 15 days and with increasing temperature frequency of irrigation was increased up to mid June. For bigger size and sweetness of the grape clusters were dipped in 100 ppm Gibberelic acid (GA) solution at 4mm diameter of the berries (ProGibb Bulletin, 1987).

Layout of the Vine Yard at RDA Nursery-1

Variety/Line	R_1	R_2	R_3	R_4	R_5
V1-RDA1 (Sapling no. 8)	V_1	V_1	V_1	V_1	V_1
V2-RDA2 (Sapling no. 3)	V_2	V_2	V_2	-	-
V3-RDA3 (Sapling no. 3)	V_3	V_3	V_3	-	-
V4-RDA4 (Sapling no. 2)	V_4	V_4	-	-	-
V5-RDA5 (Sapling no. 2)	V_5	V_5	-	-	-
V6-RDA6 (Sapling no. 1)	V_6	-	-	-	-
V7-RDA7(Sapling no. 4)	V_7	V_7	V_7	V_7	-
V8- RDA8 (Sapling no.9)	V_8	V_8	V_8	V_8	V_8
V9- RDA9 (Sapling no. 22)	V_9	V_9	V_9	V_9	V_9
V10- RDA10 (Seeded sapling no.1)	V_{10}	-	-	-	-
Total Saplings-55					

Results and Discussion

The grape vines were transplanted in 2004 and 3 saplings fruited in 2007, 5 saplings (including 3 of the last year) fruited in 2008 and 45 saplings fruited in 2009. The reproductive buds came out in the month of February and cluster of flowers called panicles started blossoming from first week of March and continued up to third week. The exotic varieties of grapes (RDA1, RDA5 and RDA7) ripened and harvested on 07 June, 2009. The indigenous variety of grape (RDA8) started ripening from first to third week of June and RDA9 ripened in mid July. From the study it is found that most of the panicles of RDA8 consisted of 50-60 fruits after thinning and weighed 140-170 g averaging 3.0 g per fruit. The mature fruits were large, juicy and round in shape and filled with large quantities of soluble sugars. The collected native variety of grape (RDA8) showed two seeded slipskin characteristics, i. e. the skin of the fruit (epicarp) was readily separated from the pulp (mesocarp) when fruits were eaten. On an average, 4.40 Kg and 3.60 Kg of grapes were harvested from each sapling of RDA8 and RDA9. The variety RDA1 and RDA10 are sweet and seedless and crunch at chewing. The size is relatively small and oblong. The single bunch of RDA1 consisted of 196-210 berries of 510 g wt.

and RDA10 produced about 250 g berries. The sugar percentages of RDA1, RDA5, RDA7, RDA8, RDA9 and RDA10 were19- 20%, 12-14%, 17-18%, 18-19%, 12-13% and 18-19% respectively. The sugar percentage of marketed variety (Australian and Indian grape) is 20-23%. We are very much hopeful and interested with the variety RDA1, RDA8 and RDA10 until others become fruited and tested. Three Jakkaw saplings fruited again in June and another harvesting is possible in September of the same year.

Table-1: Yield of Grape 2009 (g/plant)

Variety/Line	Budding month	Flowering month	Ripening month	Average Yield (g/Plant)
V1-RDA1 (Sweet oblong variety)	February 4w to March 1w	March 2w	June 1w	510
V2-RDA2 (Sweet small variety)	February 4w to March 1-2w	March 2-3w	June 1w	490
V3-RDA3 (Not yet fruited)	-	-	-	000
V4-RDA4 (Black variety)	February 4w to March 1-2w	March 2w	June 1w	320
V5-RDA5 (Dog ridge)	March 1-3w	March 2w	June 2w	100
V6-RDA6 (Not yet fruited)	-	-	-	000
V7-RDA7 (Wine variety)	February 4w to March 1-2w	March 2-3w	June 1w	330
V8- RDA8 (Jakkaw)	February 4w to March 1-2w	March 2-3w	June 1w	4400
V9- RDA9 (Blackruby)	February 4w to March 1-2w	March 2-3w	June 3w to July 2w	3600
V10- RDA10 (Seeded variety)	February 4w to March 1w	March 2w	June 1w	250

W= Week

Production and Marketing

It is found that RDA-8 is capable of producing 4.0 kg grape/ plant. As per transplant procedure 10.00 sq.m land is needed for each and every vine. So, 1000 vines can be

transplanted in 1.0 ha of land or, 400 vines/ acre or, 135 vines/ bigha. As a result, per hectare or per acre or per bigha yield will be 4000 Kg. or 1600 Kg. or 540 Kg of grape and @ Tk. 100.00/ Kg of grape total gross income will be Tk. 4,00,000.00 or 1,60,000.00 or 54000.00 respectively. In every household of 10 decimal plot, 40 vines can be transplanted and yield will be 160 Kg of grape and income will be Tk. 16,000.00. So, poverty alleviation and nutritional problem can be solved easily like incase of other fruits and a number of labours can be employed in grape garden if it is thought to be cultivated on commercial basis. It is remembered that if once a grape garden is established it will be continued up to 80 to 100 years or more.

Table-2: Results of Sweetness Observed in 2009

Sl.No.	Variety/Line	Characteristics	TSS Value (%)	Remarks
1.	RDA-1	Sweet variety	**19-20**	TSS values of RDA's grape are nearer to the marketed grape.
2.	RDA-5	Rootstock type	12-14	
3.	RDA-7	Wine variety	14-18	
4.	RDA-8	Jakkaw variety	**18-19**	
5.	RDA-9	Blackruby	12-13	
6.	RDA-10	Developed from seed	18-19	
7.	Indian variety	Collected from market	20-21	

Table-3: Results of Sweetness Observed in 2008

Sl.No.	Variety/Line	Characteristics	TSS Value (%)	Remarks
1.	RDA-1	Sweet variety	**20-21**	Sugar percentage of RDA's grape is nearer to the Australian marketed variety.
2.	RDA-5	Rootstock type	12-14	
3.	RDA-7	Wine variety	14-18	
4.	RDA-8	Jakkaw variety	**18-19**	
5.	RDA-9	Blackruby	12-14	
6.	Australian	Collected from market	21-23	

Table-4: Results of Sweetness Observed in 2007

Sl.No.	Variety/Line	Characteristics	TSS Value (%)	Remarks
1.	RDA's variety	Seedless variety	19-20	TSS value of RDA's variety is nearer to the marketed variety.
2.	Jakkaw	Locally collected	16-18	
3.	Australian	Collected from market	21-23	

Observations

On the basis of experimentation conducted in the RDA Nursery-1 grapes are grown well in warm sunny climate with mild winter and dry periods during fruit ripening. The vines shade their leaves and go hibernation in winter, put forth new growth in spring and mature in summer. Generally, grape does not thrive in humid summer. It can tolerate frost and foggy weather during the resting period but succumbs to it readily during its growing period. At flowering time bright sky yields more grapes. At blossom and green grape stage low temperature and at ripening high temperature with dry weather are better. It was observed that for rains at flowering and ripening stages flowers ran down and fruits became less tasty as well as smaller than the desirable size. So, grape harvesting is desirable before rain. The harvesting period may bring earlier through pruning and hormone application and if not, spreading cover over the garden to protect rain may be the alternative.

The problems facing for the exotic grape cultivation in RDA farm are the fungal diseases i.e. downy mildew, powdery mildew and anthracnose. The severity was observed both in monsoon and winter seasons and mostly on leaves and young shoots. Downy mildew was found to occur under humid weather conditions, powdery mildew in dry and cold climate and anthracnose in rainy season.

Major Points of Grape Production Technology

- Grape vines should be transplanted in sunny place.
- There should not be any water logging in the vineyard.
- Grape vines and canes should be pruned every year particularly from 15 January to 07 February.
- Soil around the plants should be fertilized after loosening it by spade.
- To reduce acidity or to increase p^H (> 7.0), soil should be ameliorated with lime.
- Shady place is not suitable for grape.
- Side buds of the vines should be avoided before their reaching the fences or trellises.

- Terminal buds of the vines should be broken after their reaching in the trellises so that lateral branches may come out at least two from each side.
- When the lateral branches will be 50 cm long, terminal buds should be broken again so that 16 branches may come out and almost cover the trellises.
- Since grape vines may live long (80 –100 yrs), trellises should be prepared using iron or cemented pillars.
- Grapes grow in a wide variety of soils but do best in sandy loam, highly organic soil of p^H 5.5 to 7.5 that has been supplemented with compost or manure. Heavy clay soil usually induces many leaves but produces relatively few and inferior grapes.
- For transplanting grapevines March-April is the appropriate time.
- Grapes mature in 110-120 days. They grow well in warm, sunny climate with mild winter and dry periods during fruit ripening.
- When grapes become spongy at the age of 70-80 days after blossom they may be in the last stage of sourness and this is not at all ripening stage.
- Sugar content increases after 80 days and it is in the pick in 120 days or more. Ripe grapes show waxy and straw colour.
- Grapes should not be touched with fingers because it removes waxyness and lessens market value.
- Insecticide spray should be prohibited after flowering because it hampers pollination.
- From early spring to before rain irrigation should be done regularly.
- Grapes are potash-loving crop. So, plants are sufficiently fertilized with potash.
- At mungbean size grapes, cluster should be thinned so that the size and shape of the grapes become uniform.
- To avoid rain at ripening stage panicle/bunch should be covered with polythene, otherwise the shape and size of the gapes may be deformed and the grapes may be cracked and tasteless.

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ISSN 1019-9624
The Bangladesh Rural Development Studies Vol. XIII No. 1 (2010)

Comprehensive Village Development Program: A Sustainable Approach to Rural Development

Md. Habibur Rahman[1]

Abstract

Comprehensive Village Development Program started its experimental journey in 1975. It took the shape of an action research project under ADP in 1988-89. Experimental Phase was wound up in 2004 and the pilot phase of the project was begun in 2005. The implementing agencies were BARD, RDA, BRDB and Co-operative Department. It is found that CVDP has been able to develop a strong institutional base at the village level having massive participation of the people. Training provided by the project has created a huge impact in the areas of technology transfer, employment and income generation. CVD cooperatives have become able to launch their credit Programs with their own capital and stand on a solid foundation. This is how the cooperatives under CVDP are flourished as self-sustained organization at the village level.

Background

The Co-operative Movement in this Sub-continent was started in 1904 with a view to reducing poverty through providing credit to the small farmers, landless, artisans and others. Under the Co-operative Act and Rules a few organizations like agricultural cooperatives, weavers, fishermen, sugar-cane, milk producers cooperatives etc. were formed under direct supervision of the Department of Co-operatives. But those traditional cooperatives could not provide significant breakthrough towards the qualitative change in the life of the rural people. During 1960's the two-tier co-operatives came into existence and later on some informal societies were formed under Bangladesh Rural Development Board (BRDB). Beside, a large number of groups or samities were formed by the Non-Government Organizations. As a result of hasty formation of various village level organizations, a village has been divided into many parties or factions. Consequently, disparity took place among the villagers in lieu of unity and cohesion. Thus, assistance-dependent development culture has grown. Comprehensive Village Development

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Program (CVDP) has been emerged as an alternative to those traditional development approaches.

Comprehensive Village Development Program was initiated by Bangladesh Academy for Rural Development (BARD), Comilla in 1975 in the name of 'Total Village Development Program (TVDP)' with a view to examining the one-village-one-organisation concept. The central thrust was given to mobilisation and utilisation of local resources for making villagers self-reliant irrespective of age, sex, class and profession. The project was included in the 3rd FYP and renamed as 'Comprehensive Village Development Program'. The Second phase of the project was started in 1991-92 during the Forth FYP, and the Rural Development Academy (RDA), Bogra was involved as an implementing partner with BARD. In this Phase, CVDP was implemented by RDA and BARD in 80 villages of Rajshahi, Khulna, Dhaka, Chittagonj and Sylhet Divisions. The experimental phase of the project was wound up in June 2004.

In the experimental phase, CVDP was able to create positive impacts for the betterment of the rural people and could convince the government to adopt CVDP as a **model concept** for rural development. It was decided to implement the project in 21 Upazilas of 19 districts for a period of four years on **pilot basis** before going for wider replication throughout the country. This phase was started in July 2005 and ended in June 2009. It was undertaken under the aegis of Rural Development and Co-operatives Division of the Ministry of LGRD & Co-operatives. RDA, BARD, BRDB and Department of Co-operatives worked as implementing agencies in the pilot phase.

Bangladesh is a developing country where forty percent of the population lives below the poverty line. The Poverty Reduction Strategy Paper (PRSP) of the government targeted to reduce the rate of poverty to 50% by the year 2015. Again, there are eight Millennium Development Goals (MDGs) which have also to be achieved by 2015 (Rahman, 2007). The objectives of MDGs are:

- to reduce absolute poverty and uncertainty of food security;
- to reduce the number of people below the poverty level to 50%;
- to reduce the disparity of education of secondary and higher secondary level among men and women;

- to reduce the rate of infant mortality;
- to reduce the rate of maternal mortality by 75%;
- to ensure reproductive health;
- to establish social justice for disadvantaged groups especially for women and children; and
- to reduce risk in disaster management and ensure sustainable development.

CVDP is designed to address all the issues through its different components like training and motivation, production and employment, health and sanitation, plantation and so on. It has given priority on training over micro-credit. But it gives emphasis to build up the capital base so that the Comprehensive Village Development Co-operative Society (CVDCS) can launch self-financed credit Program in order to create self-employment and additional income of the co-operators. The present study highlights the impact of CVDP in the light of socio-economic emancipation of the beneficiaries. The study covers general information of the participants, their occupation, income and employment as a result of training and micro-credit of the co-operative societies, building linkage and decision making etc.

This report is based on the secondary data and observations. Some secondary sources of data such as research reports on CVDP, annual reports of the project, resolution registers, proceedings of monthly joint and coordination meetings and final evaluation report of the project are consulted.

Performance of CVDP at Different Phases

First Phase: This phase was implemented by BARD. The first phase started in January, 1989 and ended in June, 1991. During this period 30 village cooperative societies were formed in the Sadar Upazila of Comilla and Sylhet districts. Under those societies 6974 individuals became member and accumulated Tk. 19.20 lakh as savings and Tk. 65.72 lakh as share capital. A total of 1655 co-operators of the project were provided training on awareness building and skill development in various aspects (RDCD, 2009).

Second Phase: Both RDA and BARD were jointly involved in implementing the second phase of the project started in 1991 and ended in 1996. In this phase the project

was implemented in 80 villages of eight Upazilas under four Divisions. The project covered 66% families of the project area and the aggregated number of the members of the societies were 15,880. Total capital of those societies stood at Tk. 139.27 lakh of which savings was Tk. 49.35 lakh and the share capital was Tk. 89.92 lakh. Apart from these, the societies created resources/assets of their own worth Tk.199.21 lakh. The societies have distributed loan of Tk. 110.65 lakh to 7890 co-operative members. The societies distributed Tk. 21.00 lakh to 938 members from seed capital and rate of repayment of the loan was 94%. Various issues related to rural development were acquainted to the members of the societies through management and skill development training from the project aiming at making them self-reliant. In addition, awareness raising Program on modernization of agriculture, providing health care facilities along with family planning services, sanitation facilities and other relevant issues were undertaken to make them enable in harvesting supports from Nation Building Departments (NBDs).

Third Phase: Third phase was started in July 1996 and ended in June 1999. In this phase the project area was same as to the second phase. The project covered 70% families of the project area and the total number of co-operators was 19,638. By now, total capital stood at Tk. 260.05 lakh. Out of this, savings was Tk.136.57 lakh and share was Tk. 123.48 lakh. Apart from this, the CVDP societies created resources/assets amounting to Tk. 305.88 lakh. The societies disbursed Tk. 212.00 lakh to 10,290 members from their own fund and Tk. 101.00 lakh distributed to 5208 members from seed capital and rate of repayment was 95%.

Demonstration phase: The Demonstration phase was started in July 1999 and ended in June 2004. Throughout this phase the result and learnings of the previous phases was brought into the notice of the general masses. In other words, this may be called as result demonstration phase. The project area remained the same i.e., 80 villages of eight Upazilas. The project covered almost 80% families of the project area through 26,503 socicties. An amount of Tk. 377.87 lakh was accumulated as capital of the societies of which savings deposit was Tk. 201.56 lakh and share Tk. 176.31 lakh. Apart from this, the societies created fixed assets of Tk. 400.92 lakh. The societies distributed Tk. 500.00 lakh to 7142 co-operators from seed capital and societies' own fund. Apart from employment and income generation, social development was quite remarkable.

The pilot phase: The Pilot phase of CVDP was started in July 2005 and wound up in June 2009. The project was sponsored by Rural Development and Co-operatives Division and implemented by BARD, RDA, BRDB and Department of Co-operatives. It was implemented in 1575 villages of 21 Upazilas in 19 districts under six Divisions. The project covered 75% families of the project area and the aggregated membership- of the societies was 175577 from 135468 households (April 2009). The accumulated capital raised to Tk. 2091.41 lakh. The societies have distributed Tk. 1570.55 lakh to 29324 co-operative members from the societies' own fund and repayment rate of the loan was almost 98.30%. The project has contributed a lot to create self-employment and poverty reduction of the rural poor. The salient feature of the credit Program is that the co-operative societies need not borrow money from outside sources as they became able to operate micro-credit from their own sources. After his visit to 20 Thanas in 1971 Dr. Akhter Hameed Khan expressed his happiness to see that the co-operative societies deposited savings and repaid the loan on regular basis. He remarked that "co-operative societies should stand on these discipline and practice, they should not borrow money from outside sources and they should not be dependent on the Central Bank for additional money. The lending money has to be repaid within the stipulated time" (Khan, 1971). CVDP perceives this ideology of Dr. Akhter Hameed Khan in order to make the co-operatives self-reliant.

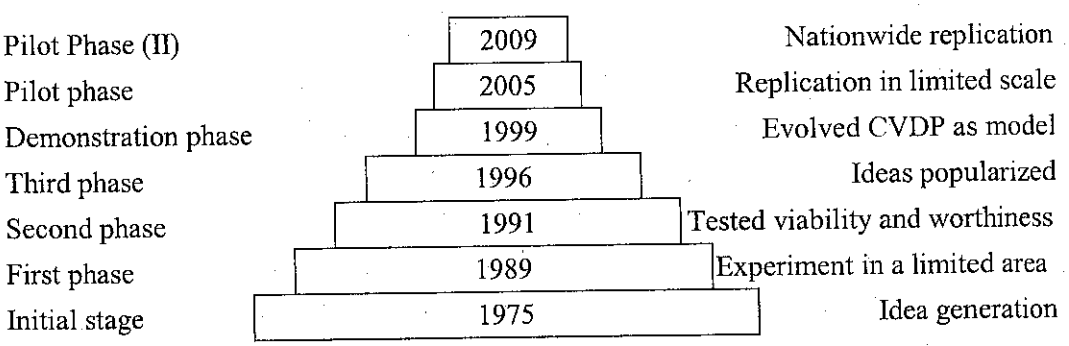

Figure -1: Gradual Evolution of CVD Model

Different studies on CVDP showed positive impact in the project areas. Changes in occupation and landownership were seen. Due to capital accumulation and investment employment generation were also observed. Training has contributed a lot towards those

changes. Micro-credit from the societies' own fund played a vital role in generating employment opportunities and additional income for the co-operators and contributed a lot to social development of the villagers, especially in family planning, EPI, hygiene and sanitation promotion and education. It was found that 77% (39) of trained cooperators got self-employment and earned an amount of Tk. 17,390.00 per capita annually by utilizing their training knowledge and skill (Ahmad, 1999). Similarly, 84% (142) of the trained co-operators had been able to do so. Of them, 88 got self-employment and earned a total net amount of Tk. 2, 27,033.00 (Rahman, 2008).

An Evaluation study conducted in March, 2009 on CVDP in 10 Upazilas by an Inter-Ministerial Evaluation Committee showed that the project has been able to create a huge impact on the livelihood improvement of the beneficiaries. Some of those are highlighted in a summarized form below:

(a) **Occupational change:** Occupation has been considered as an important indicator to measure the social status and improvement of a person. Findings of the evaluation study show that a considerable change in occupations of the cooperators has taken place. Training and micro- credit were found to be the contributing factors towards the changes. A total of 31 persons (19.37%) were engaged in farming, previously the number was 22. It was found that the unemployed youth has secured employment as a result of micro-credit supported training. Training on tailoring, handicrafts and electric and house wiring have made a breakthrough to change their profession.

(b) **Change in land ownership:** All landowner and landless can take membership to the Comprehensive Village Development Co-operative Societies (CVDCS). The evaluation report indicates that there were 160 respondents. Of them 91 (57%) were landless having a piece of land below 50 decimal. Small farmers were 54 (34%), medium farmers were 14 (9%) and large farmer was only one. It is evident that the landowners from all categories had access to the co-operative societies as member. This is a unique feature of CVDP societies. This has contributed to build a amicable atmosphere and social harmony among the co-operators and the villagers as well.

(c) **Income:** Income is an important indicator to measure the socio-economic development of the co-operators. CVDP is a poverty reduction project having multi-dimensional activities. Findings of the evaluation study show that the respondents could earn their income from 15 various sources. About 95% of the respondents were found able to earn while it was only 4% before joining CVDP. Total amount of income was found Tk. 34, 67,312/- and Tk. 17, 96,263/- respectively. That means the ratio of income level is about 66:34. Twenty four respondents belong to income group of Tk. 50,001/- and Tk. 60,000/-, previously it was only 11 persons (RDCD, 2009). Their principal sources of income were tailoring, farming and petty business. Cattle and poultry rearing, pisciculture, service were some of the other major income sources.

(d) **Capital formation:** The CVDP societies have been able to form a capital of Tk. 2091.41 lakh (April 2009). The evaluation report showed that the respondents have accumulated a capital of Tk. 3, 95,200/- i.e. Tk. 2470/- per capita. Out of this, the share of male and female members were Tk. 2, 29,839/- and Tk. 1, 65,361/- respectively. The woman cooperators were found parallely competent in depositing their savings as the male partners. The evaluation report also depicted that the co-operators were found active and punctual in weekly savings and other deposits as their income generating activities got momentum. As a result, the societies gradually acquired ability to operate the credit Program with their own capital.

(e) **Micro-credit:** In CVDP societies there is no provision of disbursing loan from the project fund. The co-operative societies are playing the same role as the project or any other financing institutions do. Different reports on CVDP show that on an average more than 60% co-operative societies under CVDP operate their own credit Program efficiently. The number of such societies under BARD and RDA were 80%. A total of Tk. 1570.55 lakh has been disbursed to about 30,000 cooperators and the recovery rate of loan was 99%.

It was also found in the evaluation report that 62 respondents (38%) were provided credit with highest amount of Tk. 5000/-per head. They utilized their credit for the purpose of petty business, poultry and duck rearing, beef-fattening, leasing in land, purchase of sewing machine and van/rickshaw, pisciculture, nursery etc. They

earned an annual income Tk. 23, 39,705/- while it was only Tk. 9, 44,165/- before taking the membership of the cooperatives. In this way, their per capita present income rose to Tk. 37,737/- and it was only Tk. 15,228/- before joining the co-operatives (RDCD, 2009). It has been observed that the credit Program of the co-operative societies has become the real strength day by day. Their dependence on outside sources of credit has declined gradually. As a result, some NGOs have been compelled to withdraw their Program from some CVDP villages.

f) **Linkage between CVDCS and NBDs:** CVDP believes in collaborative approach. It plays a catalytic role to push the co-operatives towards achieving the goal of the project. Comprehensive Village Development Co-operative Society (CVDCS) formed in 1575 villages comprising the villagers. These organisations interact with all the Nation Building Departments (NBDs) and Local Government Institutions (LGIs) like Union Parishad and Upazila Parishad. On the other hand, all the departments extended their hands to support the villagers. In some cases, NGOs also work closely with the village co-operatives. Thus, CVDP societies have been emerged as a 'lead agency' in the village to provide all inputs including micro-credit towards becoming a self-reliant society.

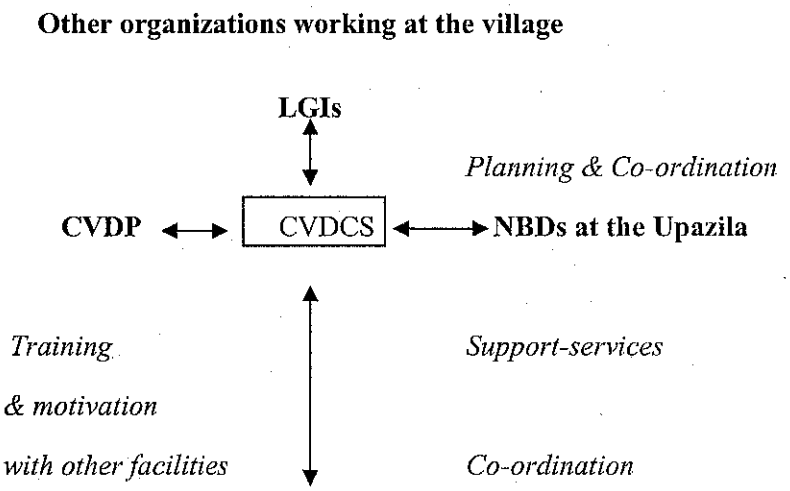

Figure-2: Linkages between CVDP and other agencies.

Nation Building Departments (NBDs) at the Upazilla level are the main centres for chanalization of inputs for undertaking different activities related to agriculture, fishery, livestock, family planning and so on in the rural areas. In many cases these inputs cannot reach the villagers in time due to lack of proper coordination and linkage between the officials and the villagers. CVDP societies have made it possible to reach the rural community as a whole.

CVDP has made necessary arrangements for holding meetings and sittings both at the Upazila and the society levels which were participated by UP representatives, Upazila level officials and cooperators. This forum works for establishing a good linkage between the service providers and service recipients. This is done through Monthly Joint Meeting, the co-operators named it as *'Mashik Milon Mela'*. Thus, CVDP has succeeded to improve service delivery and receiving mechanism in the rural areas.

Summary and Conclusion

CVDP is being designated as poverty alleviation project having components of management and skill development training, self-employment and income generation, health and sanitation including maternity and child care, livestock and fisheries development, plantation and so on. So it is very difficult to quantify its benefits in terms of monetary value. But definitely it has brought a qualitative change in the standard of life of the village people as a whole. Training has played a key role towards the positive changes in terms of employment and income generation, increase of agricultural productivity, development of fisheries and livestock, improvement in health and family planning, promotion of hygiene etc. In the mean time 1575 co-operative societies have been formed. Within the purview of the co-operatives, villagers directly or indirectly get benefit from the project. The co-operators are getting support-services for social and economic development from the Upazila level Nation Building Departments. The capital generated by co-operators through weekly savings, shares and other deposits has been invested for production and income generation and the number of beneficiaries stand at 877,885 so far (as on May 2009). Apart from these, a 'bottom up planning' mechanism has been evolved with the active participation of the villagers, UP representatives and Upazila Parishad members.

Rural Development is not a one-shot game; rather it comprises a set of multifarious activities. Rural Development encompasses all the socio-economic components related to human development such as health and sanitation, family planning, education, environment protection, employment and income generation and so on. CVDP comprises all these issues to achieve a level for sustainable development. It seems that CVDP has been able to evolve as an independent and effective village level institution having multi-dimensional initiatives like own capital base, group cohesiveness and social integrity. A considerable number of CVDP co-operatives are found as Lead Organization in the villages. They are playing effective roles in reducing the poverty level of the village community. CVDP has given rise to a good deal of learnings which can be summarized as follows:

a) Co-operatives can run with their own if they are provided backup support in holistic approach.

b) Co-operatives have to develop a capital base through thrift deposits and shares so that they become able to disburse credit from their own fund. CVDCS believe that credit from outside sources can only help to subsistence, not to make sustainable development or growth.

c) Co-operators can plan, manage and help themselves if they are guided by a group of dedicated development workers. That means, they can exercise their power and wisdom for changing the society.

d) Training plays contributing role for development in terms of employment and income generation.

e) The linkage between the Nation Building Departments (NBDs) and the village organizations together can play vital role in planning and utilizing resources in convergence approach.

f) The urge for development should come out from the villagers, not from an outsider. Villagers know the pros and cons of their society. They are capable of making solution of their problems, just they need freedom to move and act.

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পল্লী উন্নয়ন ও সমবায় বিভাগ, (২০০৯)। সার্বিক গ্রাম উন্নয়ন কর্মসূচীর চূড়ান্ত মূল্যায়ন প্রতিবেদন।

রহমান, মোঃ হাবিবুর রহমান (২০০৭)। "দারিদ্র বিমোচনে সার্বিক গ্রাম উন্নয়ন সমবায় সমিতিসমূহের ঋণ কার্যক্রম, বাংলাদেশ পল্লী উন্নয়ন সমীক্ষা, খন্ড ১১, আরডিএ।

রহমান, মোঃ হাবিবুর (২০০৮)। সার্বিক গ্রাম উন্নয়ন কর্মসূচী - একটি টেকসই গ্রাম উন্নয়ন মডেল, আরডিএ।

ISSN 1019-9624
The Bangladesh Rural Development Studies Vol. XIII No. 1 (2010)

RDA-Technology Convenient for Addressing Water Crisis at Village Level: A Case Study of Neighboring Community of Boropukuria Thermal Power Plant

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Abstract

Boropukuria 300 MW Thermal Power Plant was established in 2003 based on the coal withdrawal locally and had production in March 2006. About 1200 Mt of water is extracted from Deep Tube wells (DTWs) 12 in number having capacity of 125 Mt and head 58 m each to run the plant successfully. Average distance among the TWs is 137 m which is inconvenient. There are about 2300 family of three adjacent villages (Eusufpur, Dudhipur and Sherpur) are suffering a lot due to depletion of static ground water (GW) level that goes beyond the pumping level of Hand Tube-well (HTW) as extracting required quantity of water from a confined area. The static water level in the observation well no. 04 which is 30 feet away from DTW no. 09 was found 13.3 m which is beyond the pumping capacity of HTW.

The Centre for Irrigation and Water Management (CIWM) of the Rural Development Academy (RDA), Bogra has been disseminating its rural piped water supply model for supplying safe portable water from its own financial assistance to relief the water scarcity of the local people immediately. Under this activity an automatic DTW and overhead tank having capacity of 10,000 liter have been installed at Eusufpur village. A total 2745 m length of uPVC domestic water supply network has been constructed and about102 Nos. families are connected with the network and they are supplied with safe water for drinking and household purpose. Peoples were trained on various IGAs and supported by RDA-credit to take the IGAs in action. Additional income then ensured by using water as productive input and makes them able to pay the water charge. The socio-economic level of local people is improved through the active participation and better access in the field of water resource management. The model has drawn attention for addressing water crisis at rural level.

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Introduction

Bangladesh is a land of river. A number of rivers crests-cross over the country. Most of these rivers pass by crossing over the trans-boundary. About 93% flows through these rivers come from international boundary and we have no control on them, the rest 7% are local precipitation. Due to this geographical position, in rainy season plenty of water causes flood and faces drought in dry season, lot of people migrate for searching work. In spite of this large flow till now 95% of our irrigation demand meet up from ground water (Matin *et. al.* 2000, 2001). So the adequate storage and proper management of these natural resources is highly imperative.

To meet up the increasing demand of electric power Boropukuria 300 MW thermal power plant was established in 2004. To meet up the water requirement (1200 Mt per hr) of the plant a total of 14 Nos. of DTWs were installed at the adjacent villages based on the ground water source. The plant started its production in full scale in the year 2006. After its inception, severe water crisis appeared in the adjacent villages due to withdrawal of required quantity of water. The crisis worsened day by day. To take the existing situation in control the honorable members of the Board of Governors (BOG) of RDA given the responsibility to the water resource experts engaged in CIWM to explore an alternative source for ensuring drinking water supply for the victims of the adjacent villages of the Boropukuria power plant.

Objective of the Study

The main objective of this study is to address the reasons of acute drinking water crisis which have been taken place at the adjacent village after inception of Boropukuria Thermal Power Plant and search out an appropriate system to ensure safe drinking water supply. The specific objectives are as follows:

- To quantify the water requirement of the Power Plant and asses the alternate arrangement
- To identify the discrepancy of the existing source examining all technical aspects
- To examine the authenticity claimed by the local people and
- To explore a suitable arrangement in order to overcome the adverse situation

Methodology

Severe drinking water crisis has been occurred in the adjacent village of Boropukuria Thermal Power Plant due to withdrawal of required amount of water. The situation was broadcast in various media. The study was carried out in February 2006 by the water resource experts of CIWM, RDA, Bogra. The team visited the affected site physically. Both primary and secondary information were collected from the sources as pointed out bellow:

1. Discussion with the administration of the Power Plant Authority;
2. Observation and examination of the printed materials and drawing supplied by them;
3. Observation of the situation exists at field level practically; and
4. Talk to the affected people, asses their problem and inspect the reality.

Reviewed all the information and data collected by the team and explored a fruitful solution analyzing the information profitable for the poor people.

Findings

It was decided by the authority in 2002 to install a 300 MW Thermal Power Plant at Boropukuria based on the coal collected locally to meet up the increasing demand for electric power. The technical information collected by the researcher is discussed here.

Technical Specifications of the Plant

The design capacity of the plant was 250 MW (Two number of plants having capacity of 125 MW each), but actually the plant produces about 235-240 MW electricity. Total 1200 M tons of water is required to operate the pant properly. Out of this amount only 30 M tons water is processed by the Reverse Osmosis (RO) system. The processed de-mineralized water is provided to the boiler as input for steam generation. Generator is operated by the steam. Rest amount of water is shifted to cooling tower. The plant has two cooling tower and each tower has seven number of cooling fan. Evaporation loss taken place in the fan is about 12.4 M ton per hour. The total evaporation loss is about

(12.4 m tons/fan/hr. X 7 Nos. fan X 2 tower) = 137.6 m tons. After evaporation the rest amount of water is drained out in the river Telai which is two km away from the plant. The drain is not protected, it is about 6.0m wide and 5.0m depth.

Information on Water Extracting Means

The Thermal Power Plant has installed 14 DTWs in the area acquiesced by the authority for extracting required quantity of water. Total seven Observation (OB) wells have been installed to observe water level of production DTWs as well as the GW situations. From the discussion with the concerned authority and printed materials supplied by them it was found that the liner distance between the DTWs are about 137 m which violated the law. Picture-1 shows the positions of the DTWs. Ground water level at the adjacent area is depleted as the plant authorities are abstracting a large amount of water in comparison with GW recharge by the DTWs from a confined area. The information of DTWs and pump specifications collected from the Power Plant Office are shown in Table-1 and 2 respectively.

Table-1: Technical Specifications of DTWs Installed at Boropukuria Power Plant

Housing pipe		Blind pipe		Strainer			Sand trap		Total
Diameter (mm)	Length (m)	Diameter (mm)	Length (m)	Diameter (mm)	Length (m)	Slot Size	Diameter (mm)	Length (m)	length
325	23.14	325	16.30	325	41.53	-	325	17.69	98.66
325	18.71	325	27.68	325	38.57	-	325	10.94	95.90

Source: Boropukuria Thermal Power Plant Authority

Table-2: Pump Specifications of DTWs Installed at Boropukuria Power Plant

Discharge (m^2/Sec)	Pumping head (m)	Power (kW)
125	58	30

Source: Boropukuria Thermal Power Plant Authority

Required number of DTWs are in operation to meet up the demand and the rest are in standby condition. Every DTW was run for seven days at a stretch. At the time of visit No. 09 DTW was run for 6 days. Pumping water level was measured in OB well No. 04 was 13.3 m which is 9.1 m away from the production DTW and beyond the suction limit

of hand tube well (HTW). The static water level in the observation wells are recorded in Table-3.

Table-3: Pumping Water Level in the OB Wells at Boropukuria Power Plant

Date of observation	Pumping water level (m)							Remark
	OB Well-01	OB Well-02	OB Well-03	OB Well-04	OB Well-05	OB Well-06	OB Well-07	
03/02/2008	-	11.35	10.70	12.20	-	10.34	12.08	Beyond the HTW
03/02/2008	-	11.45	10.80	12.25	-	10.45	12.10	
03/02/2008	-	11.65	11.10	12.30	-	10.85	12.45	

Source: Boropukuria Thermal Power Plant Authority

From the Table-3 it is found that the minimum water level in the OB well was 10.34 m, that is beyond the suction limit of hand tube well i.e. 7.62 m. So the hand tubewells present in the village cannot pump water.

Real Scenario of the Village

Ground water level has been depleted due to excess withdrawal of GW to meeting up the required quantity of water from the confined area. Each and every family of the village (Eusufpur, Dudhipur and Sherpur) adjacent to the Power Plant have the HTW of their own but have been suffering a lot for scarcity of drinking water. Two deep-set HTW are in the village to meet up the drinking water demand only. It is strained to operate; only a little amount of water can be collected with drudgery. Three villagers named Horipodo, Umakanta and Amulla have stated that they obtained available water before the inauguration of the Plant and water was attained easily by hand pump option over the year. At present about 2300 families of these three villages are being passed an awful life. Most of the families are hardcore poor and lived their life on agriculture. In spite of their poverty, they are willing to afford rural piped water supply facility and pay the water charge on regular basis.

Mr. Sohir Uddin lived in Usufpur village. He said that he had a deep-set HTW that could not pump water. They were being watered from neighbor's house and had bath in irrigation channel of DTW installed by Barind Multipurpose Development Authority

(BMDA). Moture Rahman was the inhabitant of the same village and had a deep-set HTW also. Small amount of water was being abstracted by drudgery. All villagers were depended on this source. Same situation was being appeared for Shallow Tube-well (STW) and most of the lands remained un-irrigated beyond the command area covered by BMDA.

RDA's Initiatives against the Arisen Situation

The Centre for Irrigation and Water Management of RDA, Bogra has been disseminating the low-cost water harvesting means with rural piped water supply system developed by them to meet up the adverse water crisis of the local people immediately under its own financial assistance. Activities undertaken are described bellow sequentially.

Low-cost DTW Installation

A low-cost DTW have been installed by CIWM at the central point of the village. The DTW is fully automatic; it can be operated automatically without operators' intervention. The boring depth of the borehole is 60 m and the borehole capacity is one lakh liter per hour. The pump immerged in the borehole is 18 m^3/hr capacity. Water extracting capacity could be increased upto 75 m^3/hr. if the future demand stands greater than before. The DTW becomes active if the water level in the overhead tank is depleted bellow the level marked earlier and be active until water level is raised up to attained the tank full. This automatic DTW ensured the uninterrupted water supply among the villagers.

Construction of Overhead Tank Domestic Water Supply Network

An overhead tank of 10,000 liter capacity has been constructed near the borehole for supplying safe portable water among the villagers. The tank height is 6 m. A total of 2745 m uPVC domestic water supply network is assembled at the village for facilitated portable water supply to about 102 households. Among the HHs a tap connection is ensured from the expended budget. Some of the families are extended this connection and facilitated water points at their desired locations such as bathroom, kitchen, dining space and so on. Many of the families are ensured shower facility at bathroom from their won cost. Safe drinking water supply has been ensured to about 102 HHs of Usufpur village by means of this model during inauguration period. Connections will be increased day by day. Initially Tk. 200/- was set as connection fee. People of this village enjoyed safe

portable piped water supply facility and paid Tk. 100/- per month per HH in the first week of each month on prepaid basis. So there will be no chance of overdue.

Improvement of Rural Life Style

The villagers are using safe water supply not only for drinking purpose but also for their poultry, dairy rearing activities as well as homestead vegetable gardening. Generally village people are not conscious about safe water. Due to their poverty they are not financially and mentally able to pay the water charges. When water is used only for drinking and household purposes it is treated as consumable item and one should have to pay the water charges from i) current income; ii) past savings; or both. As the villagers do not have the source mentioned, CIWM experts want to use water for productive purposes such as crop cultivation, horticulture and nursery development, poultry and livestock management, pisciculture, homestead gardening, small/cottage industries and other IGAs. In such cases users become able to pay for water from their additional income. The main theme of RDA-credit are to wider access/exposure to water supply system, ensure additional income and make them able to pay the water charges for rural livelihood improvement. The most important feature of RDA credit is to provide training to the villagers on various income generating activities (IGAs) based on their field of interest within the arches of productive use of water. After intensive training on their selected IGAs the target people are eligible to get credit. Additional income of the villagers' are ensured and the socio-economic level of the village poor is uplifted. These activities are lunched immediately among the villagers to ensure additional income, better access to the water resource management as well as to make the model sustained. The model has shown a positive sign in the socio-economic development of the rural poor.

Conclusion

Boropukuria Thermal Power Plant is a national level organization. It contributes to the partial fulfillment of increasing electricity demand of our country. The disaster caused by the plant on the availability of GW resource developed negative attitude against the plant authority. To minimize the public reaction, CIWM of RDA extended their water resource development model to the project villages. One of the affected three villages enjoyed portable safe water supply facility. Income generating activities and RDA-credit support are being started to enhance the economic condition of the villagers and uplift their

ability and attitude to pay the water charges as well as make the project sustain. Such type of schemes should be disseminated in the rest two villages.

In the rainy season most of the areas of our country are inundated by flood. All hand tube-wells and DTWs become contaminated and scarcity of safe drinking water supply appears. This water-sealed DTW and water supply model will prevent contamination and be able to supply uninterrupted safe water supply during flood as well as round the year. Safe water supply and sanitation are vital for protecting the environment, improving health and alleviating poverty. The success of the project is quite encouraging for enhancing the socio-economic level of the village people. This model should be replicated throughout the country through programmatic approach by the government for water safety.

Recommendations

Sustainability of installed water technologies is questionable by the community due to facing many challenges. Multipurpose use of water resources and piped water supply at rural level is a new concept in Bangladesh. It creates a lot of avenues regarding socio-economic development and improvement of quality of life in the rural areas. The success of the project is quite encouraging for enhancing the socio-economic condition of the village people. Following recommendations have been made from the observed practical impact caused by the model:

- The applied model should be replicated in the rest two villages as well as in all the villages of the country through programmatic approach by the government for water safety.
- The new dimension of this technology may create a fruitful impact in the socio-economic development of the rural poor, especially for the least developed as well as developing countries of the world.

Dissemination of such type of technology may be undertaken in the least developed and developing countries in massive scale to enhance health hygiene and water safety as well as economic and efficient use of water resources.

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ISSN 1019-9624
The Bangladesh Rural Development Studies Vol. XIII No. 1 (2010)

Globalisation and Environmental Sustainability: An Overview on Coastal Bangladesh

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Abstract

This paper tries to focus on building a relationship between globalisation and environment in the developing world perspective. Shrimp farming, ready-made garment (RMG), ship-breaking industry and over tourism are some facts of globalisation offering some new livelihood options for the poor people of coastal Bangladesh, but it does rampant negative impact on environment and society in the long run. Then this paper shows the impact on the economy and environment due to globalisation focusing both the global and local perspectives by using a schematic diagram and finally suggests that globalisation, definitely, a fruitful tool for sustainable development but when it is firmly considered not merely global issues but also respected the local interests.

1. Introduction

Globalisation, in general, is such a word that is incomprehensible to the general people though it affects their life and livelihood and also surrounding environment. Generally, globalization is not only a strong t ool for economic growth cementing the South-North relations, more importantly, it also has crucial impact on human, economic, social and environmental aspects. The environmental impact, however, might be resetting in an adverse situation for our planet as a whole, so the 'environmental sustainability' is a crying issue not only for the developing countries but also for the developed world.

The discussion of the paper is organised into six sections including this introductory section. Section two mentions the objective and methodology while section three defines the terms i.e. globalisation, environment and sustainability. Section four depicts the context of how different economic activities flourished due to globalisation and impacts on coastal environment of Bangladesh. The fifth section draws a schematic diagram showing the impact on the economy and environment due to globalisation in the context

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of global and local perspectives. Finally, section six concludes the paper with some suggestions to address the emerging environmental crisis.

2. Objective and Methodology

This paper specifically seeks to explore how globalisation impacts on environment with a special focus on coastal Bangladesh. Data for the study has been collected through reviewing the secondary sources including relevant books, articles and various official documents.

3. Definition of the Key Concepts

In this paper three concepts are being used as major variables viz. globalisation, sustainability and environmental sustainability.

3.1. Globalisation

Globalisation is one of the most overused and least understood words in the world today. Different scholars describe globalisation from different points of view. Newell (1999) argues that globalisation is often taken as a byword for any activity which extends beyond sovereign borders in the economic, political, social or cultural domain. In an economical point of view, this means the global integration of production, commerce, finance, information, organisation and technology, among other things (Wong-Gonzalez, 1998). It can be defined as the intensification of worldwide social relations which link distant localities in such a way that local happenings are shaped by events occurring many miles away and vice versa. However, globalisation means the gradual forging of links between groups and societies until they finally reach around the globe in several directions (Smith, 2006). In addition, it is essentially about trans-national flows (of people, money, cultures, goods, etc.) across borders, but its effects will always be spatially located somewhere, and virtual spaces are downloaded and accessed in particular places (Ray, 2007).

3.2. Sustainability

The modern concept of sustainability comes from *Our Common Future*, the report that come up from the 1987 World Commission on Environment and Development in which sustainable development was defined as "meeting the needs of the present generation

without compromising the ability of future generations to meet their own needs". The University of Canterbury (2006) argues that sustainability is about the relationship between people and planet; remembering that we are inextricably part of this planet, and that our societies (including economies) depend upon healthy biological and physical systems. Thus, it is interlinked with different components – environmental, social, economic and cultural.

3.3. Environmental Sustainability

Yale Centre for Environmental Law and Policy (2005) defines environmental sustainability that entails issues that are local as well as national and global in scale, all of which should figure in international comparisons. Environmental sustainability is the ability to maintain the qualities that are valued in the physical environment (CES, 2006). It means "the integration or balancing of social, environmental and economic issues", or "programs or actions based on stakeholder or community consultation" (Sutton, 2004).

UNEP (2002) argues that globalisation has an important environmental aspect which relates to the need to address a growing number of environmental dimension and 'sustainable development' is the only vision of the economy that encompasses all the major challenges of globalisation: economic development, environmental protection, the reduction of inequality and poverty and improvement of human welfare more generally.

Bangladesh: An Overview

4.1. Bangladesh towards Globalisation

Bangladesh has been experiencing the effects of globalisation since the late 1970s. After the independence in 1971 the country, carried on the brutal war and just after the great famine, tried to gain the advantage of globalisation. Therefore, during the period since independence all governments have been offering several unprecedented incentives to foreign investors. Besides, a huge number of both skilled and unskilled labour forces at a relatively low cost has made the country attractive for global investment and trade. Ready-made garment (RMG) and shrimp farming are the most attractive but also affected sectors due to globalisation (Rahman, 2003). He says that these newly emerged export-oriented industries involve wage labour jobs that are severely limited in scope, duration and security, and often employ the most docile and vulnerable people but long term impact on environment. Besides, ship breaking industry, over tourism and rampant real estate development are degrading natural environment of coastal Bangladesh.

4.2. Globalisation and Shrimp Farming

Shrimp farming is a consequence of the process of globalisation, originating because of its popularity and profitability in the northern countries (Rahman, 2003). Aftabuzzaman (1998) says that shrimp sector (including other sea foods) is the second largest export sector in Bangladesh's economy that contribute towards GDP is about 4.7% and of the total export, 9.38% and about 10 million people are directly or indirectly dependent on this sector. The country earned about Tk. 136.60 million in foreign currency during 1997-98 by exporting fish and shrimp, of which shrimp alone contributed more than 80% (Islam *et al.*, 2002). In 1999-2000 Bangladesh seafood (including shrimp) exports were the highest on record, earning some US$ 356 million from frozen shrimp alone and accounting for 6.28% of total export earnings (Pokrant, 2001) compared to Tk. 50 billion (around US$ 715 million) in 2007-2008 (Mistri, 2009). The table below shows the shrimp production of Bangladesh by year.

Table-1: Shrimp Farm Production of Bangladesh

Year	Production (Metric Ton)
1989-90	18,624
1993-94	28,302
1997-98	62,167
2001-2002	61,186
2005-2006*	211,010

*Source: DOF (2003), * BBS 2007*

In 1982-1983, there were only 5,200 ha of land under shrimp culture; by 1986, 110,000 ha had been brought under shrimp cultivation, 70% being located in the Khulna region (Mazid, 1998). Pokrant (2001) also writes that shrimp (both fresh and brackish species) are farmed over 145,000 farms covering 200,000 ha land concentrated in Khulna and Chittagong region.

Literature highlights both positive and negative impact of shrimp farming. Pokrant (2001) and Banglapedia (2002) show that positive benefits include increased employment and a growth of average wage rates, growth in purchasing power, growth in number of earners in households, improved health and increased use of facilities such as tube-wells, sanitary

latrines and more substantial house structures, greater household food security, greater earning opportunities for women etc. On the other hand, shrimp farming increases some negative impacts including growth in income inequality, violence against women and the landlessness, decline in access to sharecropping opportunities, population displacement etc. for example, under rice farming practice, landless and small farmers would have rented in land from large farmers for rice production; but with the introduction of shrimp farming that opportunity disappeared. At present, even the small farmers are compelled to lease out their land to shrimp farmers who adopt different tactics to secure land from others to make their farm larger and profitable. For this, conflict of land use arises between the shrimp farmers and small land owners (Islam *et al.*, 2002). However, nowadays many farmers have turned back from shrimp farming to rice cultivation due to adverse environmental and social impacts on local livelihoods. For example, rice has been cultivated in 57,000 ha land in Khulna district in 2008, though the target was 44,000 ha (Prothom Alo, 2009). Nevertheless, the coastal Bangladesh is also facing environmental crisis due to rampant shrimp culture.

The environmental problems associated with shrimp farming in Bangladesh have been widely reported throughout the period of 1990s. The extensive farming systems requiring large land areas contributing most to encroachment of agriculture land and mangrove clearance with increased intrusion of salinity, degradation of land and de-stabilization of coastal eco-systems (Samarakoon, 2004). Gregow (1997) critically analysed the ecological problems created by unplanned shrimp cultivation particularly in the *Chokoria Sundarbans* (more than 50% out of 18,200 ha (Banglapedia 2002)). Even the government policy of allowing use of the reserved forest for shrimp farms and human settlement encouraged some people to make forest clearing indiscriminately. Within the last decade, more than 350,000 acres of agricultural land in coastal districts of Bangladesh have been turned into shrimp farms (Rahman, 2003). In the south-western part of the country, the salt water intrusion has caused many problems because of loss in crop production, fresh water crisis and related gastro-intestinal diseases, loss of green vegetation, fodder, etc. (Deb, 1997 and Islam *et. al.*, 2002).

4.3. Ready-Made Garment (RMG)

Although Bangladesh is not developed in industry, it has been enriched in Garment industries in the recent past years. In the field of Industrialization garment industry is a promising step. It has given the opportunity of employment to millions of unemployed,

especially innumerable uneducated women of the country. It is making significant contribution in the field of our export income. History of our cloth Industry: Once the cloth of Bangladesh achieved worldwide fame. There are more than 4000 garment factories throughout the country providing employment to 2.0-3.5 million workers, more than 90% of whom are women or young girl workers. Garments are the biggest export industry of the country with annual earning of over $12.5 billion.

Over one lakh disadvantaged people, mainly garment workers live in some 1814 slums in Chittagong city (The Daily Star, 2009). The garment workers usually migrate from rural area and in order to minimize their living cost they have to move to a slum. Most of the slums are situated on the slopes of hill area. The slum dwellers cut and level tree-covered hills and collect fuel from the forest which is highly degrading the natural environment round the city. However, Over 50,000 people are still living on the dangerous slopes of hills in the port city risking their lives to fall an easy prey to landslide in the rainy season that claimed 127 lives on June 11 in 2007 and 11 lives on 18 August 2009.

4.4. Ship Breaking Industry

Ship Breaking is primarily carried out in developing nations like Bangladesh – as their laws on dealing with lead paint, asbestos and general worker's conditions fall far short of Europe and the US (Lehman, 2010). Many ships which enter the Chittagong Coast contain hazardous material and chemicals like nickel, chromium, iron, asbestos and lead inside the unclean ships, and nations like Bangladesh is unequipped to deal with the material, and as such needs to be removed before its arrival on the coast (Mahr, 2010).

In Bangladesh, shipyards can operate without the risk of personal injury lawsuits or workers' health claims, meaning many of these shipyards may operate with high health risks (Wikipedia, 2002). Protective equipment is sometimes absent or inadequate. Dangerous vapors and fumes from burning materials can be inhaled, and dusty asbestos-laden areas are commonplace. Many ship breaking yards in developing nations have lax or no environmental law, enabling large quantities of highly toxic materials to escape into the environment and causing serious health problems among ship breakers, the local population and wildlife. Approximately 50 are said to die annually from accidents; often in explosions set off by blowtorches deep inside the fume-filled holds. However, the Bangladeshi Supreme Court ruled in 2009 that "ships entering the country for decommissioning must be "pre-cleaned" in line with the Basal Convention".

4.5. Over Tourism

Tourism has had a devastating effect on the coastal environment. The Cox's Bazar sea-side is also experiencing pressure of huge number of tourists as well as new establishments. In the recent years a good number of hotels, motels and rest houses have been built to accommodate the increasing number of tourists. Various foreign chains of hotels and motels have come forward to invest in Cox's Bazar considering the visit of huge number of tourists. Nearly two million people visit the Cox's Bazar during the peak season (Priyo Bangladesh, 2010). They mainly walk along the beaches, bath in the sea, buy corals and other souvenirs from the shops. They also visit beaches of Labonee, Kalatoli, Himchhari and Innani with great interest. Local people said increased tourism cost the area a lot mainly environmentally like hill cutting, forest clearance and unplanned growth of structures along the beaches. Besides, it had also increased crime, and moral erosion or prostitution.

Furthermore, St Martin's island is Bangladesh's lone coral island and attracts tens of thousands of tourists during holiday periods. The island is home to some rare flora and fauna, including 182 wildlife species. In recent years, the island has witnessed a building boom due to a huge rush of tourists (The Independent, 2009). While visiting the island recently this correspondent found that tourists were collecting corals, algae, different species of shells, star fish and many other sea resources (Priyo Bangladesh, 2010).

5. Discussion on a Schematic Diagram

On the basis of the above discussion a schematic diagram may be drawn which is given below. The diagram shows the impact on the economy and environment due to globalisation focusing both on global and local perspectives.

In *Figure 1*, on the one hand, 'economic growth' and 'environmental crisis' are two dependent components (or variables) which mean economic development effect on environment. On the other hand, 'global' (global perspective but mostly biased by the North) and 'local' (local perspective mainly focusing the South) are two separate point of views. However, when the two components (economy and environment) are considered in both global and local perspective, some positive and/ or negative impacts on lives and livelihoods are seen.

Therefore, for example, when we consider economic growth in global perspective, some positive impacts i.e. increased global investment and world trade, technology transfer.

Conversely, if we see economy in local perspective, it has been both positive (increased economic growth through shifting RMG and ship-breaking industries from developed world to developing world, low wage labourers, suitable environment for shrimp farming, budget holiday option) and negative (increased rural-urban migration) impacts.

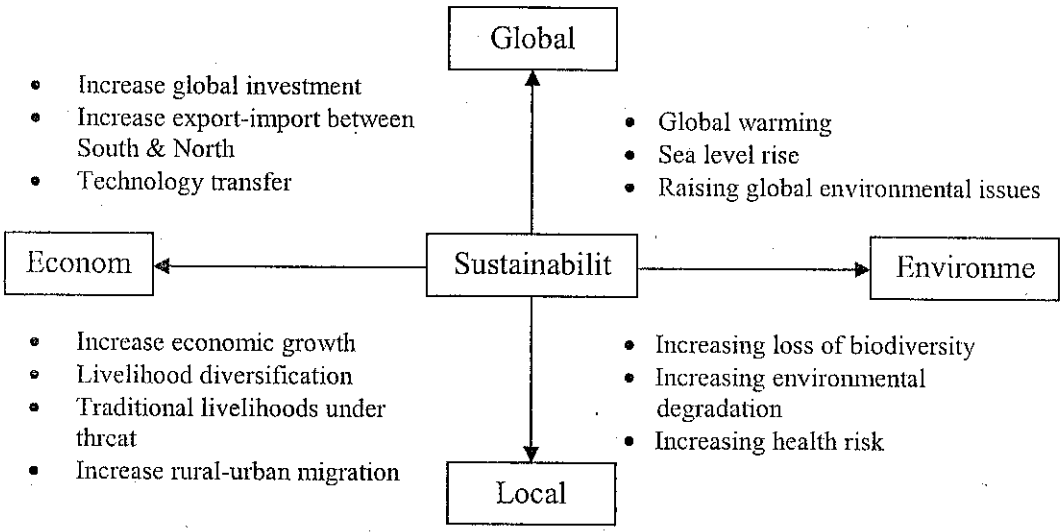

Figure 1: Economic Growth and Environmental Conservation on Global and Local Perspective

Thus, according to both the perspectives, Bangladesh earns foreign currencies from exporting shrimps and RMG products which is helping to increase its GDP but in local perspective people in coastal region shifting their occupation[2]. Besides, unemployed, especially young girls, migrate to urban areas especially Dhaka and Chittagong city for getting job in ready-made garments. Further, ship-breaking industries have severely harmful for human health.

On the other side, 'global environment' perspective has been negative impact (i.e. global warming, sea level rise) which is closely related to climate change[3]. However, few positive/mixed impacts i.e. raising environmental issues including environmental conservation is highlighting especially by NGOs and the media. Finally, the 'local environment' perspective has been extremely negative impacts like loss of bio-diversity by changing land use pattern i.e. shrimp farms, hill cutting, dropping hazardous chemicals in offshore, collecting corals and other sea resources.

Thus, a new concept (component) 'sustainability' situated on the central point for minimizing negative impacts especially on environment and local traditional livelihoods[4]. The magnitude of the impacts may be changeable because some influential components (i.e. international, regional and national policy, local culture, human behaviour, etc.) are not considered here. However, it would be better for local people if the government and foreign governments and trade organisations as well consider local traditional economic activities based on natural environment that are, in fact, related to climate change in global perspective and local level food security.

6. Conclusion

Globalisation is a trans-national flow of commodities, goods, services, money, technology and even people which is accelerating political, economic, cultural and environmental interconnections throughout the world or often in a region basis. However, relatively the developed world has benefited from it. Environmental sustainability is a certain situation which ensures sustainable development but protects the environment. Bangladesh has benefited from exporting shrimps and RMG products through globalisation from economic point of view but in the long run local environment and traditional livelihoods are poorly affected. Nevertheless, recent years the scenario is changing.

However, the paper should conclude that globalisation, definitely, a fruitful tool for sustainable development but when it is firmly considered not merely global issues but also respected the local interests. Afterwards it is possible when the developed world gives the opportunity to the South to develop their national and local level institutions, policy and management for avoiding the risks due to globalisation and coping with the existing environment.

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[2] *During the last couple of decades traditional rice cultivators have convested their fields to shrimp farms (Banglapedia, 2002)*

[3] *Chakaria Sundarbans i.e. carbon sink considering one of the major climate change mitigations, is really vulnerable to shrimp culture. The entire forest is now a barren area; stumps of trees are found all over, and only about 200 healthy trees are left (ibid)*

[4] *For sustainable and environment friendly shrimp/prawn culture, integrated polyculture with paddy and fish has recently been proven to be successful technique as paddy recycle the bottom nitrogenous wastes and fish as an ally control bacteria and other shrimp/prawn pathogens to tolerable level (Banglapedia, 2002).*

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ISSN 1019-9624
The Bangladesh Rural Development Studies Vol. XIII No. 1 (2010)

Microfinance Programmes as a Means to Effectively Reduce Rural Poverty: A Critical Evaluation

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Abstract

Microfinance emerged as a tool to reduce poverty after failure of government funded subsidised rural credit Program. The pioneer organisation of microcredit 'Grameen Bank' makes it popular after introducing collateral free loan and using group as a social capital. It gained widespread praise for their large coverage and rate of expansion in developing countries. The extent of its praise has allowed 'microfinance' to receive almost iconic status among donors, governments and policy commentators. The notion of microfinance will help very poor households to meet basic needs, improve households economic welfare and empowering women are now facing criticism. The main objective of this study was examining the effects of microfinance on rural poverty reduction. Then critically review these assumptions and evaluates the most cited successful 'Grameen Bank Model' Program, to justify how far they reduce the rural poverty. This study was conducted during June to August, 2009 at Fulchari union of Gaibandha district. Data was collected using qualitative methods. Research findings indicate Microfinance is not a miracle solution for poverty reduction. It is revealed that the often mentioned 'highly successful' and 'pioneer of microcredit' Grameen Bank itself faces many difficulties to implement microfinance Program and achieve its goals. Microfinance must also be coupled with other social Programss that are flexible to meet the diverse needs of rural poor.

Introduction

Microfinance is relatively a new concept in development discourse (Robinson, 2001). It is widely spread and recognised for its unique features without collateral loan and particular focus on women (Wrenn, 2005). After failure of the 1950's to the 1970's developing countries' donor or government funded subsidised rural credit Program;

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Grameen Bank of Bangladesh evolved with the concept of 'microcredit' in late 1970's (Robinson, 2001). According to Wrenn (2005) "microcredit refers to small loans, whereas microfinance is appropriate where Non Governmental Organisations (NGO) and Micro Finance Institutes' (MFI) supplement the loan with financial services (savings, insurance, etc)". Therefore, microcredit is a component of microfinance. Different MFIs use different microfinance approaches to tackle rural poverty.

Grameen Bank has identified fourteen approaches[2] or models for microfinance (Wrenn, 2005). Microfinance also consider as an effective tools to reduce poverty and achieving Millennium Development Goals (MDGs). Morduch (1998) mentioned from research evidence that microfinance has positive impact on poverty reduction as it relates to the first six out of seven Millennium Goals. Indeed, the relation between 'rural poverty' and 'microfinance' is ambiguous in terms of its effectiveness to reduce poverty, sustainability, women empowerment and capacity to reaching the poorest of the poor. This study aimed at evaluating the role of 'microfinance' as a tool to tackle rural poverty with the evidences from empirical data.

Objectives of the Study

The main objective of this study was examining the effects of microfinance on rural poverty reduction. Then critically review these assumptions and evaluates the most cited successful 'Grameen Bank Model' Program, to justify how far it reduces the rural poverty.

Research Methods

Study Design

This was a population-based exploratory study in which qualitative methods were used for data collection. Data ware collected from June to August 2009.

Study Area

The study area Fulchari union was selected purposively. Fulchari union is one of the poorest areas of Fulchari Upazila in Gaibandha district (Alamgir, 2004). People of this area are very poor due to Jamuna river erosion and yearly flood. Their livelihoods are

[2] *Associations, Bank Guarantees, Community Banking, Co-Operatives, Credit Unions, Grameen Model, Group, Individual, Intermediaries, NGOs, Peer Pressure, Rotating Savings and Credit Associations, Small Business and Village Banking.*

thrived mainly by agriculture (ibid). Approximately 1200 household out of 2000 of Fulchari union was under the coverage of Grammen Bank microfinance during data collection.

Data Collection Procedure and Respondents Selection

Data was collected through 36 in-depth interviews with Grameen Bank female borrowers and six focus groups discussions (FGD) with the male community people. Each group was consisted of six adult male who were either husbands or father or partner in business of the loan recipients. The respondents were selected purposively, those who were loan recipient of Grameen Bank and agreed to interview.

Study Population

Most of the respondents were house wife and they aged mainly in-between 35 to 40 years and 90% were Muslim. They came from same socioeconomic condition, as an example they were poor and illiterate (58%). Among them 90% were house wife and rest were day labourer. FDG respondents were aged mainly 50 to 65 years. Except two FGD respondents, all were husbands of in-depth respondents. Those two were father of in-depth respondents. Majority (59%) of the husbands of in-depth respondents were illiterate, only 23% have primary, 15% above primary and 3% competed graduation. Regarding occupation, majority (58%) of the husbands of in-depth respondents were day labourers, 17% were engaged in farming, 10% were involved in small business and other were van puller, carpenter, and vendor.

Research Tools

Separate pre-tested checklists were used for in-depth interview and for FGD. All sessions were tape-recorded with prior consent of the respondents.

Analysis

One anthropologist was assigned for collecting, analysing and transcribing the data. At first data were coded line by line, and then categories and themes were identified. The data were analyzed thematically. The new emerged categories were also followed by thematic analysis. Finally, collected data were critically validated with secondary data.

Critical Review of the Assumptions on Rural Poverty and Effects of Microfinance: In the Voice of Respondents

The fundamental argument regarding rural poverty is 'capital deficiency' of the poor leads to poverty (Swope, 2005). So, well established notion of Grameen Bank is if capital provision is available to the poor either directly through the supply of goods and services or through the provision of credit, it will help reduce rural poverty. Study evidence shows that only three out of thirty six respondents can improve their economic status after getting the loan, even women empowerment was also absent there. The FGD respondents mentioned "*The poor do not need aid; they need opportunity and access. The core three assumptions regarding microfinance should be, firstly, it will help very poor households to meet basic needs and protect against risks; secondly, it will improve households' economic welfare; and thirdly, it will help women empowerment through women's economic participation and as a result promote gender equity.*" The notion of increasing income through microfinance was not found in this study.

Khandker (1998) also mentioned that borrowers are also benefited from consumption smoothing and the ability to sustain gains over time. Another prime assumption is, direct correlation between 'poverty' and 'malnutrition' and greater access to health care. The study found microfinance has not substantial effect on the health care, nutrition and health of the respondents, especially for children.

Assumption regarding 'children drop-out from school' is poor parents cannot afford to send their children to school, due to poverty. Microfinance, by contributing to an increase in household income and better financial stability, enables poor families to bear the 'costs of sending children to school' (Morduch, 1998). The study found that none of any respondent re-admitted their dropped-out child in school after getting the loan. One in-depth respondent mentioned *"We do not have sufficient food to eat. My father-in-law is sick. I have used the loan for his treatment. In this condition how can I think to re-admit my son to school?"*

Another important notion, women are traditionally treated as inferior to men because of lack of economic opportunity, authority over income generation, or participation in the public sphere. Microfinance enables women to gain access to all of these empowerment tools. Borrowing credit to start a microenterprise gives women control over household

income and entry into the public domain, as well as it provides them with economic and educational opportunities (Simanowitz and Walter, 2002). The study shows the opposite scenario. All the respondents mentioned that their loan money was controlled mainly by their husbands. A finding from in-depth interview shows that microfinance is potentially harmful to women. For most of history, women were excluded from public or income-generating activities; only recently they have started to speak up about gender equality and the right to equal economic opportunity with men. There is an argument that when women take out a microcredit loan to start a business, it is often the men who control how the loan is used (Rahman, 1999). Morduch (1998) went further and mentioned when men control the loans given out to women, it further enforces patriarchal control over women's lives. Another challenge that women face with microfinance is that they have a double workload of running a business and childcare with households. This creates an enormous double burden on many women (Cheston and Lisa, 2002).

Other critics have even questioned whether microfinance reduces poverty at all. The main reason that 'microfinance does not reach the poorest of the poor' is because of selection criteria of borrowers by the NGOs' (Simanowitz and Walter, 2002). The study findings show the same. *"In our village Grameen Bank provides loan only to those who are capable to pay back the loan; whereas poorest of the poor are not selected"* (mentioned by a FGD participant). In Fulchari union Grameen Bank started their activities in 2007. The adjacent Fazlipur union is mainly inhabited by the poor people but this area is (during data collection period) excluded by the Grameen Bank due to poor infra-structure.

Some researchers find that microfinance creates a large debt for some poor people who are unable to repay the loans (Buss 1999). Wright (2000) particularly mentioned that small businesses in developing countries are subject to a great number of obstacles; statement by a loanee mentioned here as an example: *"lack of adequate infrastructure, inability to access supplies needed for a business, flooded markets if enterprises are too similar, difficulties with money management due to improper schooling and lack of training or skill"* . He also added that *"...Borrowing money is always a risk, but particularly so for the poor who are already extremely vulnerable to economic shock. Sometimes all it takes is a business failure or medical emergency to plunge a poor person into severe debt and even greater poverty"*. Javier (2004) also argued that in spite of

having all the right ingredients, the business may still fail because lack of potential customers, fellow neighbours in poverty, do not have the means to purchase the goods or services offered. Versluysen (1999) pointed out that microfinance cannot be utilized by the very young, the old, the sick, or physically handicapped. *"Microfinance Programss are also charged with excluding rural locations without infrastructure or access to markets, areas with a dispersed population, or communities that depend on a single economic activity"* mentioned by an respondent . The most biting indictment against microfinance is that it requires the poor to be entrepreneurial (ibid). Critics argue that microfinance is exclusive and that most impoverished people are poorly educated, marginalized by society, and unlikely to have the entrepreneurial drive needed to establish a business (Khandker, 1998). However, from above wealth of literature and empirical evidences it is seen that a strong correlation between 'microfinance' and poverty reduction prevails.

Discussion

Grameen Bank is already considered as an 'Icon' or 'Model' to others MFIs (Hulme and Mosley, 1996). In this part of the study, the well-known Grameen Bank Program is critically evaluated.

Impact of Credit on Monthly Income

The notion that micro-credit Programs can increase income and therefore reduce poverty is criticised by Hulme and Mosley (1996). The study found that the impact of credit on Grameen Bank members' monthly incomes has been limited, particularly when inflation is taken into account.

Not Reaching to the Poorest of the Poor

Despite of huge expansion of Grameen Bank, some critics argued that it is yet not successful to reach the poorest of the poor. Concerning the Program related difficulties, Evans et al. (1999) see the membership requirements as major obstacles for the bottom poor. Paying registration fees, savings, attending group meetings and participating in various training sessions are often impossible and too time consuming for people who need all their time and assets to survive the day. Likewise, the group mechanism does not make things easier for them. The study also found that 21 respondents mentioned that the

process of achieving membership and getting loan is lengthy. Moreover, the mandatory weekly meetings create some extra burden of time management and sometimes create family problems.

Hulme and Mosley, (1996) refer to the fact that future members of Grameen Bank often do not want to take up bottom poor in their group. They regarded them as too risky. Morduch (1998) also mentioned that bottom poor always fearing an even greater burden of debt, they do not want to take part in a micro-credit scheme. But even when they take a loan they can get into trouble when the returns from investment fall short of the cost of borrowing. However, all the respondents of the study mentioned that during the formation of the credit group they preferred the better of to avoid risk of defaulter. Develtere and Huybrechts (2002) also argued that if we focus on the client-related barriers; self-selection or self-exclusion is regarded as one of the major obstacles.

Garson (1997) mentioned that a destitute family that struggles every day to survive will rarely have the energy to launch into an ambitious business enterprise. The poorest of the poor can barely meet basic needs, much less run an entire business and they lack the necessary education, management skills, and social networks. The exclusion of the poorest from microfinance is not an indication that the poorest cannot benefit from Microfinance Institute (MFI) services, but rather, it is an indication of the failure of MFIs to design programs to fit the needs of destitute families (Marcus *et al,* 1999). The study found that microfinance has tended to exclude those that cannot use the one-size-fits-all services provided. The services that have been developed tend to meet the needs of a particular segment of the client market, and have led to the exclusion of those who cannot use or pay for these services.

High Dropout Rate from the Micro-Credit

This may also be the reason for huge number of drop-outs from micro-credit Programs which is estimated at 15 per cent per year for Grameen Bank (Develtere and Huybrechts, 2002). He added that poor are not homogeneous group; there are a lot of gradations of poverty. Therefore, an often heard criticism against micro-credit institutions is that they do not reach the bottom poor. In Grameen Bank's targeted approach they mention their target group as those who have less than half an acre of land. The study indicated that this official criterion is often neglected.

Unsatisfactory Rate of Women Empowerment

The notion of positive effects of micro-credit Programs on the women empowerment is questioned by many researchers. Particularly, in terms of women's control over loan use and domestic violence. Goetz and Gupta (1996) have investigated whether female members of Grameen Bank actually control their credit. They shows that about 63% of the women involved in these Programs only have 'partial', 'very limited' or 'no control'.

The research findings show that the single women have more control over their credit. This is also the case for women who invest in traditional activities. These traditional activities, such as livestock and agriculture, are often considered as female activities and do not generate much extra income. The higher the amount of money, the quicker men take over control. These findings can also explain the diminishing level of female control over credit when membership extends over time. Loan repayment remains the major difficulty when it comes to women's control over loan use; particularly when a husband refuses to pay back the money he has used, as the wife remains responsible for the repayment to the centre. Moreover, the tensions that this situation brings may escalate into domestic violence in Fulchari union. Rahman (1999) also found in his study that out of 120 Grameen Bank members he interviewed, only 18% said that domestic violence had decreased, while 70% claimed an increase of violence and aggressive behaviour in the household of Grameen Bank lonees.

Hidden Transcript of Grameen Bank

Goetz and Gupta. (1996) criticise Grameen Bank's hidden policy to take advantage of women's vulnerability. They mentioned that they deliberately use women as they are easily traceable, more reliable, more disciplined, and submissive than men. Therefore, loan with high-interest can collect easily from women than to men. Findings from FGDs also support this statement and mentioned this as the 'hidden transcript' of Grameen Bank.

Conclusion

Microfinance is not a miracle solution for poverty alleviation. In fact, there is no quick fix model to tackle rural poverty. Microfinance must also be coupled with other social Programs that are flexible to meet the diverse needs of rural poor. From the above mentioned 'Grameen Bank' case study it is revealed that the often mentioned 'highly successful' and 'pioneer of microcredit' Grameen Bank itself faces many difficulties to implement microfinance Program and achieve its goals. Despite many achievements, MFIs should focus more on reaching the poorest of the poor by implementing integrated programs. It is difficult for MFI's achieving both financial sustainability and widening their outreach while still focusing on the neediest in the society. MFIs should develop unique and innovative practices to account for the difficulties of providing credit to the poor. To overcome this problem, MFI's may work together to minimise the overlapping of their Program implementation area and can reduce their operating cost. An MFI should also be sure to incorporate the customs and practices of the people into its Programs. They should work together to find-out a holistic approach to fighting poverty and a recognition of the importance of the poor as agents of change. Any poverty purging strategy that aims at marked reform needs to recognize that the poor know how to help themselves far better than aid agencies and social organizations. Microfinance should give emphasis on the power to the people. True poverty alleviation Programs fight poverty by addressing the social, political, and economic constraints that keep the poor in an oppressed condition and by implementing tactics specified to overcome those constraints.

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ISSN 1019-9624
The Bangladesh Rural Development Studies Vol. XIII No. 1 (2010)

Cultural Perspective of Pregnancy and Neonatal Care in Two Villages of Bangladesh

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Abstract

The study aimed at exploring maternal and neonatal care practices, how socio-cultural factors and traditional belief influence these practices and how well the community women response to the services at the community level. This study was conducted during December 2006 to August 2007 in two sub- districts (Domar and Joldhaka) of Nilphamari district. Data was collected using qualitative methods including informal discussion and periodic follow up of 56 pregnant women till their postnatal period. Research findings indicate that grassroots health providers are providing doorsteps antenatal and postnatal care services but majority of the women have not received it properly. They still preferred home delivery conducted by traditional birth attendant as they perceived pregnancy as a normal family matter. Traditional believes misinterpreted the actual causes of pregnancy complication and influenced choice of treatment. Traditional practices such as cutting cord by "Daiyani", rest and food restriction, conception of impurity, mother confinement resulting treatable maternal and neonatal health problem life threatening. To eliminate misconception service providers should need to be concerned about cultural and social constraints. Study findings will help health policy planner to develop cultural sensitive interventions and promoting maternal and neonatal care in such ways that rural people can internalize in their own live context.

Background

Maternal and neonatal mortality is one of the vital indicators with the greatest disparity between developed and developing countries (Mamady *et. al.*, 2005).

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Globally over half a million women die each year during pregnancy, delivery or shortly thereafter (WHO, 2009) and about four million children die before they reach the end of first month of life, 99% of these deaths occur in low- and middle-income countries (Ahmed *et. al.*, 1998). Causes of maternal and neonatal deaths are similar in these countries (NIPORT, 2004). However, the distributions of causes differ somewhat culture to culture (Mamady *et. al.*, 2005).

Culture can be defined as a 'complex whole' that refers to learn pattern of thoughts and behavioural characteristics of a social group. It involves religion, kinship, knowledge, belief, art, morals and childbearing practices (Brown, 1998). The tendency to act or not in the presence of a maternal and neonatal complication is also influenced by the interpretation supported by cultural beliefs and perception (Islam *et. al.*, 2005). Several studies carried out in Africa and elsewhere (Rosato *et. al.*, 2008) have highlighted how cultural perspective influenced maternal, neonatal care practices and health seeking process (Islam *et. al.*, 2005).

Former study of maternal and neonatal death in Bangladesh indicated a decrease in numbers but neonatal mortality rate (NMR) and maternal mortality rate (MMR) continue to be unacceptably high compared to many other developing countries (NIPORT, 2004). The reason behind the cause, socioeconomic and cultural factors influence women receiving safe maternal and neonatal care in Bangladesh and other developing countries as well (NIPORT, 2001).

Obstetric causes of maternal and neonatal death in Bangladesh are well documented (NIPORT, 2004), but little attention is paid to the cultural perspective. In order to reach Millennium Development Goal of reducing maternal and neonatal mortality women's access to good quality healthcare is embedded in a human rights. Access to proper care is one of the elements that may contribute significantly towards the goal (Mamady *et. al.*, 2005).

To reach the goal and to reduce maternal, neonatal and child mortality, particularly amongst the poor, BRAC is also not lagging behind. Consolidating more than 30 years of experience in health interventions, BRAC Health Program (BHP) has launched a comprehensive maternal, neonatal and child health (MNCH) Program since the end of 2005 customized for the rural population in Nilphamari district. MNCH emphasis on

clean and safe delivery by trained traditional birth attendants (TBA) and provides doorstep antenatal, neonatal and postnatal care services by community grassroots health provider namely *Shasthya Karmi* (SK) and *Shasthya Shebikas (*SS) the community health volunteer.

However, empirical studies show that the services utilization is a complex behavioural phenomenon, which is not only dependent on the availability or quality but also costs of service charge and cultural believes, perception and practices (Chakraborty *et. al.*, 2003). This study explores in-depth of community beliefs, perception, knowledge, cultural practices and its influence on pregnancy and newborn related care. The findings will help the Program planners to identify the gaps in intervention components and strategies, and thus to develop women-friendly services.

Objectives of the Study

The study aimed at exploring maternal and neonatal care practices in terms of community perspectives and how socio-cultural factors and traditional belief affect that practices.

Study Setting and Study Population

The study was carried out in Domar and Jaldhaka sub-districts of Nilphamari district of Rajshahi Division. The study primarily targeted 56 pregnant women in the study areas who were in their third trimester of pregnancy (above 28 weeks). The secondary targeted population included husband, mother-in-law and relatives, respective grassroot service providers (SS, SK, trained and untrained TBA) of those selected women.

Sampling and Data Collection

A multi-stage sampling procedure was followed in this community-based exploratory study. Domar and Jaldhaka sub-districts were selected purposively. Then 28 (14 from Domar and 14 from Joldhaka) villages were selected randomly. All the pregnant women those who expecting delivery date in August (32 from Domar and 24 from Jaldhaka) were interviewed from the selected villages. Total 56 selected women were followed up during pregnancy to 42 days after delivery (December 2006 to August 2007) by periodic follow-up, observation, and informal discussion.

Pregnancy, Delivery and Newborn Care-related Practices

This article explores respondent's life style to elicit community perception, beliefs, traditional practices and superstitions relating to pregnancy, delivery, and neonatal and postnatal periods.

Daily Practice during Ante Partum Period

Daily Activities

Pregnant women continued daily work as they were before pregnancy. They stopped nothing even the heavy work such as pumping tube-well, carrying heavy pot, thrashing, and husking grain with traditional husking equipment (*Dheki*). Even in the case of sexual relations women did not maintain any restriction during pregnancy. In their view to deny a husband is a great sin. Women had a perception that the work could be done seated such as cooking, sewing the like. They did not have the idea of rest as physical and mental relaxation. They avoided taking rest as it was believed foetus would become larger. Pregnancy related superstitions restricted free movement of pregnant women. They could not go to bamboo groves, cross roads, under big banyan trees, or beside ponds and river banks, especially at noon and at midnight. They believed in those entire places malevolent sprite were most active.

Diet During Pregnancy

Effort to provide larger quantity of food for the pregnant woman was rare in poverty. Women perceived that expensive foods (meat, big fish) were only nutritious. Pregnant women were denied to eat fish for fear of deformity of the baby. They also avoided eating *Jamtia* (Twin fruit in a single peel; such as two bananas inside a single peeling). Women avoided eating such kind of foods because this might cause twin baby and delivery complications.

Perceptions of Pregnancy Complications and Care-seeking Practices

In general the respondents believed that evil wind (*Bao batash*) caused pregnancy complications, especially spontaneous abortion and stillbirth. In community, maternal complications were usually first treated with herbs prescribed by traditional healers (*Kobiraj*), then they preferred '*Mukh jobani osud*'. '*Mukh jobani osud*' mainly prescribed by village doctor (*Palli Chikitsok*), or drug sellers. Women described their problem to

husbands or close female relatives. Usually their husbands went to the dispensary, described the complexity and brought medicines. Community people liked it not only for its low cost but for avoiding transport cost also. They preferred homeopath as they believed it cured germ without side effect. Only when the *'Mukh jobani osud'* or homeopath failed to cure then they chose allopathic treatment. They did not prefer to share gynecological problems with male doctor because of shyness.

Delivery Care Practices

Women preferred home delivery with the assistance of locally available Traditional Birth Attendant in Bangladesh (TBA) i.e. *Dai* because of perceiving pregnancy as a normal family matter. Choice of TBA depends on in-laws and husbands. Parents decided only when women went to the parental house to give birth. Decision of the pregnant women was secondary here.

Birth Preparation

Preparation for giving birth was unfamiliar among the women. Arrangement for funds and blood donor was not found. In case of any complications during delivery they believed that God would help them. Separate place for delivery was not reserved until the delivery pain started. Corners of kitchen or bedroom were used for the purpose. Women gave birth on floor, not to pollute their bed. On the floor they lie on mat (*Chaut*) and in winter straw bundles were put underneath the mat.

Birth Attendant's Practices during Delivery

Trained and untrained TBAs conducted delivery in recumbent position either kneeling or squatting. In case of squatting they often had great difficulties in carrying out vaginal examination. During examination both trained and untrained TBAs used several methods such as oil massage (hot-mastered oil or coconut oil) to lubricate vagina and open up the cervix in order to hasten delivery. TBAs were fearful of small opening of cervix and obstructed labour. Some times they fasten mother's upper abdomen to create pressure and feed the mother chanted water and gave oxytocin drip.

Placenta Delivery

After delivery TBAs were impatient to get the placenta expelled. If a piece remains inside it could cause great trouble and that is why the birth attendants apply lot of techniques to

make it come out. For instance, they feed the mother onion, put bundles of hair on her mouth and feed kerosene to induce vomiting which helps the retained placenta to come out.

Cutting Cord by Daiani

In Domer the birth attendants cut umbilical cord. On the other hand in Jaldhaka the birth attendants were forbidden to cut umbilical cord. The respondents of Jaldhaka stated that cutting cord was the task of *Daiani* (local midwife). They were mainly from *Badia* (Musician) clan. Their main profession is to play music in social and religious festivals and cut the umbilical cord. The respondents thought if any other person cut the umbilical cord meant devalued the right of *Daiani* because it is their source of income.

Essential Newborn Care Practices

Study found that in the areas essential newborn care was provided mostly by the family members, relatives or neighbors. Until placenta delivered birth attendants left the baby uncovered and uncleaned on the floor. They explained that the baby's life depended on blood of placenta so they felt that if some blood re-enters into the newborn body it would become stronger. They massaged mustard oil to remove vernix as they perceived it as impure and cause skin problems.

First Food of Newborn

They usually initiate life with a taste of sweetness. They thought that the taste of sweetness made the newborn's voice sweet. Preferably honey was given to the newborn's tongue. In absence of honey sugar syrup was the second choice. Some respondents said that they used to clean newborn's tongue with mustard oil. Two-and-a-half days after delivery mothers feed sugar syrup, honey or cow milk as they think that the newborns were not getting sufficient breast milk.

Perception of Impurity and Purity

Community people perceived that until given bath and the hair shaved the newborn remains impure. They liked to give the newborn a bath just after they were born. Newborn bathing after three days and shaving hair at least after one month is a new concept to community people. Though the women were convinced and did not give bath or shave newborn hair they did not have family support. Though the rate of bathing

immediately after birth was decreasing, the mothers still preferred rubbing for cleaning the newborn. Consequently vernix removed earlier than natural.

Disposal of Placenta and Its Association with Newborn Health and Family Planning

Usually they buried placenta in a cool place that the newborn would feel comfort and the umbilical cord would heal soon. They perceived this would be protected newborn from vomiting. To stop vomiting respondents pat the place where placenta was buried.

They also believed that the spacing between two children related with how the placenta would be buried. The Community women believed that if the placenta cord buried upward and far from the delivery room the next pregnancy would not come quickly. They buried placenta into a deep hole, as there was a great fear that a dog, jackal, or some other scavengers might dig up and eat placenta. In that case most serious consequences would result such as mother's milk would dry up and the newborn might die.

Neonatal Sickness and Care

Though exception was found, the respondents and their family blamed evil wind or the effect of malevolent sprites for any type of neonatal health problems. To be protected the mothers tied amulets (*Tabij*) at the newborn's hand, given by spiritual leaders. The mothers were more concerned about the babies who were born in the Bengali month *Chaitra* (March-April). They were given wheat necklace. The community people believed that all those newborn had more chances to be affected by *Chaita batas*h (evil wind of month *Chaittra*) and the wheat necklace can protect them from *Chaita batash.*

Postnatal Care Practices

Diet during Post-natal Period

The mother's diet was rigidly more controlled at postpartum period than during pregnancy. After delivery usually the mothers were given hot raw tea and dry food like puffed rice, beaten rice or bread. They believed that medicinal properties of hot raw tea helped to remove the pain after childbirth and dry food helped mother's wound to recover. The community women said that until the umbilicus dried they usually gave pepper dust and rice with black cumin seed mash or salt to dry up the umbilicus cord.

After the umbilicus heals, the mother ate *Panta* (watery rice), salt, pepper without any kinds of meat and vegetables. They believed that eating various types of food might

cause mothers and the newborns more defecation. Mothers avoided eating rice, especially at night otherwise edema would occur. Potato, leafy vegetables, cabbage, radish, bean, banana were strictly prohibited fearing that these might attack the newborn with pneumonia, cough, cold, asthma and abdomen and chest pain. Food restrictions were maintained up to 42 days after delivery. Respondents had the misconceptions about drinking water. Lactating mothers did not drink water properly, especially before breastfeeding. They believed that cold water chilled breast milk and caused neonates cold. Food restrictions were kept strictly among all the respondents until the umbilicus dried, then they gradually relaxed day by day after 42 days of delivery.

The Period of Confinement

The community women described the time of confinement as *Chhoa* (Touch). During this time a mother was considered as impure. Her movement was almost restricted into a room where the natural light and air was insufficient. The restriction continues for 42 days after delivery. The community perceived that this practice protected mothers and newborns from *Bao batash* (evil wind). During the time of confinement they hung nets, kept steam of banana tree, iron and broom on the doorsteps of mother's room. This time the mother was forbidden for cooking, washing, cleaning for others, as she was considered impure. The community women usually dressed in old cloths during this time because they throw out all those cloths later because it was used during impure period.

Discussion

Understanding of traditional belief and practices relating to the maternal and neonatal care is needed in the development of interventions to reduce maternal and neonatal mortality (Chakraborty *et. al.*, 2003). The study revealed different aspects of existing maternal and neonatal cares perception, beliefs and practices in two sub-districts (Domar and Jaldhaka) of Nilphamari district. The evidences indicate social and cultural forces that directly influenced on women practices regarding pregnancy, delivery, neonatal and postnatal period.

Improving Care during Antenatal Period

With a view to improving MNCH Program provides doorstep antenatal services including examination of anemia, measurement of blood pressure, and fetal position, but the community women need to go to satellite clinic or government hospital for others

antenatal services such as collecting iron or calcium tablets, albumin test and measuring weight. Women received only doorstep antenatal services. They did not like to go to satellite clinics, hospital or other ANC centre as the delivery date comes nearer.

Attending Antenatal Care (ANC) four times is one of the major WHO recommended interventions as it is associated with improved maternal and neonatal outcomes (Villar *et. al.*, 2009). However, we found this to be rare in practice. The rate of twice-received antenatal care is higher than to three times receive and no one reported attending ANC four times during pregnancy. The reasons given for this included knowledge barriers, service delivery gaps, financial constraints, cultural, traditional beliefs and practices. In such conservative society utilization of those services is related not only with availability, quality and cost of services, but also with social structure, health beliefs and personal characteristics of the users (Nasreen *et. al.*, 2006).

Care during Delivery

Another important component to reduce the maternal and neonatal death is ensuring safe delivery (Nasreen *et. al.*, 2007). Safe delivery associated with element of birth preparedness, complication, readiness and use of skilled provider at delivery (Nasreen *et. al.*, 2006).

Study findings show that home delivery by TBAs is common among the respondents. However, even today less than one in five of these TBAs are trained. Evidence from previous study shows that even those who have received training do not necessarily absorbed or performed properly (Nasreen, 1994). In both study area trained and untrained TBAs was doing the same kind of harmful practices regarding arrangement of clean surface, hand wash with shop, boiling thread and using new blade.

Community women were informed about birth preparedness in ANC but implementation is poor due to limited knowledge. Participants revealed to us that husband and mother-in-laws are key persons to birth preparedness since women rely on them for decisions and support. Family member were found confident to face delivery complications and to manage transport if needed. Therefore, advanced planning for transport was low although the MNCH Program intervention raising awareness for transport through program messages. This could be due to the fact that the family members might have better understanding about the importance of birth preparedness and about safe deliveries.

Essential Newborn Care

The essential components of normal newborn care include clean delivery, cord care, thermal protection, early and exclusive breast feeding (Nasreen, 1994). Our study explores some disappointing findings regarding essential newborn care. The practice of waiting for the placenta to deliver before cutting the umbilical cord by *Daiyani* was observed. This practices delays immediate wrapping and breast feeding. However, it showed that 22% neonatal death could be prevented if breastfeeding started within first hour (Akuse *et. al.*, 2009). Evidences shows bathing the baby immediately after birth, early shaving hair and massage of mastered oil to the newborn is still well established practices in the study area due to perception of impurity. Recently there have been increasing concerns about all these traditional practices as it is thought to influence newborn to the risk of hypothermia (Sreeramaredt, 2006). Our findings on essential newborn care shows that the community people were much conservative with own patterns of newborn care. Traditional belief, perceptions, low level of education and local myths are correlated with their newborn care practices.

Movement and Dietary Restriction after Delivery

Evidences shows that after delivery community women lived into an ill-ventilated, ill-lit and unhygienic rooms which are seldom visited by a selected few persons. Eating norms that restricts the food intake of mothers during postnatal period have been found in both the study areas. Previous study showed nearly 75% of women withholding food for eight hours after delivery and other restrictions in dietary staple and animal foods thereafter. In addition, during child or maternal illness, one-third of lactating women restricted their overall food intake, and other one-third cut back on some component of the diet (Shubh *et. al.*, 1997). Local myths and beliefs encourage maintaining such kind of restrictions in study area.

Sickness Perception and Care-Seeking Behavior

Community people explain causes of any kind of complication (regarding maternal and newborn) with their traditional beliefs, and perceptions. Especially, women had the tendency to hide their gynecological problems. The cultural constraints of hiding maternal complication influence women's health-seeking behavior and expectations concerning outcomes of treatment (Nasreen *et. al.*, 2007). Community people depend on

such healthcare system consists of a Health and Family Welfare Centre (H&FWC) at the union level where services are provided by a Sub-Assistant Community Medical Officer (SACMO) and a Family Welfare Visitor (FWV). Services are also available from the Satellite Clinics (SC) at the community level. At the sub-district level, the Upazila Health Complex (UHC) is the first referral centre where medical doctors provide services. Childcare facilities are available at all these levels (Ahmed *et. al.*, 1998). But misconception of identifying illnesses causes improper choices of treatment, which lead them to depend on traditional practices to heal.

Conclusion

We found strong cultural and traditional ties that deter women from decision-making and delivering at health centers or with medically trained attendants because their mothers have given birth naturally for generations. In community traditional beliefs and perceptions, which have deep emotional basis, discouraged women to get appropriate services. Not only that, family norm has been influencing the entire process of maternal and neonatal care practices. The burden of women's household work, lack of freedom for decision-making, mobility restriction, lack of earning opportunities, cultural and social stigmatization, domestic violence or culture of 'wife beating' lag behind women to access proper maternal and neonatal health services in the community. The people of both the study areas had very limited knowledge about maternal and neonatal health but had large number of beliefs, taboos, rituals and practices. Some of those appeared to be of no use or even harmful.

The study findings will help health policy makers and planners to identify the gap and to develop cultural sensitive interventions and promoting maternal and neonatal care in such ways that rural people can internalize in the context of their own lives.

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ISSN 1019-9624
The Bangladesh Rural Development Studies Vol. XIII No. 1 (2010)

Participation of Pregnant Women in Monthly Weight Gain Monitoring and Promotion Sessions in Bangladesh National Nutrition Program: The Case in Bhanga Upazila

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Abstract

A statistically representative sample of 480 households in Bhanga Upazila was studied to assess the participation behavior of pregnant women in the Bangladesh National Nutrition Program (NNP) pregnancy weight gain monitoring and promotion (WMP) sessions. However, 38% of the women did not participate in the sessions regularly mainly due to either they did not feel it necessary or they had no time to attend.

The participation rates were insensitive to the observed socioeconomic and personal characteristics of the women but related to the women's eligibility in supplementary feeding. The women in supplementary feeding were 5 times more likely to participate regularly compared to those not in supplementary feeding. There was evidence that as the women's level of literacy increased their participation rate increased and the program had disproportionately favored the poor.

A strong public awareness campaign is likely to improve the women's motivation to participate, and cutting down the supplementary feeding services would substantially reduce the participation rate.

Introduction

The Government of Bangladesh with support from the World Bank, UNICEF and few bilateral donors introduced the Bangladesh Integrated Nutrition Program (BINP) in 1995 with a view to addressing the maternal, child and adolescent malnutrition in the country. National Nutrition Program (NNP) designed after the lessons learnt from BINP. Initially NNP was introduced in all BINP Upazilas and by 2005 it was expanded to 105 Upazilas in the country.

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Although NNP differed from BINP in some details of program administration and management, the basic nutritional services delivered to the target population and the institutional arrangements for the service delivery in the two programs were similar. The basic services delivered were monthly weight gain monitoring and promotion (WMP) of pregnant women, monthly growth monitoring and promotion (GMP) of under two year old children, daily supplementary feeding of. malnourished children and energy deficient pregnant and lactating women, micronutrient supplementation, home visits and referrals of illness. At the community level the program is implemented by a local Community Nutrition Promoter (CNP) responsible for a Community Nutrition Center (CNC) covering 200 to 250 households under the supervision of contracted NGOs (WB, 2000).

Among the services provided under the program monthly WMP sessions of pregnant women and monthly GMP sessions of under two years old children have special significance. All pregnant women and all mothers of under two years old children along with the children are specially encouraged to attend the sessions regularly. During the WMP sessions pregnancy weight gain of the women are monitored, antenatal services are provided, and the energy deficient women are enrolled in a free daily supplementary feeding scheme for until the end of lactation. During the GMP sessions anthropometric measurements of the children are taken, and if the weight fell below the standard weight for the age in two successive measurements they are enrolled in a free daily supplementary feeding scheme for until the weight for age catches up with the standard normal.

Objectives of the Study

The main objective of this study is to assess the participation behavior of pregnant women in monthly WMP sessions in NNP. Specifically the study examined the frequency of participation and reasons for non-and irregular participation and related the participation rates with the socioeconomic and personal characteristics of the women.

Materials and Methods

The study was conducted in Bhanga Upazila, one of the six first-phase BINP Upazilas, in Faridpur district where the program had been in operation since 1995. Data were collected in April 2005 from a statistically selected representative sample of 528 mothers having 6 to 59 months old children by the researchers themselves through personal interview of the mothers using a pre-tested questionnaire.

The households were selected in two stages. Bhanga had 195 CNCs. Assuming that on the average 70 households having 6 to 59 months old children would be available in each CNC, seven CNCs were selected systematically in the first stage. In the second stage all the households having 6 to 59 months old children in the selected CNCs were studied. However, valid program participation data were available from 480 women. Some of the women did not participate in WMP sessions as they did not live there during their pregnancy or NNP was temporarily inoperative due to changeover of contracting NGOs. These samples were excluded from the analysis[2].

Results

Participation Rates in WMP Sessions: It was found that 83% of the pregnant women ever participated in WMP sessions. Among those who participated 75% participated regularly, 22% participated irregularly and 3% participated rarely. Among all the pregnant women studied 17% never participated, 62% participated regularly, 19% participated irregularly and 2% participated rarely (Figure 1).

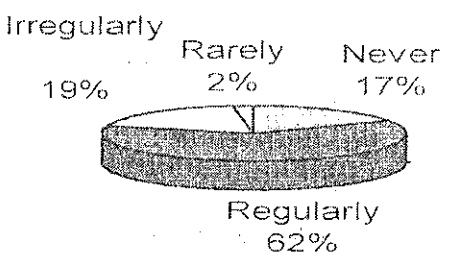

Figure 1: Frequency of participation in WMP by pregnant women

[2] The minimum sample size required for the study was:

$$n = \frac{Za^2 P (1 - P)}{d^2} \times f.$$

Where P = anticipated prevalence rate and Za = 1.96 at a = 0.05. Assuming d = 0.05 and f = 1.25, the minimum sample size required for the prevalence rate of 50% was 480.

Reasons for Non-and Irregular Participation: 'Did not feel it necessary' was the major reason for non-or rare participation and 'had no time to attend' was the major reason for irregular participation of the women in WMP sessions. About one-half of the women did not participate in the sessions due to these reasons. 'Services were not useful or poor' was also an important reason for non or rare participation and 'did not feel it necessary' was an important reason for irregular participation. About one-quarter and one-third of the women did not participate due to these reasons respectively. 'Family objected' was a relatively minor reason for non-and irregular participation (Table 1).

Table-1: Reasons for Non-and Irregular Participation in WMP Sessions

Reasons	Never or rarely participated (% women)	Irregularly participated (% women)
Did not feel it necessary	47.3	31.4
Services were not useful or poor	23.6	10.1
Family objected	15.1	2.3
No time to attend	14.0	56.2

Factors Affecting Participation: The study examined the factors affecting three levels of the women's participation in WMP sessions, namely, never or rarely participated, regularly participated and irregularly participated. The results indicate that the participation levels were unrelated to their household size, farm size, levels of literacy, levels of their husbands' literacy and their husbands' major occupation. Of the factors studied the levels of participation were significantly related to their eligibility in NNP supplementary feeding. Farm size had an inverse relationship with the levels of participation indicating that as the farm size increased the level of participation decreased. The relationship was significant at the 91% level of confidence (Table 2).

Effects of Eligibility in Supplementary Feeding: Table 2 also allows calculating what would happen to the participation rate if the NNP supplementary feeding services were withdrawn. The table indicates that of the women who were not in supplementary feeding 55% participated in WMP sessions regularly, 38% participated irregularly and 7% participated rarely. It may be expected that the rates would hold for all pregnant women

in the absence of the feeding service. Applying these methods to all pregnant women it worked out that cutting down the supplementary feeding services would increase the never and rarely participation rate by 19%, reduce the regularly participation rate by 27% and increase the irregularly participation rate by 70%. The overall participation rates would be never 17%, rare 6%, regular 45% and irregular 32%.

Table-2: Factors Affecting Participation in WMP sessions

Factors	Never or rarely participated group	Regularly participated group	Irregularly participated group	Significant level p-value [a]
Women's literacy				
No schooling (no. of women)	40	125	39	0.389
Class I – V (no. of women)	23	98	31	
Class VI or more (no. of women)	30	75	19	0.772
Husbands' literacy				
No schooling (no. of husbands)	37	124	39	
Class I – (no. of husbands)	18	71	18	
Class VI or more (no. of usbands)	38	103	32	
Household (hh) size				
Less than 5 members (no. of hh)	26	86	20	0.679
5 – 6 members (no. of hh)	41	143	46	
7 members or more (no. of hh)	26	69	23	
Farm size owned No land (no. of hh)	33	132	33	0.090
Less than 100 dec. (no. of hh)	33	117	37	
100dec. or more (no. of hh)	27	49	19	
Husband's occupation				
Farmer (no. of husbands)	32	98	33	0.702
Laborer (no. of husbands)	22	86	26	
Business (no. of husbands)	25	82	18	
Others (no. of husbands)	14	32	12	
Eligibility in supplementary feeding [b]	11	84	58	0.000
Ineligible (no. of women)	0	214	31	

a. The associations were tested using Chi-square

b. The analysis excluded 82 women who never participated

Changes in Participation Behavior in GMP Sessions: NNP also encouraged the mothers of under two year old children to attend GMP sessions regularly along with their children. It might be interesting to see how the pregnant women's participation behavior

in WMP sessions changed during the GMP sessions after their childbirth. Matching data for this analysis was available for 466 women. Of the women who never or rarely participated in WMP sessions 8% participated regularly and 8% participated irregularly in GMP sessions. Of the women who participated regularly in WMP sessions 8% participated irregularly and 8% participated never or rarely in GMP sessions. Of the women who participated irregularly in WMP sessions 22% participated regularly and 34% participated never or rarely in GMP sessions. Overall, the participation rates in GMP sessions fell compared to those in WMP sessions. Whereas 19%, 62% and 19% of the women participated never or rarely, regularly and irregularly in WMP sessions, 27%, 58% and 15% participated so in GMP sessions (Table 3).

Table-3: Changes in Participation Rates in GMP Sessions

Participation in WMP		Participation in GMP (% women)		
Level	% of women	Never or rarely	Regularly	Irregularly
Never or rarely	19.3	84.4	7.8	7.8
Regularly	62.2	7.6	84.5	7.9
Irregularly	18.5	33.7	22.1	44.2
All	100.0	27.3	58.3	14.4

Determinants of Participation in WMP Sessions: A multivariate binary logistic model was estimated to find the determinants of the women's participation behavior in WMP sessions. The levels of participation (regular = 1, else = 0) was used as the dependent variable. It may be theoretically argued that the levels of the women's literacy, their husbands' literacy, household size, farm size, their husbands' occupation and eligibility in NNP supplementary feeding services would influence their participation behavior in WMP sessions. As such the variables were used as the independent variables. The correlation coefficients between the independent variables were generally small (≤ 0.5). Initial runs showed that the regression coefficients of the husbands' literacy, household size and husbands' occupation were not significantly different from zero even at high levels of probability. The variables were, therefore, dropped in the estimated final equation.

The results indicated that literate women were (80%) more likely to participate regularly compared to illiterate women. Women from large farm households were 47% and less likely to participate regularly compared to those from landless households. The women in

supplementary feeding were 5 times more likely to participate regularly compared to those not in supplementary feeding (Table 4).

Table-4: Determinants of Regular Participation in WMP Sessions

Factors	Odds ratio	95% confidence interval		Significant level p-value
		Minimum	Maximum	
Semiliterate women (class I–V)	1.179	0.659	2.111	0.578
Literate women (class VI or more)	1.837	0.924	3.650	0.083
Medium farm owners (0.01-99.99 dec.)	0.881	0.504	1.539	0.656
Large farm owners (100 dec. or more)	0.533	0.259	1.108	0.092
Included in supplementary feeding	6.052	3.651	10.032	0.000
Constant	1.141	-	-	0.613

Participation by Factor Pattern: Based on the estimated odds ratios predicted probabilities of the women's regular participation in WMP sessions can be calculated for various factor patterns. Such calculations for selected factor patterns are presented in Table 5. It indicated that illiterate women coming from large farm households not included in supplementary feeding had the lowest probability of regular participation in WMP sessions. As the level of literacy of the women increased or farm size decreased there were some but small improvement in the participation. The probability of participation jumped for the inclusion of the women in supplementary feeding.

Table-5: Predicted Probability of Regular Participation in WMP sessions by Selected Factor Pattern

Factor pattern	Predicted probability [a]
Literate women, landless households, included in supplementary feeding	0.927
Illiterate women, landless households, included in supplementary feeding	0.873
Illiterate women, landless households, not included in supplementary feeding	0.533
Literate women, large farm households, not included in supplementary feeding	0.527
Illiterate women, large farm households, not included in supplementary feeding	0.378

a. The predicted probabilities were calculated multiplying the odds ratios of the factors in the patterns including that of the constant which gave the odds ratios of the factor patterns and dividing the numbers by one plus the numbers.

Discussions and Policy Implications

This study assessed the participation behavior of pregnant women in monthly WMP sessions in NNP area in Bhanga Upazila in Faridpur district. It was found that 38% of the women either never or irregularly participated in WMP sessions and the participation rates declined in GMP sessions after their child birth. BINP midterm evaluation observed that 15% of the women with under two year old children either never or irregularly participated in GMP sessions (INFS, 1998). In comparison the participation rates did not improve in this study.

The majority of the women who did not participate in WMP sessions did so because they did not feel it necessary, and the majority of the women who participate irregularly did so because they had no time to participate. Family objection was a minor constraint. It meant that the women were not fully convinced of the importance of the WMP sessions indicating that a strong social mobilization and public awareness campaign could better motivate them to participate more regularly realizing the full potentials of NNP.

The participation of the women in WMP sessions was fairly random. It was insensitive to the women's socioeconomic status and personal characteristics but varied with their eligibility in supplementary feeding. Women in supplementary feeding were 5 times more likely to participate in WMP sessions regularly compared to the women not in supplementary feeding. The results highlight the importance of supplementary feeding in affecting the participation of the women in the activity. Although not statistically significant the participation rate improved for higher levels of the women's literacy and smaller farm size. In rural Bangladesh farm size is a strong indicator of wealth indicating that NNP had disproportionately benefited the poor. Similar results were also observed in other studies involving NNP data (Karim et. al. 2001).

At present there is a strong debate at the program policy level whether to continue the supplementary feeding services of NNP as it involves high costs. This study observed that the feeding services could be discontinued but at a substantial cut of the participation of the pregnant women in the WMP sessions.

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ISSN 1019-9624
The Bangladesh Rural Development Studies Vol. XIII No. 1 (2010)

Recycling of Seepage Water through Dug Well for Irrigation: A Study at RDA Demonstration Farm

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Abstract

An attempt has been made to conduct a study with a view to evaluate the Performance of a dug well at RDA demonstration farm in relation to water quality for crop production, well efficiency, pump efficiency, cost effectiveness and other relative parameters. The performance of the dug well was evaluated for both dry season (i.e. month of October, November and December) and rainy season (i.e. month of June, July and August). From a comparative study of both seasons (dry and rainy), the water table was found very near to the ground surface (average 0.91 m below) in rainy period where as in the dry period average water level depth was 2.72 m. The recovery of dug well was found about five times high during rainy period (1.68 m depth of water) than the dry period (0.367m depth of water). From the comparative analysis during both the dry and rainy period, it was observed that dug well can produce much water during rainy period than dry period. In respect of water quality, the concentrations of Dug Well water were found too high than DTW water. As a result, enough nutrients can be obtained from the dug well water than DTW water and additional chemical fertilizer is not necessary if dug well water is applied in the crop field. Different crops can easily be grown in the farm using dug well water with the very low application of those parameters. It was also found that arsenic was absent and nitrite was same (01 mg/l) in both the water and total hardness as $caco_3$ and pH in the dug well water was present in a small amount than DTW water. Acidity was low in the dug well water than DTW water. From these investigations, it can be concluded that dug well is suitable for crop production especially vegetables production in the field.

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1.0 Background

In Bangladesh generally ground water is being used for irrigation through DTW and STW. But the quality of water already deteriorated. To save the water resources and ensure quality irrigation water, Rural Development Academy (RDA), Bogra, has set up a

Dug Well experimentally to recycling ground water used for irrigation as well as compare the quality of water with DTW especially for crop production. With a view to this idea, two Dug Wells were constructed at RDA demonstration farm. One is installed for drip irrigation and other for sprinkler irrigation purpose. It is therefore, needed to analyze the water quality of the Dug Wells for assessing suitability for irrigation and also to assess its importance for both type of irrigation in respect of cost.

An attempt has therefore been made to conduct a study with a view to describe cost and water quality analysis of Dug Well and also to compare with DTW water. Further studies in relation to well and pump efficiency, cost effectiveness and other relative parameters have been made.

2.0 Objectives of the Study

The main objective of this study was to find out the water suitability of Dug Well and DTW installed at RDA demonstration farm.

The specific objectives are given below:

- To analyze the water quality of Dug Well and DTW for crop production;
- To examine the cost effectiveness of Dug Well with DTW;
- To measure the well performance with the view to static water level, specific draw down, pump capacity, recharge and discharge of Dug Well.

3.0 Methodology

The DTW and Dug Well installed at RDA demonstration farm had been considered for this piece of study. All the necessary data were collected from the RDA field as well as from the relevant literatures available in the RDA library. Researchers were directly

involved for collecting data. The relevant data have been collected from the Dug Well during two seasons. First one was in dry period i.e. October to December and second one was in the rainy period i.e. May to August. A sludge pump of 01 hp was used in the Dug Well in order to collect necessary data such as water level, specific draw down, recharge and discharge of the well. All these data had been measured during the both rainy and dry season for comparing the performance of Dug Well. Data related to installation cost of deep tube well at RDA demonstration farm was also recorded. Moreover water quality of both Dug Well and DTW was tested and compared in order to determine suitability for irrigation purpose only.

4.0 Result and Discussion

4.1 Status of Dug Well in Dry period (October to December)

The performance of Dug Well located in RDA farm during dry season i.e. October to December is tabulated bellow. Hence, data related to total depth, volume and lifting period have been measured and the total discharge has been calculated. Again time of recovery and the total depth of water level after recovery have also been measured.

Table-01: Performance studied of Dug Well in the month of October

	Sl. no.	Dia. of Dug Well (m)	Total depth of water (m)	Total volume of water (m^3)	Total water lifting period (min)	Total discharge (m^3/min)	Recovery		Remarks
							Total time (hr)	Total depth of water (m)	
Trial No-01	1	0.91	1.98	1.28	4.09	0.31	3.12	1.49	*Water table=2.74m and pump capacity, H=12-2.6m, Q=0.3-6.4 l/s, hp-01.*
	2	0.91	1.49	0.96	3.06	0.31	4.09	1.21	
	3	0.91	1.21	0.78	2.50	0.31	5.15	0.91	
	4	0.91	0.91	0.59	1.88	0.31	6.22	0.42	
	5	0.91	0.42	0.27	0.87	0.31	6.24	0.40	

Table-02: Performance studied of Dug Well in the month of November

	Sl. no.	Dia. of Dug Well (m)	Total depth of water (m)	Total volume of water(m^3)	Total water lifting period (min)	Total discharge (m^3/min)	Recovery		Remarks
							Total time (hr)	Total depth of water (m)	
Trial No-02	1	0.91	1.88	1.22	3.89	0.31	2.55	1.37	*Water table=2.70m and pump capacity, H=12-2.6m, Q=0.3-6.4 l/s, hp-01.*
	2	0.91	1.37	0.89	2.84	0.31	4.01	1.16	
	3	0.91	1.16	0.75	2.40	0.31	5.09	0.83	
	4	0.91	0.83	0.54	1.72	0.31	6.14	0.44	
	5	0.91	0.44	0.28	0.91	0.31	6.19	0.38	

Table-03: Performance studied of Dug Well in the month of December

	Sl.no.	Dia. of Dug Well (m)	Total depth of water (m)	Total volume of water(m^3)	Total water lifting period (min)	Total discharge (m^3/min)	Recovery		Remarks
							Total time (hr)	Total depth of water (m)	
Trial No-03	1	0.91	1.91	1.24	3.96	0.31	3.27	1.51	*Water table=2.72m and pump capacity, H=12-2.6m, Q=0.3-6.4 l/s, hp-01.*
	2	0.91	1.51	0.98	3.13	0.31	4.22	1.19	
	3	0.91	1.19	0.77	2.46	0.31	5.32	0.89	
	4	0.91	0.89	0.57	1.84	0.31	6.24	0.35	
	5	0.91	0.35	0.22	0.72	0.31	6.29	0.32	

From the above tables, performance of the Dug Well has been shown in three times during the month of October, November and December. In trial 01, it was found that water table was 2.74 m in the month of October and the pump was operated by head-12

to 2.6 m having discharge of 0.3 to 6.4 l/s and hp-01. It was observed that recovery of the Dug Well depend upon the total time with the depth of water. If the required time was large, the depth of water was low. Also finally it was found that the required time and depth of water were about constant i.e. when the required time was 6.22 hr then the depth of water was 0.44 m and again when the required time was 6.44 hr, then the depth of water was 0.40 m.

In the trial 02 and 03, the water table in the Dug Well was 2.70 m and 2.72 m respectively and the used pump capacity was same. Recovery is near about same as the trial 01.

4.2 Status of Dug Well in Rainy period (June to August)

Also, the performance of Dug Well during rainy season i.e. June to August is tabulated bellow. Hence, data related to total depth, volume and lifting period have been measured and the total discharge has been calculated. Again time of recovery and the total depth of water level after recovery have been measured same as Rainy period.

Table-04: Performance studied of Dug Well in the month of June

	Sl. no.	Dia. of Dug Well (m)	Total depth of water (m)	Total volume of water ($m^{3)}$	Total water lifting period (min)	Total discharge (m^3/min)	Recovery		Remarks
							Total time (hr)	Total depth of water (m)	
Trial No-01	1	0.91	3.81	2.47	7.9	0.31	1.42	3.29	*Water table=0.91m and pump capacity, H=12-2.6m, Q=0.3-6.4 l/s, hp-01*
	2	0.91	3.29	2.13	6.82	0.31	2.56	2.94	
	3	0.91	2.94	1.91	6.09	0.31	4.13	2.52	
	4	0.91	2.52	1.63	5.22	0.31	5.23	1.98	
	5	0.91	1.98	1.28	4.10	0.31	6.29	1.95	

Table-05: Performance studied of Dug Well in the month of July

	Sl. no.	Dia. of Dug Well (m)	Total depth of water (m)	Total volume of water (m^3)	Total water lifting period (min)	Total discharge, (m^3/min)	Recovery		Remarks
							Total time (hr)	Total depth of water (m)	
Trial No-02	1	0.91	3.76	2.44	7.79	0.31	1.34	3.22	*Water table=0.89m and pump capacity, H=12-2.6m, Q=0.3-6.4 l/s, hp-01*
	2	0.91	3.22	2.09	6.67	0.31	2.39	2.78	
	3	0.91	2.78	1.80	5.76	0.31	3.48	2.25	
	4	0.91	2.25	1.46	4.67	0.31	4.57	1.66	
	5	0.91	1.66	1.07	3.44	0.31	6.11	1.61	

Table-06: Performance studied of Dug Well in the month of August

	Sl. no.	Dia. of Dug Well (m)	Total depth of water (m)	Total volume of water (m^3)	Total water lifting period (min)	Total discharge (m^3/min)	Recovery		Remarks
							Total time (hr)	Total depth of water (m)	
-Trial No-03	1	0.91	3.82	3.44	10.98	0.31	1.18	3.29	*Water table=0.92 m and pump capacity, H=12-2.6m, Q=0.3-6.4 l/s, hp-01*
	2	0.91	3.29	2.13	6.82	0.31	2.37	2.79	
	3	0.91	2.79	1.81	5.78	0.31	3.49	2.12	
	4	0.91	2.12	1.37	4.39	0.31	4.43	1.54	
	5	0.91	1.54	0.98	3.13	0.31	5.52	1.48	

From the above table, it was performed the Dug Well in three times during the month of June, July and August. In first trial, it was found that water table was 0.91 m in the month of June and pump was operated by head 12 to 2.6 m having discharge 0.3 to 6.4 l/s and hp-01. Recovery of the Dug Well depends upon the total time with the depth of

water. If the required time was increased, the depth of water was decreased. Also finally time and depth of water were about constant i.e. when the required time was 5.23 hr, then the depth of water was 1.98 m and the required time was 6.29 hr, then the depth of water was 1.95m that were both the same.

In second and third trial, the water table was 0.89 m and 0.92 m respectively and the used pump capacity was same. Recovery was near about same as the trial 01.

Table-07: Comparison of Recovery during Dry and Rainy Period in Dug Well water

Season	Month	Water Table (m)	Av.	Recovery of Dug Well Water			
				Total Time(hr)	Av.	Constant Depth of Water (m)	Av.
Dry period	October	2.74	2.72	6.24	6.24	0.40	0.36
	November	2.70		6.19		0.38	
	December	2.72		6.29		0.32	
Rainy Period	June	0.91	0.91	6.29	5.97	1.95	1.68
	July	0.89		6.11		1.61	
	August	0.92		5.52		1.48	

From both period (Dry and Rainy period), it was found that water table was very near to ground surface in Rainy period which was average 0.91 m and Rainy period was average 2.72 m. Recovery of Dug Well who found to be near about five times high in Rainy period (1.68 m depth of water) than the Rainy period (0.36 m depth of water). It can be said from the comparative analysis both the dry and Rainy period that much water can be obtained from the Dug Well in Rainy for the same time.

4.3 Water Quality of Dug Well

Table-08: Raw water from Dug Well

Sl. No.	Water quality parameters	Unit	Conc. present
1	p^H	-	6.1
2	Iron, Fe	mg/l	1.71
3	Arsenic, As	μg/l	nil
4	Manganese, Mn	mg/l	0.2
5	Nitrate-Nitrogen, No_3-N	mg/l	03
6	Nitrite, No_2	mg/l	1
7	Sulfate, So_4	mg/l	05
8	Total Hardness as $CaCo_3$	mg/l	52
9	Turbidity	NTU	161.77

4.4 Command area covered by Dug Well

A Dug Well is essentially a well of larger diameter than that of a tube well and obtains its supply from the first water-bearing formation. It has a small discharge, about 200 to 250 litre per minute depending upon the position of static water-table and geological formation. The average discharge of the Dug Well was 0.004 cumec. An average irrigation well in RDA could produce 10-15 thousand cubic metres of water annually and irrigate 1.5 hectares of cultivable land. The Dug Well penetrates 2 to 9 ft. below the water-table so that 3 to 15 ft minimum infiltration head or draw-down is available to ensure sufficient supply during a dry year

4.5 Detailed Cost Estimate of DTW at RDA Farm

Table-09: Cost of Deep-tube well (Capacity 2.0 cusec)

Sl. No.	Description	Unit	Quantity	Rate (Tk.)	Amount (Tk.)
	Part- A				
1	Mobilization	-	L/S	-	5,000.00
2	Drilling 500 mm. diameter hole for screen and well casing	lin. m	35	1000.00	35,000.00
3	Furnishing and installing 350 mm dia 5mm thickness MS housing	lin. m.	30	4000.00	1,20,000.00
4	Furnishing and installing 150 mm dia PVC strainer (Class-C) with centering guides	lin. m.	45	600.00	27,000.00
5	Furnishing and installing 350 mm dia MS bail plug (05 mm thickness) with end cap	lin. m.	1	10,000.00	10,000.00
6	Furnishing and installing gravel packing	cum. m	10	1300.00	13,000.00
7	Develop well	hr.	48	300.00	14,400.00
9	Furnishing, installing and removing test pump, Disinfecting and Capping well	-	L/S	-	10,000.00
10	Demobilization	-	L/S	-	5,000.00
11	Supply of Column pipe (150 mm dia MS)	lin.m	24	2500.00	60,000.00
12	Supply of Delivery pipe and Connection with main pipe (150 mm dia MS)	lin.m	3	2500.00	7,500.00
				Sub-Total (A)	**3,06,900.00**
	Part- B				
13	Submersible pump with motor, KSB, Brand of INDIA BPN 394/2+HB 413, Hp=41,H=49-34 m, Q=90-180 m3/h	No.	1	312,000.00	312,000.00
14	Panel board with Auto & Manual system, Over load control, Amp& volt meter with selector switch, and Indication bulb (3 nos.)	L/S	0	52,000.00	52,000.00
				Sub-Total (B)	**3,64,000.00**
				Total (A+B)	**6,70,900.00**

4.6 Water Quality of DTW

Table-10: Raw water from DTW

Sl. No.	Water quality parameters	Unit	Concentration present
1	p^H	-	7.0
2	Iron, Fe	mg/l	0.17
3	Arsenic, As	ug/l	nil
4	Manganese, Mn	mg/l	0.1
5	Nitrate-Nitrogen, No_3-N	mg/l	1.2
6	Nitrite, No_2	mg/l	1
7	Sulfate, So_4	mg/l	02
8	Total Hardness as $CaCo_3$	mg/l	78
9	Turbidity	NTU	1.33

4.7 Comparative assessment of dug and DTW water

Table-11: Comparison of water quality parameters

Sl. No.	Water quality parameters	Unit	Concentration present	
			Dug Well water	DTW water
1	p^H	-	6.1	7.0
2	Iron, Fe	mg/l	1.71	0.17
3	Arsenic, As	ug/l	nill	nill
4	Manganese, Mn	mg/l	0.2	0.1
5	Nitrate-Nitrogen, No_3-N	mg/l	03	1.2
6	Nitrite, No_2	mg/l	1	1
7	Sulfate, So_4	mg/l	05	02
8	Total Hardness as $CaCo_3$	mg/l	52	78
9	Turbidity	NTU	161.77	1.33

From the above table, the concentrations of Dug Well water are P^H (6.1), Iron (1.71 mg/l), Arsenic (nil), Manganese (0.2 mg/l), Nitrate-Nitrogen (03 mg/l), Nitrite (01 mg/l), Sulfate (05 mg/l), Total hardness as $caco_3$ (52 mg/l) and Turbidity (161.77 NTU). Also the concentrations of deep tube well water are p^H (7.0), Iron (0.17 mg/l), Arsenic (nil), Manganese (0.1 mg/l), Nitrate-Nitrogen (1.2 mg/l), Nitrite (01 mg/l), Sulfate (02 mg/l), Total harness as $caco_3$ (78 mg/l) and Turbidity (1.33 NTU). It was found that the concentrations of Dug Well water is comparatively very high than DTW water. As a result, enough nutrients can be obtained easily from the Dug Well water than DTW water and additional fertilizer is not necessary if dug water is applied in the crop field. So different crops especially vegetables can easily be produced by using Dug Well water with the very low application of those parameters. Also, arsenic is absent and nitrite is same (01 mg/l) in both the water and total hardness as $caco_3$ of Dug Well water is less than DTW water. The pH of the Dug Well is less than DTW water. So acidity is low in the Dug Well water than DTW water. Finally it was found that Dug Well is especially suitable for crop production in the field.

4.8 Water Saving

By using Dug Well water can be saved instead of installation of DTW in the places where suitable aquifer are not found. From Dug Well, it was found that an average irrigation well in RDA could produce 10-15 thousand cubic metres of irrigation water annually and irrigate 1.5 hectares of cultivable land by the installation cost of Tk. 20,500.00. But, from a DTW having average discharge (Assuming a DTW runs per season 03 months and yearly 06 months for the 02 season basis) 34-40 lacs cubic meters of water annually by the installation cost of Tk. about 7.00 lacs can irrigate about 750-800 hectares of cultivable land. The capital cost of such installation is very high which can not be borne by the farmers easily and it can not be done without technical persons and equipments. But a Dug Well can be constructed by farmers easily to their own hand equipments.

5.0 Conclusion

Proper utilization and management of available water resources are the key factors in accelerating agricultural development of the country. Ground water has become the dependable source for meeting over 70% of irrigation needs and almost total potable demand of our country. But due to lack of proper management and high operation and maintenance costs of water abstraction devices and pumps, installation of traditional DTWs are not more economically viable now a days. Dug Well water is used in the agricultural field as well as for drinking purpose all over the country. A large amount of water and power can be saved through Dug Well in agricultural field. Finally, the following conclusions can be achieved from the study regarding beneficial use of Dug Well in relation to ground water development locally.

1. Dug Well water is used as recycle way in the field for irrigation as well as drinking purpose.
2. As Dug Well water can be recycled, it is much better than DTW water for irrigation purpose.
3. As Dug Well water is seepage from irrigation water, it contains more nutrients and sufficient fertilizer is not need for crops.
4. If Dug Well water used for irrigation purpose, significant electric power can be saved and hence cost of crop production be reduced..
5. By using Dug Well water, DTW pumping can be reduced and hence after effect of ground water pumping can be avoided.
6. By using Dug Well water contamination can be reduced.
7. More nitrogen can be obtained through the use of Dug Well water.
8. Pumping of Dug Well water needs very low cost without any technical support

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ISSN 1019-9624
The Bangladesh Rural Development Studies Vol. XIII No. 1 (2010)

Effect on Crop Production Using RDA-Irrigation Technology

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Abstract

Agriculture is still a dominating factor in the economy of Bangladesh in terms of Gross Domestic Product (GDP), though not in terms of food production. This report evaluates the impact of the irrigation technological diffusion in crop production, based on comparison of data between pre and post period of the deep tubewell technology transfer project located at Mahastangar, Bogra. The empirical analysis of irrigation technology diffusion on crop production is based on standard welfare concepts, i.e., by estimating the changes in crop production, variation of species selection, yield rate, crop producers' surplus or profit, cropping pattern, cropping intensity, crop rotation, etc. Data for the study was obtained from questionnaire survey, land use survey, PRA sessions, farmers' group studies and interviews, and secondary review like BBS, newspaper and so on. Level of analysis is based on descriptive statistical tools such as trend analysis, percent variation, charts and diagrams,etc. It was found from the results of the analysis that after irrigation technology diffusion, double and triple cropped area increased by 41.55%, and hence cropping intensity from 113.48 to 165.98. Enormous changes in cropping pattern and crop rotation were identified. Due to availability of irrigation water throughout the year farmers are using HYV seeds and find variation on species selection. It was found that yield rate increased resulting significant increment of crop production. As a whole, farmers earned 20% more profit than pre - project period in the study area. It is revealed that agriculture sector has the ability to contribute more in the national economic development if the irrigation technology diffusion properly spreads over the whole country considering also other important agricultural inputs such as seeds and fertilizer. With some limitations, irrigation technological diffusion would significantly promote crop production and hence attain national food security.

Introduction

Bangladesh is among the few countries in the world where the majority of the population have no food security, as reflected in extreme poverty and the reality of hunger in their

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everyday living. In response to this situation, agricultural policy in Bangladesh is still production oriented. However, food production and consumption both have a vice-versa influence on each other. An understanding of this relationship is essential for effective agricultural policy formulation. Given the limited land base, the diffusion of modern technology i.e, new varieties, irrigation, fertilizers and insecticides/ pesticides, etc. is clearly a more appropriate path of technological progress for Bangladesh than labor saving mechanization. However, the adoption of such technology depends critically upon the expansion of irrigated production area. This report analyzes the role of diffusion of irrigation technology on crop production in the context of Bangladesh.

In Bangladesh, insufficient and non-uniform distribution of rainfall throughout the crop period is main obstacle for crop production. For optimum yield of a crop, it is essential to supply the required quantity of water at some fixed intervals. This is feasible only through a systematic irrigation practice. Therefore, there is a necessity for the artificial application of water by means of irrigation. The use of modern Irrigation technology has begun during early 1960s in this country and the Government of Bangladesh approached to the expansion of irrigation facilities through large-scale projects carried out by Bangladesh Water Development Board (BWDB). Besides, Bangladesh Agricultural Development Corporation (BADC) initiated the minor irrigation equipments such as DTW, STW and Low-lift pump at subsidized prices from late 1950s in the rural area. till 1987, the total irrigated area was nearly one -fourth of the total cultivated land, but by 1993, the increased to 43% coverage. It was found that irrigation technologies were expanding to bring the cultivated areas under irrigation facilities (BBS, 1995). However, cultivators prefer to grow crops such as paddy, maize and cash crops e.g. vegetables, potato, fruit trees etc. which would bring them better return. These crops require abundant supply of water and frequent watering for maturity, which cannot be met from normal rainfall during the crop period and thus irrigation has become essential.

This report describes how irrigation technologies are greatly influencing the changes in variation of species selection, yield rate, crop producers' surplus or profit, cropping pattern, cropping intensity, crop rotation, etc. and the importance of irrigation in context of crop production. Moreover, irrigation technologies are keeping the balanced use of other resources and rural infrastructures. It is also affecting the rural employment pattern, income and other socio-environmental aspects.

Objectives of The Study

- To explore irrigation technology diffusion in the study area; and
- To assess the impact of irrigation technology diffusion on crop production

Methodology of The Study

For the achievement and successful accomplishment of the research, a systematic and well-arranged methodology was maintained to harmonize the study. The study was conducted under major three phases. In each phase, respective outputs were considered to contribute towards the overall composition of the irrigation technology diffusion and its impact on crop production profiling. Indicators of the study was emerging and pacing technology, innovators, syndication, early majority, introduction, early adopters and growth for irrigation technology diffusion based on species selection variation, yield rate, crop producers' surplus or profit, cropping pattern, cropping intensity and crop rotation for assessing crop production. For the study, data source was primary field data, qualitative, quantitative and explanatory information, questionnaire survey, land use survey, community level PRA/ FGD sessions, interview and secondary review like BBS report, newspaper, article on agriculture production, etc. Level of analysis was based on trend line, differences of percentages, growth rate, chart, diagram and so on.

Result And Discussion

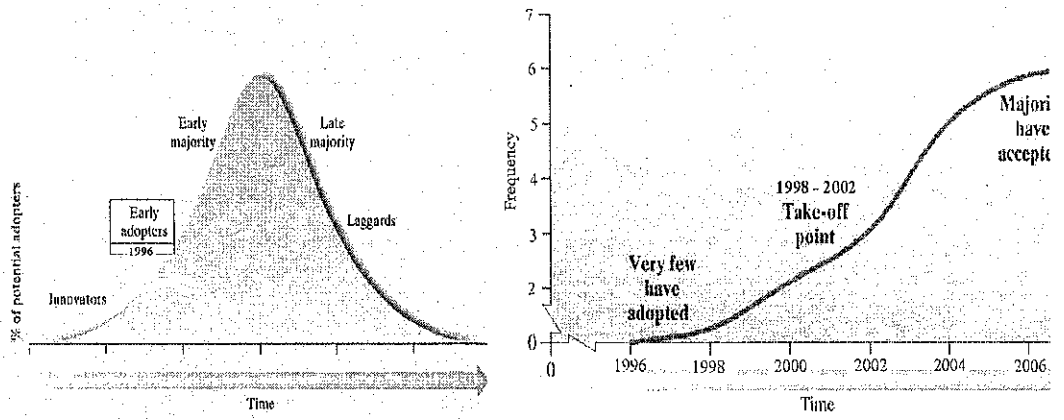
Existing Irrigation Technologies And Its Diffusion

There are four major recognizable types of agricultural production technologies such as: (a) biological technology e.g. improved varieties of seeds and breeds; (b) chemical technology e.g. fertilizers, insecticides and pesticides, (c) land augmenting technologies in the form of irrigation and water management; and (d) mechanical technology i.e. power tillers. Sprayers, Adoption and diffusion patterns of a new technology are the result of explicit maximizing behavior of a heterogeneous population. Unlike the views of 'epidemic' models, diffusion is considered as a process of imitation and its speed is affected by profitability and other economic considerations. Along, the threshold approach requires identification of the various dimensions of heterogeneity in the population that are relevant for the adoption of specific technology and incorporates them in the analytical study. It was identified that irrigation technology was an important factor in the choice of crop production. Therefore, economic analyses of adoption and diffusion of irrigation technology choices should explicitly incorporate physical (engineering and

agronomic) and irrigation-specific features of the new technology, such as irrigation efficiency and capital and equipment costs, as well as location characteristics, such as land quality, water quality, and so on, in addition to economic factors.

Mahastangar is surrounded by the Korotoa River and Kalidah Beel of Bogra district. Before 1996, traditional irrigation system was mainly depending on these two water sources. By the sides of the water sources people cultivated their land. However, there was scarcity of water for irrigation besides the embankment areas. For solving the problem, National Minor Irrigation Development Project [NMIDP] installed a DTW there during 1996. After that in 2004 RDA, Bogra under its ADP funded project titled "Multipurpose Use of Low-cost Deep Tubewell for long-term post flood Rehabilitation (MUDP)" extended the facilities to modify the DTW with submersible pump, buried pipe irrigation network, multipurpose overhead tank and domestic water supply system. These technological facilities developed by RDA which can improve the socio-economic condition as well as quality of village people through utilizing the DTW water in different Income Generating Activities linked with RDA-Credit programme recognized as "Multipurpose Use of DTW model". Thus, the people of Mahastangar were first introduced with modern irrigation system for crop cultivation.

A Farmer who was willing to take high risk of installing deep tubewell there was the **Early Adopter** [Figure: 01(a)] of the irrigation technology in that area. Firstly, he irrigated 10 acres of land but in 2006 using the DTW only 7 acre land was cultivated and safe drinking water was supplied for the villagers. After that from 1998 to 2003 (5 years), four deep tubewells and a shallow tube well were installed there. That period is considered as **Take off point** [Figure: 01(b)]. All farmers are served from that irrigation technology for crop production except very few. Water lifting depth is more than 100 ft in case of STW but in case of DTW it is 180 ft and more. Both these modern irrigation technology served 155 acre during Boro season and 123 acre in Kharif season. It is to be noted that the DTW irrigation technology has been identified as profitable one. It means that the irrigation technology is cost effective or a viable substitute for irrigation than traditional technology or is viewed as one that has a competitive advantage. This is known as **Emerging Irrigation Technology.** From 1998 to 2003, this period can be specifyed as **Early Majority** [Figure: 01(a)]. Because, every year an irrigation source is installed in the study area for continuous supply of water.



(a) Technology Life Cycle **(b) Technology Diffusion Stage**

Figure 01:Technology life cycle and its diffusion Stage in the study area

In the study area farmers got inspiration to install modern irrigation technology privately. The farmers attained improvement in agriculture through expansion of irrigated land, increase in cropping intensity, adoption of more productive cropping pattern etc. Thus, diffusion of deep tubewell irrigation technology in rural area increases crop production. In the study area, the farmers have started to adopt deep tubewell irrigation technologies since 1996. However, in 2006, it has become more popular among the farmers. Recently, the farmers are using deep tubewell for irrigation purpose and supply of safe drinking water for every day uses. In the study area, two types of modern irrigation technologies (DTW & STW) used by the villagers have been enumerated in the following **Table 01**:

Table 01: Information of Existing Modern Irrigation Technologies Used by the Villagers

Installment Year	Irrigation Technology	Installed by.	Water Lifting Depth [ft]	Command Area [acre]		Cumulative Frequency
				Boro Season	*Others*	
1996	Deep tube well	NMIDP [Gov.]	180	5	7	1
1998	Shallow tube well	Private	130	10	5	2
1999	Deep tube well	Private	200	40	35	3
2001	Deep tube well	Private	190	30	16	4
2002	Deep tube well	Private	250	35	30	5
2003	Deep tube well	Private	220	35	30	6

Source: *Field Survey, 2006*

Impact Of Irrigation On Land Utilization

Irrigation means the application of water to the soil for the purpose of crop production. In other words, irrigation is essentially the artificial application of water to overcome deficiencies in rainfall for growing crops (Carton, 1967). Nevertheless, the irrigation is necessary not only for growing crops but also for getting a stable prosecution (Alim, 1974). In respect of this view, modern irrigation is inevitable in Bangladesh, where rainfall is unreliable, inadequate and unpredictable. Moreover, it is required in the dry season all over the country.

In the study area, the farmers are now using modern irrigation technology with other agricultural practices for crop production. Some farmers are the owner of these technologies and some farmers are using on the basis of sharing through cash compensation or sharing of crops. Table-01 illustrates the different types of irrigation technologies, used by the villagers. In the study area, land utilization statistics over different time have been enumerated in the followingTable-02:

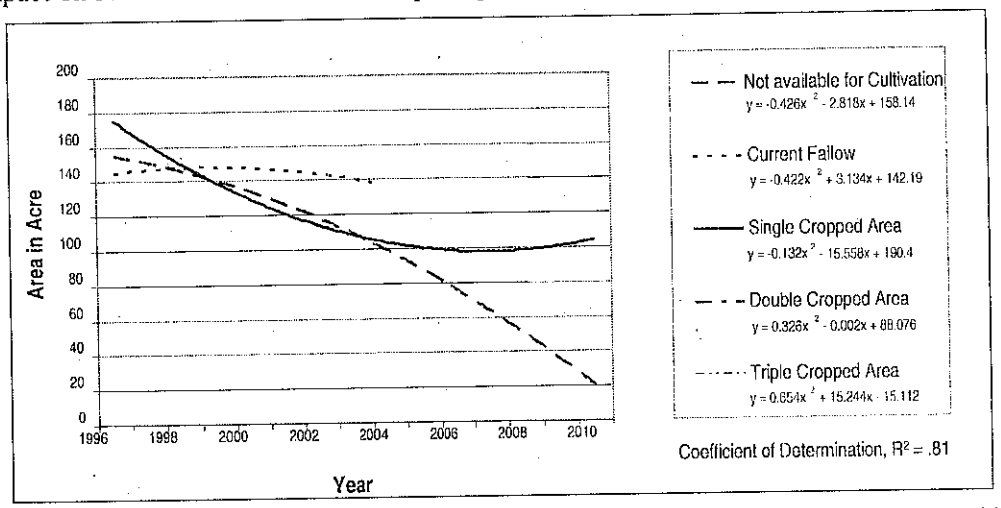
Table 02: Land Utilization Statistics over different time in Mahastangar

Item	1996		2001		2006	
	Area in acre	*%*	*Area in acre*	*%*	*Area in acre*	*%*
Not available for cultivating	154.9	27.48	125.9	22.33	85.6	13.41
Current Fallow	144.9	25.71	145.8	25.87	135.6	22.28
Single Cropped Area	175.5	31.13	120.6	21.39	78.4	17.46
Double Cropped Area	88.4	15.68	99.8	17.70	127.5	22.62
Triple Cropped Area	00.0	00.00	71.6	12.71	136.6	24.23
Total Land Area	563.7	100.00	563.7	100.00	563.7	100.00

Source: *Field Survey, 2006*

The **Table 02** shows that 31.13% of land in Mahastangar was under single cropped area in 1996, while in 2006 it came down to 17.46%. The percentages of major land use categories for 1996, 2001 and 2006 are presented in following figure. (Fig-02) Not available for cultivations, current fallow and single cropped area gradually decreased over the years 1996 to 2006. On the other hand, Double and Triple Cropped Area increased over the years. In 2006, triple cropped area in the study area is 24.23%, whether it was 0% during 1996. Again, double cropped area also increased. Based on Three years (1996, 2001 & 2006) data, trend line of different land utilization is shown in the figure-02.

The trend line (**Figure 02**) shows that fallow land gradually decreased but there is no chance of increasing single cropped area in future. Again double and triple cropped area will be increased in future if some conditions are fulfilled and some facilities can be provided in the study area. This indicates that irrigation technology diffusion have an impact on land utilization that in turn put a positive impact on crop production.



Source: Field Survey, 2006

Figure 02: Trend line of Land Utilization over different time in Mahastangar

Impact Of Irrigation On Production And Yield Rate

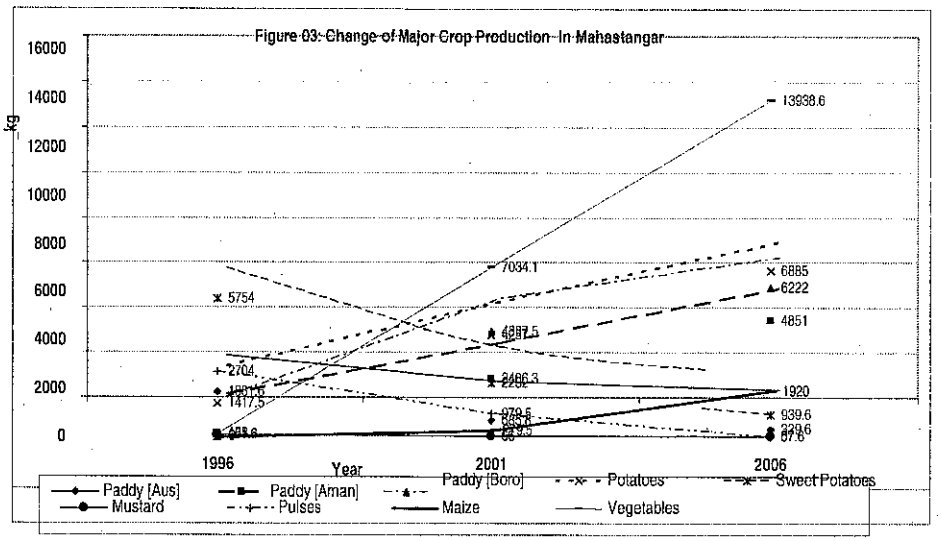
One of the reasons for low per acre yield is the lack of irrigation water. It can, therefore, be said that an increase in irrigation water lead to an increase in per acre yield (Ikramullah, 1990). Moreover, some varieties is of crops cannot be cultivated without water. In the dry season, the Boro rice cannot be cultivated without irrigation water. Therefore, there is a difference in production between irrigated and non-irrigated agriculture. The difference in production of these different period in the study area have been discussed in the following table **(Table- 03)**

Table 03: Areas [in acre], Yield Rates and Production of crops in Different year and Change

Crops		Area in Acre			Yield Rate [kg/acre]			Production [kg/acre]		
		1996	*2001*	*2006*	*1996*	*2001*	*2006*	*1996*	*2001*	*2006*
Rabi	Paddy [Boro]	0	97.5	103.7	0	45	60	0	4387.5	6222
	Potatoes	10.5	25.8	30.6	135	165	225	1417.5	4257	6885
	Sweet Potatoes	54.8	18.6	5.4	105	120	174	5754	2232	939.6
	Mustard	12.7	5.5	3.2	8	12	18	101.6	66	57.6
	Pulses	135.2	65.3	0	20	15	0	2704	979.5	0
	Vegetables	3.4	79.3	135.9	45	60	70	153	4758	9513
Kharif- I	Paddy [Aus]	78.4	25.4	10.3	24	27	32	1881.6	685.8	329.6
	Paddy [Aman]	0	36.5	54.7	0	39	42	0	1423.5	2297.4
	Vegetables	.0	37.9	62.5	0	27	32	0	1023.3	2000
	Maize	0	4.3	25.6	0	65	75	0	279.5	1920
Kharif- II	Paddy [Aman]	4.5	25.2	60.8	30	39	42	135	982.8	2553.6
	Vegetables	0	46.4	75.8	0	27	32	0	1252.8	2425.6

Source: *Field Survey, 2006*

The **Table 03** revealed that the production of HYV (transplanted) Boro paddy and maize increased from 2001. Again in 2006 production of HYV Aman paddy, potatoes increased than that of 1996. But Aus paddy, Sweet potatoes and Mustard production declined over the years. From the study it has been identified that production of vegetable increased. During 1996, pulses were cultivated in 135.2 acre but in 2006 cultivation of pulses declined. Conversely, Boro and Aman paddy, Kharif vegetables and maize were cultivated in this area from 2001 because of irrigation technology diffusion. In 2006, yield rate of potatoes is 225 kg/ha or kg/acre in the study area. Table reveals that, the observed per acre production of different crops in the study area, after installation of modern irrigation technology, significantly increased than before. This table, confirms that there has been significant improvement of crop production after proper irrigation supplies. **Figure 03** presents the production of major crops in kg/acre over time. Production of Aman paddy, potatoes increased but Aus paddy, Sweet potatoes and Mustard production sharply decreased in 2006.



Source: *Field Survey, 2006*

Impact Of Irrigation On Cropping Pattern

Cropping pattern shows the different shares of crops in different crop seasons. Change in share of crops affects the total annual production. Change in production affects the socio-economic condition of the surrounding people. Of all the factors influencing the pattern of cropping are: topography, rainfall, soil type, irrigation water and farmers' financial position, etc. (Hamid, 1982). Among these factors, however, irrigation water is one of the crucial one. Inception of irrigation facilities brought about significant change in farmer's production plans and thus influenced in cropping pattern. A technology in the study area obviously has influenced the cropping pattern of the respondents. Following **Table 04** shows the share of the crops in different years and differences in percentages of crop cultivation.

Table 04: Share of the Crops in the Cultivated Area of the Study Area

Crop Season	Crops	Percentage of Crop Cultivation			Differences of Percentage		
		1996	*2001*	*2006*	*1996-2001*	*2001-2006*	*1996-2006*
Rabi	*Paddy [Boro]*	0	17.30	18.40	17.30	1.1	18.40
	Potatoes	1.86	4.58	5.43	2.72	0.85	3.57
	Pulses	9.72	3.30	0.96	- 6.42	-2.34	-8.76
	Mustard	2.25	0.98	0.57	-1.27	-0.41	-1.68
	Sweet Potatoes	23.98	11.58	0	-12.4	-11.58	-23.98
	Vegetables	0.60	14.07	24.11	13.47	10.04	23.51
Kharif - I	*Paddy [Aus]*	13.91	4.51	1.83	-9.4	-2.68	-12.08
	Paddy [Aman]	0	6.47	9.70	6.47	3.23	9.70
	Vegetables	0	6.72	11.09	6.72	4.37	11.09
	Maize	0	0.76	4.54	0.76	3.78	4.54
Kharif - II	*Paddy [Aman]*	0.80	4.47	10.79	3.67	6.32	9.99
	Vegetables	0	8.23	13.45	8.23	5.22	13.45

Source: *Field Survey, 2006*

Table 04 shows the frequency of different crops in different cropping seasons. It shows that before the installation of irrigation technology, in 1996, in Rabi season pulses and sweet potatoes occupied 9.72% and 23.98% of cultivated area respectively. Again, in Kharif season 13.91% land was occupied with Aus paddy. On the other hand, during 2001-2006, major crops of Rabi season was Boro paddy and vegetables occupied 17.30% and 24.11% respectively and in Kharif season vegetables was found 24.51% of the total cultivated land. In the last decade (1996-2006), shares of Boro paddy and vegetables increased in different seasons, On the other hand, share of sweet potatoes and Aus paddy decreased. Change of cropping pattern occurs in the study area because of better irrigation facilities. Availability of proper irrigation increased land utilization. Current fallow and single cropped area gradually decreased over the year1996 to 2006. On the other hand, double and triple cropped area played the dominant role over the years.

Land utilization influences cropping pattern in different seasons. After analyzing the existing cropping pattern, the amount of cultivated land for Sweet Potatoes, Mustard and Pulses gradually diminished. Farmers usually select different HYV crops for cultivation in modern age, which is more profitable. In study area, with proper irrigation farmers had opportunities in selection of varieties of crops. Transplanted HYV Aman is sown in Kharif season. Its popularity increased more than Broadcasted local Aman. Again, Boro HYV was cultivated in December to mid February and transplanted HYV Radish was sown during whole the year. Following table shows variation in the areas of crops cultivation in Mahastangar

Table 05: Variation in the areas under species selection of crop cultivation in Mahastangar

Species selection Variation		Area in Acre		
		1996	2001	2006
Aus	Local	25.9	7.8	0.0
	HYV	52.5	17.6	10.3
Aman	Local	4.5	16.4	12.9
	HYV	0.0	45.3	74.6
Boro	Local	0.0	23.2	19.2
	HYV	0.0	74.3	84.5
Potatoes	Local	10.5	18.6	5.4
	HYV	54.8	25.8	30.6
Vegetable	Local	3.4	75.3	61.8
	HYV	0.0	88.3	212.4

Source: *Field Survey, 2006*

It is reveled from the above table that, HYV crops were more popular than local crops in the study area. During 2006, land coverages under the cultivation of HYV Aman, Boro, Potatoes and vegetables were 74.6, 84.5, 30.6 and 212.4 acres of land respectively. Cultivation of HYV crops need proper time of irrigation that was ensured after irrigation technology diffusion. Over all, species selection influence land utilization that directly affected cropping pattern. So, it is clear that the Modern Irrigation Technologies had influenced the respondents to adopt a productive and profitable cropping pattern.

Impact Of Irrigation On Cropping Intensity

Intensity expresses the frequency of cultivation in a piece of land in a year. Positive change or increase in cropping intensity means need of more labors, increase in income, increase in production, etc. Cropping intensity is one of the most important indicators of crop production. The following formula is used to calculate cropping intensity:

$$\text{Cropping Intensity} = \frac{\text{Total Cropped Area}}{\text{Net Cropped Area}} \times 100$$

Irrigation technologies have a discernible impact on the intensity of crop. Moreover, in the dry season (Rabi season) availability of irrigation water influenced the cropping intensity of that area. However, installations of Modern Irrigation Technologies ensured the irrigation water during the dry season. Moreover, cropping intensity varied quite distinctly according to the land ownership of the farmer. It was much higher for the small and medium scale farmers than that of the large-scale farmers, implying that small-scale farmers used lands more intensively. The following **Table 06** shows the variation of the cropping intensities in different seasons and years

Table 06: Cropping Intensity in different years

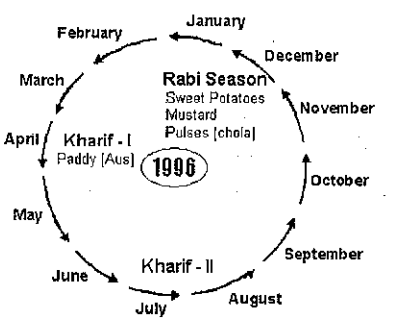
Cultivate Land [in acre]			Total Cropped Area [in acre]	Net Cropped Area [in acre]	Cropping Intensity	Comparison in CI		
						96-01	01-06	96-06
1996	Rabi	295	299.5	263.9	113.48	46.69	05.81	**52.5**
	Kharif - I	0						
	Kharif - II	4.5						
2001	Rabi	317.4	467.7	292	160.17			
	Kharif - I	78.7						
	Kharif - II	71.6						
2006	Rabi	289.1	568.5	342.5	165.98			
	Kharif - I	142.8						
	Kharif - II	136.6						

CI- Croping Intensity ***Source:*** *Field Survey, 2006*

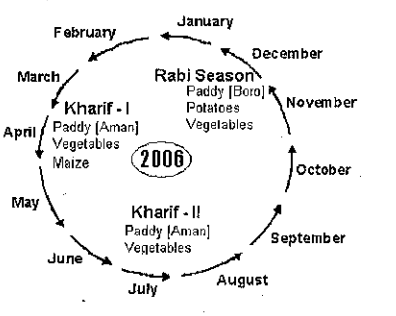
The **Table 06** shows that, before installation of Modern Irrigation Technologies in the study area, in the year 1996 the farmers used 263.9 acres of net-cropped area with total cropped area of 299.5 acres. As a result, the cropping intensity was 113.48. After installation of Modern Irrigation Technology in 2006, cropping intensity increased at 165.98 with a net-cropped area of 342.5 acres and total cropped area of 568.5 acres. This is a positive change in cropping intensity with a change of 52.5% (1996-2006), which is essential for crop production. Another remarkable change that total cropped area increased by 89.80% in 2006 compared to 1996. Copping intensity increased for creating better irrigation facilities and availability of fertilizer, insecticides, HYV/ hybrid/ quality seeds, modern mechanization technologies including inter cultural operations for crop cultivation. So, irrigation technology diffusion took place because of crop cultivation environment (both natural and man made) available in that area. When better irrigation facilities were adopted in that area with the help of other agricultural facilities, double and triple cropped area increased which resulting in an increase of cropping intensity. So, irrigation technology diffusion has direct impact on crop production.

Impact Of Irrigation On Crop Rotation

In order to retard the deterioration of the soil, a systematic arrangement for growing crops with a regular sequence on the same land, which is followed with a schedule of crop growing or proposed to be grown in an area is known as crop rotation. In other word, it is the process of growing different crops in rotation on the same land. Comparative crop rotation of the study area is expressed in the following diagram:



Before Irrigation Technology Installment



After Irrigation Technology Diffusion

Source: *Field Survey, 2006*

Irrigation technology diffusion creates tremendous changes on crop rotation. Before 1996, farmers depended on traditional natural irrigation system. As water-holding

capacity of the soil is very low, Aman and Boro paddy were almost absent in crop rotation except the pulses (Chhola/ Gram) and mustard. After diffusion of irrigation technology, crop rotation changed. Some crops were included and some crops had abolished from the crop rotation. Boro paddy was included in crop rotation. Because of proper irrigation vegetables were cultivated throughout the year, Maize was also cultivated. Again, Aus paddy, pulses and mustard were disappeared from the present crop rotation. Therefore, with the help of adequate irrigation facilities, some crops can be adopted and some crops were disappeared from the crop rotation over the year. From the above discussion, it is found that, impact of irrigation technology diffusion had the ability to change the crop rotation in Mahastangar, which, within a very short run, put a strong influence on crop production.

Impact Of Irrigation On Crop Producers' Surplus Or Profit

A family with a land holding of less than 0.05 acre is regarded as 'Landless' or Non Farm holding. The Non- farm holdings occupied 2.96%, 4.7% and 6.28% of the total land in the year of 1996, 2001 and 2006 respectively. As regards to land ownership patterns in 1996, 2001 and 2006: Small Farm Holdings were 28.10%, 28.69% and 29.68% and Medium Farm Holdings were 19.19%, 18.96% and 22.48% of total land respectively. Following table represents operated, crop area and irrigation as classified by size of holdings.

Table 07: Operated, crop area and irrigation classified by size of holding

Year	Classification	Land (in Acre)	All Holdings	Operated Area (in Acre)	% of Total Land	Irrigation Area in Acre	
						Traditional Irrigated	*STW/ DTW Irrigated Area*
1996	Non Farm Holding	*<0.05*	136	16.7	2.96	9.7	0
	Small Farm Holding	*0.05-2.49*	179	158.4	28.10	31.6	0
	Medium Farm Holding	*2.5-7.49*	28	108.2	19.19	62.7	0
	Large Farm Holding	*7.5 +*	15	135.5	24.04	159.9	0
	All Holding	-	**358**	**418.8**	**74.29**	**263.9**	**0**
2001	Non Farm Holding	*<0.05*	191	26.5	4.70	9.2	13.7
	Small Farm Holding	*0.05-2.49*	167	161.7	28.69	19.6	98.5
	Medium Farm Holding	*2.5-7.49*	24	106.9	18.96	13.1	51.2
	Large Farm Holding	*7.5 +*	14	122.8	21.78	21.4	65.4
	All Holding	-	**396**	**417.9**	**74.14**	**63.2**	**228.8**
2006	Non Farm Holding	*<0.05*	211	35.4	6.28	6.4	16.1
	Small Farm Holding	*0.05-2.49*	201	167.3	29.68	14.7	116.4
	Medium Farm Holding	*2.5-7.49*	25	126.7	22.48	12.3	79.3
	Large Farm Holding	*7.5 +*	11	98.7	17.51	19.4	77.9
	All Holding	-	**448**	**428.1**	**75.94**	**52.8**	**289.7**

Source: *Field Survey, 2006*

The above **Table 07** suggests that non-farm holdings were increasing. During 1996, major portion of traditional natural irrigation system was supported by the large farm holding but it was found in 2001 and 2006 that small farm holdings covered major irrigated area. Therefore, small farm holdings got more irrigation facilities than other holdings and became more profitable from crop production surplus. Per acre cost benefit calculation represents that the ratio of cost benefit before irrigation technology diffusion was 1: 1.15 and after irrigation technology diffusion the ratio became 1: 1.35 **(Table 08)**. So, it is clear that after irrigation facilities diffusion, crop production surplus was increased in irrigated area. Again, over the decade the agricultural turnover has been increased. Farmers increased crop intensity of their land as well as the cost-benefit ratio was raised by adopting the modern irrigation technology.

Table 08: Per Acre Cultivation Cost and Return [Average]

Item	Before Irrigation Technology Diffusion				After Irrigation Technology Diffusion				
	Paddy [Aus]	Sweet Potatoes	Mustard	Pulses	Paddy [Boro]	Paddy [Aman]	Maize	Potatoes	Vegetables
CULTIVATION COST [in Tk.]									
H.Labour [Hired & Family]	3250	3500	2500	3000	3500	3000	4000	5000	2500
Cultivation [Bullock/ Tiller]	600	800	450	600	1200	1200	1200	2500	1200
Seedlings [Purchase/ Own]	500	2000	450	750	700	800	2000	14400	750
Manure [Purchase/ Own]	150	550	150	300	300	200	600	800	500
Fertilizer [Urea, tsp, mp]	600	1200	400	600	1800	1200	2400	5900	1800
Pesticides	200	750	150	550	500	300	1200	1500	1500
Irrigation	200	300	150	300	2700	2700	2700	2700	400
Land Rent	1000	1500	1000	1000	2000	2000	2000	2000	2000
Others Cost	300	500	100	200	500	300	500	2000	1000
Total Cost	**6800**	**11100**	**5350**	**7300**	**13200**	**11700**	**16600**	**36800**	**11650**
MARKETING COST WITH RETURN [in Tk.]									
Yield Per Acre [Maund]	30	85	9	15	46	38	65	210	50
Market price Per Maund	250	180	600	550	325	350	350	280	350
Gross Return in terms of Cultivation Cost	**7500**	**15300**	**5400**	**8250**	**14950**	**13300**	**22750**	**58800**	17500
COST : BENEFIT	1 : 1.1	1: 1.37	1: 1.01	1: 1.13	1: 1.13	1: 1.14	1: 1.37	1: 1.60	1: 1.50
	1: 1.15				1: 1.35				

Source: *Field Survey, 2006*

Conclusion

The Government of Bangladesh (GoB) has implemented several projects with different agricultural development objectives and strategies to ensure agricultural and rural development. The rural area of Bangladesh is mainly agro-based in nature, where the majority of the people are dependent on agriculture. So, agricultural development is necessary for ensuring their food and nutritional security and also for sustainable rural development. On the other hand, the main aim of rural development is the improvement of standard of living and development of socio-economic condition of the rural people and their agriculture. Among them, food self-sufficiency, adoption of modern irrigation practices and balanced utilization of water resource were major concern. With assured irrigation technology diffusion, water can be applied to the fields as and when required and in desired quantity. Thus, the quantity and the yield of a crop can be improved. Also because of assured supply of water, two crops, even three crops can be grown in a year. This adds two-fold impacts to the wealth of the country; firstly, by making it self-sufficient in food requirements and secondly in earning foreign exchange by exporting the surplus food products. Agriculture contributes a lion share (16.91% at 2006) in Gross Domestic Products. The Government of Bangladesh is trying to attain self-sufficiency in food production through agricultural development. So, government agencies and other development partners have given emphasis on agricultural development through mechanization, HYV, other modern inputs, adoption of modern irrigation technology etc. Among the different techniques and approaches of agricultural development, irrigation technology has priority all over the country and obviously, it has a satisfactory level of development in agriculture.

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