

ROLE OF COMPACT TOWNSHIP AND ITS CONSTRAINTS IN ACHIEVING ENVIRONMENTAL SUSTAINABILITY IN BANGLADESH-A CASE STUDY OF RANGPUR UNION

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ABSTRACT

Exploring the link between Compact Township and environment sustainability is an important theme in rural development research. This paper contributes to understand about the role of Compact Township in environment sustainability and the constraint in the way of achieving sustainable environment. Bangladesh is a resourceful country with heavy man power and this population is increasing. But with the increasing of population encourage the rural agricultural lands disappearing which would be a major threat to the environment. Sometimes environmental sustainability hampers through natural disaster and by human like crime, improper waste management, and different kinds of discriminations. The analysis showed that the presence of disperse settlements, improper distribution of public services, poor sanitation etc. major constraints of sustainability. So, sustainable conscious approach has to be taken in planning, designing and construction of the township to ensure safe and environment friendly atmosphere and also to maintain ecology of the site.

Keywords: Compact township; environmental sustainability; rural development

INTRODUCTION

Bangladesh is a country of different environmental occurrence and it is carrying low-lying land with full of greenery and river beds. Bangladesh has been experiencing degradation of the natural environment for decades in terms of deforestation, river erosion soil quality depletion, water and air pollution, poor solid waste disposal, pollution from chemical fertilizer and pesticides, biodiversity loss and urban congestion like other densely developing countries. More recently climate change impacts consequent on more frequent and devastating extreme climatic events like Aila, Sidr etc and this is affecting on both to natural and human systems. In Bangladesh, there are 105,305,414 people living in rural area (World Bank, 2013) which is 67% of the total population. The agriculture land is 70.1 % of the total land in whole Bangladesh (World Bank, 2012) but at 1989 agricultural land is 80.2 % in total agricultural land which is decreasing than before (World Bank, 2012). Bangladesh will be left with only 0.07 acres (283 sq. meter or 3049 sq. feet) of agricultural land per person by the year 2051 (Hossain 2011). The main objective of Compact Township is to save agriculture land. Compact Township can be defined as an agglomeration of houses, schools, hospitals, markets, rural industries and local governmental unit providing all basic services. (Rashid and Quayes, 2000) This nature of Compact Township ensures environmental sustainability. Every year the country is losing 1% arable land due to the population growth and its infrastructure development. (Islam and Hassan, 2011) Rural people live in an unplanned environment but in a Compact Township their life can be managed in a new systematic way which will increase the food productivity by using lands. Compact City consists of high-density settlements, less dependence on automobiles and clear boundaries from surrounding areas (Rashid and Quayes, 2000). This also adds points for ensuring environmental sustainability. Compact Township plays an important role in village economy by establishing rural industry, which also a great attempt to ensure sustainability in environment. The Compact Township refers to a state in which the density of the settlement functions is constituted adequately, neither excessive nor lacking, with the environment loads. The growth of the township will be kept well balanced with the surrounding environment (Shrivastava, 2009). In the year of 1997, "Smart Growth" was come to the modern world with similar ideas of compact city or township. (Zhou and Yu, 2010). The compactness of urban form affects energy

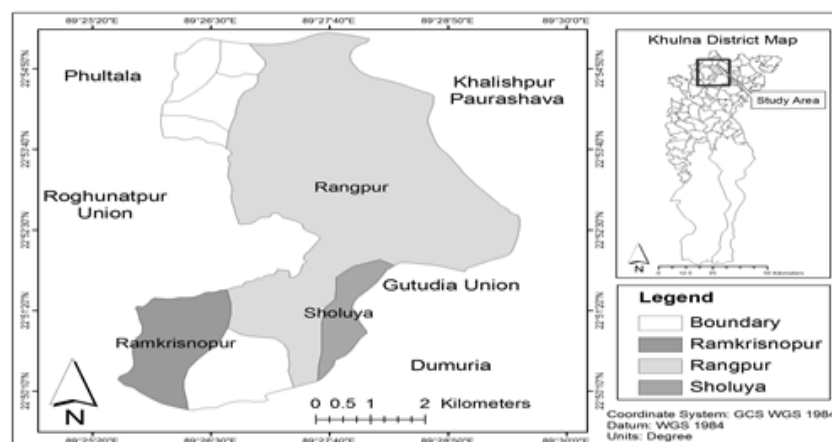
demand and environmental quality. A significant part of the environmental impact of urban activities is related to energy consumption. In most cases, the amount of energy consumed by industrial production is similar to that consumed by transport and by buildings, although energy use in buildings is now increasing to become (Jenks and Burgess, 2000).

METHODOLOGY

The whole methodology has been divided into 2 parts as study area selection and data collection.

Study Area Selection

Rangpur Union of Dumuria upazilla is considered the study area situated at the middle point of the Bil Dakatia in the southeast part of Bangladesh. Total area is 36.98sq kilometer (8960 acre). Total area is divided into 9 wards (BBS, 2001). There are 8 villages in the Rangpur Union which are named as Sharavita, Botbera, Baranoshi, Mujarghuta, Rangpur, Soluya, Ghona Mother Danga, and Ramkrishnopurr. Among them, Rangpur is the biggest one and selected for study purpose of assessment of environmental sustainability in Compact Township according to area and population.



(Source: Authors Construction in GIS, 2015)

Fig. 1: Study Area Map

The settlement pattern is dispersing in nature. So there is huge opportunity to develop new settlement and there is huge amount of agriculture land for food production. Two houses are standing within around 400-500 square meter interval each other (Field survey, February 2015). In the whole Dumuria upazilla there is no river erosion occurred (BBS, 2011).

Data Collection

Conceptualization of the study by reviewing some journal paper, report, document related to 'Compact Township'. A reconnaissance survey conducted in three villages of Rangpur Union named as Rangpur, Sholuya, Mujarghuta. Then the questionnaires were prepared. Primary data were collected by Focus Group and Key Personnel Discussion and secondary data were collected from the website and Union Parishad Office. The data thus obtained from both primary and secondary sources were then analyzed using SPSS and MS Excel to evaluate the future impact of Compact Township in environmental sustainability.

FACTORS OF ENVIRONMENTAL HEALTH

The factors used for analysing the constraints to achieve the environmental sustainability in Compact Township described below. The possible worst condition like source and quality of water, unhealthy sanitation usage, misuse of resources for fuel etc. are responsible for achieving sustainability in Compact Township in Rangpur union.

Water Quality Analysis

Maximum villagers use water from deep tube-well and the percentage is 70%. Deep tube-well water is adequate and hygienic for the villagers. Some villagers also use water from pond which is unhygienic. From the analysis it can be said that it easy to provide water through deep tube-well by the project of Compact Township. The safe drinking water facilities are quite good and water source is secure and available. According to observation, the ground water table is high in this area because the aquifer of these are is near to ground level because of beel area and in the rainy reason the low land was filled water.

Table 1: Water Source Type

Water source	Percentage
Deep tube well	70 %
Shallow tube well	28 %
Pond	2%

(Source: Field Survey, February, 2015)

Sanitation

The sanitation problem is common in all places so as Rangpur union. The toilet facilities are available in different manner. The water sealed sanitary facilities are available at 61.3% and non-water sealed sanitary facilities are 23.8% (BBS 2001).

Table 2: Types of sanitation usage

Sanitation type	Percentage of presence
Single pit	88 %
Twin pit	5 %
Water sealed	5 %
Hanging	2 %

(Source: Field Survey, February, 2015)

Waste Disposal

In here, environmental condition is very poor. People are disposing their waste into local pond and beside street. The percentage is 60% for local pond and 40% for beside street (Field Survey, 2015). This pollutes the environment badly. In this analysis the reason behind the occurrence is that the people don't have proper facilities to use dustbin or other system. Union Parishad also don't cooperate with them or use rules to bond them or their behaviours. The people need closed system to dispose their waste. This kind of misconduct is polluting the environment constantly. This will increase the odor and unhygienic condition of pond and street. So this will need to be stopped.

The case is even worse in areas where there is no specific dumpsite. The collected waste is disposed through crude dumping in low-lying areas, nearby water bodies or on a vacant lot. Much of the uncollected waste is also disposed in the same manner.

Fuel Usage

Most of the people are used wood rather than leaf. Wood user is 53%. Fuel usage is controlled by the availability of fuel products with the cost bearing. Wood, leaf will produce black smoke and it will destroy the greenery. It is organic in nature. But it will destroy the whole environment. So bio-gas or gas can be used instead of wood or leaf. It will reduce cost and also environment friendly. In compact township, wood usage can make conflicting situation for concrete structure.

Table 3: Fuel Type

Fuel type	Percentage
Wood	53%
Leaf	32 %
Others	15%

(Source: Field Survey, February, 2015)

Water Logging

In the Rangpur union, the village shows the significant amount of variation in different villages. In the study, the majority says that 69% of those areas don't have any water logging. Recent observation says that the road network on that area is improving. So the water logging is disappearing day by day. 24% says that water logging is high in Rangpur village. This is because Rangpur village is containing 50% beel area which is main reason for existence of water logging. (Field Survey, 2015)

Drainage Facilities

There is no drainage facility so it is possible to provide drainage facilities. The construction cost of providing drainage facilities rather than demolish the existing is low. Compact Township is going provide these facilities. The constraint between Compact Township and Environment Sustainability, can be occurred when people don't know how to use or maintain drainage system. People's inappropriate behavior can turn this whole system in hazardous condition.

Solid Waste Management

Disposing of solid waste in open dumps is the most common method used for ultimate disposal of urban solid waste. In some cities and towns there are designated dumping sites where the collected waste is dumped in unsanitary manner. No waste segregation, waste compaction or daily top seal are used in these dumpsites. In Rangpur Village, the cleaning duration of their solid waste is 75% monthly basis and 25% quarterly. In Compact Township, there will be accommodated huge number of people in one building which required lots of pressure in the system. So monthly or quarterly cleaning system need to be improved in Weekly manner.

Table 4: Cleaning Duration of Solid Waste

Cleaning duration	Percentage
Monthly	75%
Quarterly	25%

(Source: Field Survey, February, 2015)

Transportation Usage

There are many people who use two type of transport system to travel inside and outside the union. In Rangpur union, there are huge gap in distributing the service facility like health facility, major haat, school, college, Union Parishad etc. 56% people motorized vehicle to travel to Dulatpur to other parts of union and 34% people use non-motorized vehicle like van, easy bike, bi-cycle etc. to travel inside (Field Survey, 2015). Motorized vehicle is responsible for a major part of CO₂ emissions and other forms of air pollution. Habitual usage of motorbike can be constrained in the path of achieving environmental sustainability.

RESULTS AND DISCUSSION

It is known that Compact Township is a composite of every basic facility which is required for human living. The Compact Township generally involves building up cities within the villages in which people would receive some urban facilities viz. schools, colleges, healthcare for their children. The theme of a Compact Township is new to our country especially for those people who will be included in it. The study of different analysis shows that Compact Township could be more feasible for the people of Bangladesh and remain environmentally sustain, if it copes with the livelihood pattern of people.

Environment Is Sustainable or Not?

Compact township and sustainability is designed very specific in nature. Accessibility in different services is ensured by compact township but it is not always sustainable. Sustainable can be achieved through proper management of any services. The level of accessibility is increasing with time because people can easily be habitat with any system with time. Like improper waste management, absence of dustbin, poor drainage system, usage of fuel, increasing motorize vehicle etc. are the few obstacles that hamper the environmental sustainability of the Rangpur union. Water supply and source, the percentage of people in access to an improved water source that will indicates the percentage of people will get improved water supply. The improved drinking water source in rural area includes deep tube well,

water pipe line connecting to the house and collected rain water or well. WASA provide water in urban area but it is not available in rural area because it is inadequate.

Table 5: Improved water source for Bangladesh

Year	Improved water source %
1990	65
2000	74
2012	84

(Source: World Bank, 2014)

The energy savings of an efficient transport system or electric supply also relate to the social and economic benefits. The settlement pattern of Rangpur village is dispersed which caused more resources losses. But if Compact Township is going to be implemented then more energy can be saved from now. Bangladesh is improving in day by day. In the past there was no available data for rural people and their health condition. Their needs are always being compromised but now situation is changed. Rural or regional level people are now also get services like urban dwellings through Compact Township. Every development is not only providing positive sides like Compact Township facilities in Rangpur union can be turned into chancy condition.

Most people of this area are engaged in agricultural activity and their economic condition is very low. So they can't afford proper sanitation system and also there is more problem in drinking water. Water logging also causes some sort of environmental pollution here. If it is possible to provide them all the basic needs in a Compact Township system, these environmental issues can be easily solved and can be possible to conserve more energy by applying it.

The Ultimate Relationship between Environmental Sustainability and Compact Township

Most people of this area are engaged in agricultural activity and their economic condition is very low. So they can't afford proper sanitation system and also there is more problem in drinking water. Water logging also causes some sort of environmental pollution here. If it is possible to provide them all the basic needs in a Compact Township system, these environmental issues can be easily solved and can be possible to conserve more energy by applying it. The environment is very healthy because there is no industrial on that area. Most of the people are worked as farmer and fisher man directly or indirectly. If this people are being part of the Compact Township, they will serve with safe fresh water, proper improved sanitation system, high land service for living and using for passing, energy generation with natural way, proper solid waste management system. It also provides drainage facilities to improve the environment. So the studies have been said that the relation between Compact Township and environmental sustainability is proportional. If the Compact Township is implemented, then there is huge possibility of 100% sustainable environment this assumption of such environmental component, sustainability can be placed in easy way and no constraints can make any path between them. Environmental sustainability can be only achieved if proper maintenance program like focus group discussion, raising awareness, helping to use technological support etc. will included in compact township program.

Summary of Key Findings

This research has some findings which are given as follows:

- The improper practice of waste management is responsible for environmental degradation.
- Sometimes environmental sustainability is a major concern because behaviour inappropriateness.
- The usage of wood, leaf as fuel instead of bio gas is endangered the sustainability of environment.
- Increasing the number of motorized vehicle is the reason for CO₂ emission in the nature.
- Proper cleaning of solid waste keeps the environment liveable.

CONCLUSION AND RECOMMENDATION

Rangpur village is traditional village and it was recorded since 1910s. The savings from poverty and malnutrition is come first to save this people. The land is decreasing with the time for sheltering the new generation and it will destroy the food production. According to the research of 'CT foundation' it was found that every year the country is losing 1-2% of its land (Compact Township Foundation, 2012). The

land use pattern of the country is changing at a great momentum. The World Bank study reveals that a total of 20 million people will be environmental refugees within next 100 years (Daily Star, 2011). With sustainable environmental condition, Compact Township will ensure equal distribution of public utility services, playing an important role in village economy and protecting environment by saving land and natural resources. There is huge opportunity to introduce of multi-retail shop, create opportunity of setting up basic facilities within walking distance etc. So without the proper implementation of Compact Township project Bangladesh will face serious problems in future. There is some recommendation for the adaptation of further study:

- Government and authority should directly communicate with rural people to convince them rather only discussing with focused group. This will gradually switch the negative impression of the government towards positive to rural people.
- Need to raise awareness on the usage of technology used in Compact Township
- Increase usage of non-motorized vehicle and reduce the load on motorized vehicle.
- Induce rules and regulations to control the usage of services so that the excessive use won't turn into hazardous condition

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DEVELOPING A WEB BASED DECISION SUPPORT SYSTEM FOR DISASTER MANAGEMENT ON AILA AFFECTED AREA OF KOYRA UPAZILA

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ABSTRACT

Bangladesh is one of the most disaster prone countries of the world and has been subjected to frequent natural disasters in many forms, particularly cyclonic storms and storm surges. The low-lying coastal areas are particularly vulnerable, thus placing these population, infrastructure, agriculture, livestock and economic development in a high-risk situation. The situation calls for an effective cyclone warning and dissemination system. With a view to address that this research intends to develop and manage a website containing all the information for helping in taking decision about disaster management. As its common knowledge that disaster victims need immediate, efficient and effective rescue and relief services, this system will provide relief and rescue workers with a platform easy to use, fast to search, retrieve and access information and most importantly will help in preventing the duplication of relief works. Overall, proper co-ordination will be ensured among the existing organization seems to be lacking due to the shortage of effective information dissemination system.

Keywords: Disaster management; warning and dissemination system; relief works

INTRODUCTION

Bangladesh is one of the most disaster-prone countries in the world. Physical hazards often cause considerable loss of life and catastrophic physical damage and disruption to society and the national economy, these include exceptional widespread of flooding, severe tropical cyclones and associated coastal storm surges, drought and earthquakes. The geographical setting of Bangladesh makes the country vulnerable to natural disasters. The mountains and hills bordering almost three-fourths of the country, along with the funnel shaped Bay of Bengal in the south, have made the country a meeting place of life-giving monsoon rains, but also make it subjected to the catastrophic ravages of natural disasters. The country has been subjected to frequent natural disasters in many forms, particularly cyclonic storms and storm surges. The low-lying coastal areas are particularly vulnerable, thus placing these population, infrastructure, agriculture, livestock and economic development in a high-risk situation. The situation calls for an effective cyclone warning and dissemination system. It's a fact that humans do not have the capacity to survive without food, water, medicine and shelter for more than a few days.

Since Bangladesh is a disaster prone country, it is subject to colossal damages to life and property almost every year. The effects of a natural disaster or a combination of more than one natural disaster may be direct loss of life and certainly damage to physical properties. Therefore, the consequences of these natural hazards and the resulting environmental degradation pose a serious threat to the economic development of the country. To overcome these issues and to be in a better position requires large amount of resources for disaster management including mitigation, recovery and preparedness. Therefore, an effective disaster warning and dissemination system is necessary. A timely and accurate alert system about impending disasters will help reduce the loss of life and property (Pramanik, 1991). Web based decision support system can be a useful tool by which dissemination of information will ensure accuracy and quickness. These mechanisms will help all the concerned people or organizations to have the adequate information about a disaster. Information dissemination system of Bangladesh is confined with traditional postal system, which takes lots of time. When a post disaster situation arises, the damage information of the certain disaster takes few days to reach to the center (DMB).

Nevertheless, for effective disaster management it needs to be faster to save as many lives as possible. If the web based DSS can be introduced, then it can help by spreading the information of a disaster to everybody in real time. It can also help to pin pointing those locations which are most vulnerable. People can be saved by a huge number if this system can be adopted. Without the web based system the disaster management would be slow as before.

CONCEPTUAL FRAMEWORK

Disaster is an important issue now-a-days in Bangladesh. Every year Bangladesh experiences tremendous physical and economic losses due to natural disasters. These losses hamper the national development process grossly. Therefore, there must be an effective disaster management system to reduce the losses. To help the policy makers in formulating an effective disaster management plan, effective and efficient dissemination of data is much helpful. As a result, this step has been taken to develop a web based DSM for disaster management for a small community. Here an attempt has been taken to establish a DSM for disaster management for South-West Coastal Region of Khulna division, in a small context.

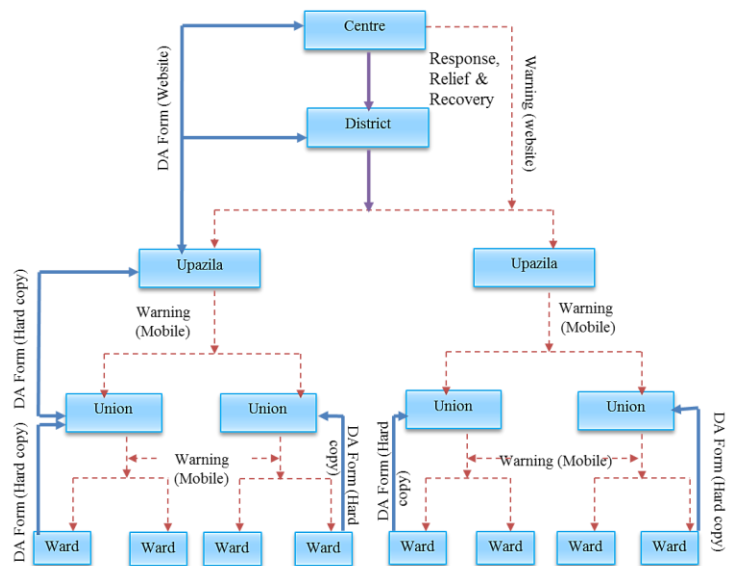


Fig. 1: Conceptual Framework

NEED FOR EFFICIENT DISASTER RESPONSE SYSTEM

The recurrent devastating disasters cause substantial losses in infrastructure, life and property in Bangladesh. Economic growth of the country significantly depends on efficient structural and non-structural measurement against disaster. As a poor country, Bangladesh cannot afford huge amounts of money required for structural measurement. That is why it is more rational to place emphasis on non-structural measures such as developing a website which will contain risk maps, damage information and relief situation etc. Ultimately, the web based procedure may help policy makers to make effective response against possible disasters in near future. Furthermore, these data will be stored in the website so that the data remain safe and all the people can use those data and maps. There are also many reasons behind developing a website. Those reasons are like disaster victims need immediate, efficient and effective rescue and relief services. That is why a website can be very handfull in disseminating information. Also to provide relief and rescue workers with a platform easy to use, fast to search, retrieve and access information, prevent duplication of relief works. Overall, proper co-ordination among the existing organization seems to be lacking due to the shortage of effective information dissemination system.

POSSIBLE SOLUTION

The inevitability of natural disasters almost every years leads to the belief and concern that a system or some mechanism is required in order to mitigate the loss, or prevent the catastrophic events and aftermaths as well. That is why an effective early warning system is solely required which might have comprised of-

- Rapid damage assessment in the study area
- Mapping of routes for rescue and relief operation
- Information dissemination to the emergency service providers
- Provide capabilities for efficient data mining

WEBSITE CONTENT

Before making of a website it is necessary to make content so that the data that will be required for each menu can be easily distributed. Content is most essential part before making a website because it helps to do the work in a planned way. The content of the website is divided in two parts. They are-

- Main menu
- Sub Menu

In the main menu the tabs that will be kept are given below-

- HOME
- WARNING
- AREA & MAP
- ACTIVE NGOs
- DAMAGE INFORMATION
- RECOVERY

The following content will be incorporated and included in the website.

- Risk map- Use as the primary layer to determine the areas where places are highly vulnerable.
- Road network- Shortest path and alternate evacuation path delineation.
- Utility network- Assess the damage to communication network and water supply.
- School and population data- Assess the vulnerable people present to prioritize rescue operations.
- Hospital and shelter data- Assess the capacity of the hospital and shelter locations in admission of disaster victims as well as act as destination point in network analysis.

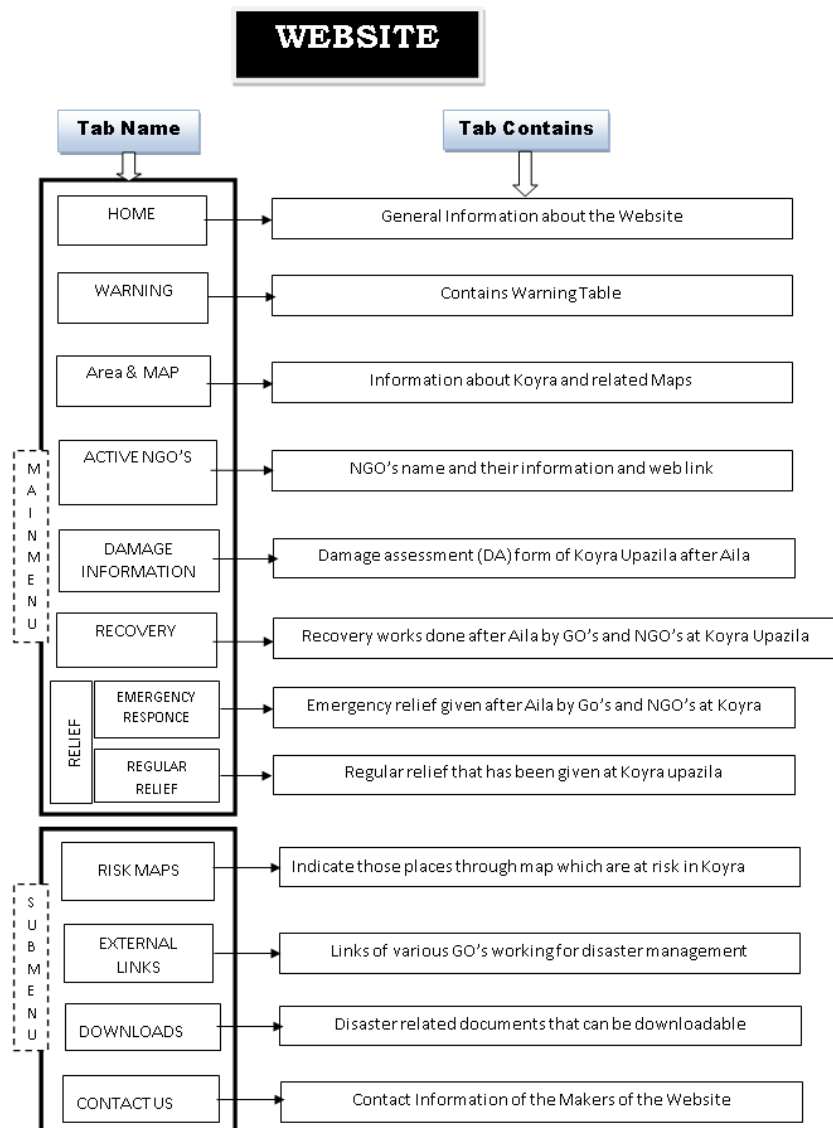


Fig. 2: Website Content

WHY IS SUCH SYSTEM USEFUL?

The introduction of such website or early warning system will provide the following benefits-

- Proper and faster dissemination of information at the time of disaster.
- Better address the vast opportunities to utilize geo-data and tools via the WWW.
- Properly co-ordinates the activities and available resources among the existing bodies.
- Provides specialized / limited applications that meet specific needs.
- Platform to integrate information from other sources to best manage and rescue the disaster scenario.
- Relatively easy for user to use, search, retrieve and access through visualization.

LONG-TERM RECOMMENDATIONS:

- Work with communities, civil society, and government to bring basic services to scale (with a focus on disaster resilience).
- Develop local food storage system
- Introduce salinity tolerant varieties of rice
- Expand training on alternative livelihood and climate change adaptation
- Develop community food bank
- Strengthen micro-finance support
- WASH contingency plan and stock, including water/desalination plant
- Multipurpose disaster resilient market/school cum cyclone shelter
- Permanent family shelter and cluster houses for land less people
- Forestation/ Watershed development
- Expand household and community water harvesting system
- Increase sanitation coverage in market and other public areas.
- Expand disaster resilient Watson system at household and community level
- Study on deep aquifer to explore safe water sources
- Incorporate DRR into the education program

Currently GOs and NGOs have been working to recover structural damages in the Aila affected zones. However, most of the embankments are still damaged and in some parts they are fully disappeared, where it is hardly possible to distinguish the locality from the water body. In every high tide water enters into locality through breaches and there is a risk of further inundation of the whole area in case of 5 m high tide. At the initial stage organizations were much more concerned with the emergency needs and responses. A number of GOs and NGOs provided food and non-food (cloths, wallet etc.) items to the affected families. Medical care, temporary shelter materials and wash kits were distributed by a numbers of local and international NGOs among the affected households. Local government officials at Padmopukur informed that they have already distributed 10.5 million BDT for rehabilitation works including 4000 VGF cards. Each VGF card holder receives 20 kg rice per month.

IMPORTANCE OF WEBSITE IN CONTEXT OF PLANNING

The main consideration of this website is to help in taking decision about disaster management. The website will help in every aspect of the disaster management cycle. That are- prevention, mitigation, preparedness, response and recovery.

Prevention

- Current status of prevention.
- Adequate assessment and monitoring of disaster hazards and vulnerabilities.
- Risk maps.

Mitigation

- Continuous monitoring and evaluation.
- land use map.
- Assessing strength / capacity of the cyclone shelters.
- Identifying the soil salinity.

Preparedness

- Supporting coordination among different organizations (GOs & NGOs)
- Helping to calculate the relief needed for the people under risk.
- Showing the signals and also giving information on the immediate response.

Recovery

- Type of recovery work is going and needed.
- The number of people benefited by the work.
- Which organizations are doing what type of recovery work.

Response

- First of all, the damage assessment form is provided in the website.
- It's helpful in calculating the need that is required in the affected area.

- Response measures can be taken immediately prior to and following disaster based on the information in the website.
- This website will help to quantify the actual needs in the study area.
- For quickest dissemination of information's and decisions.
- The site can show the evacuation routes available in the study area.
- This site shows the works done or will be done or doing by various organizations for helping the people.

INTENDED USERS OF THE WEBSITE

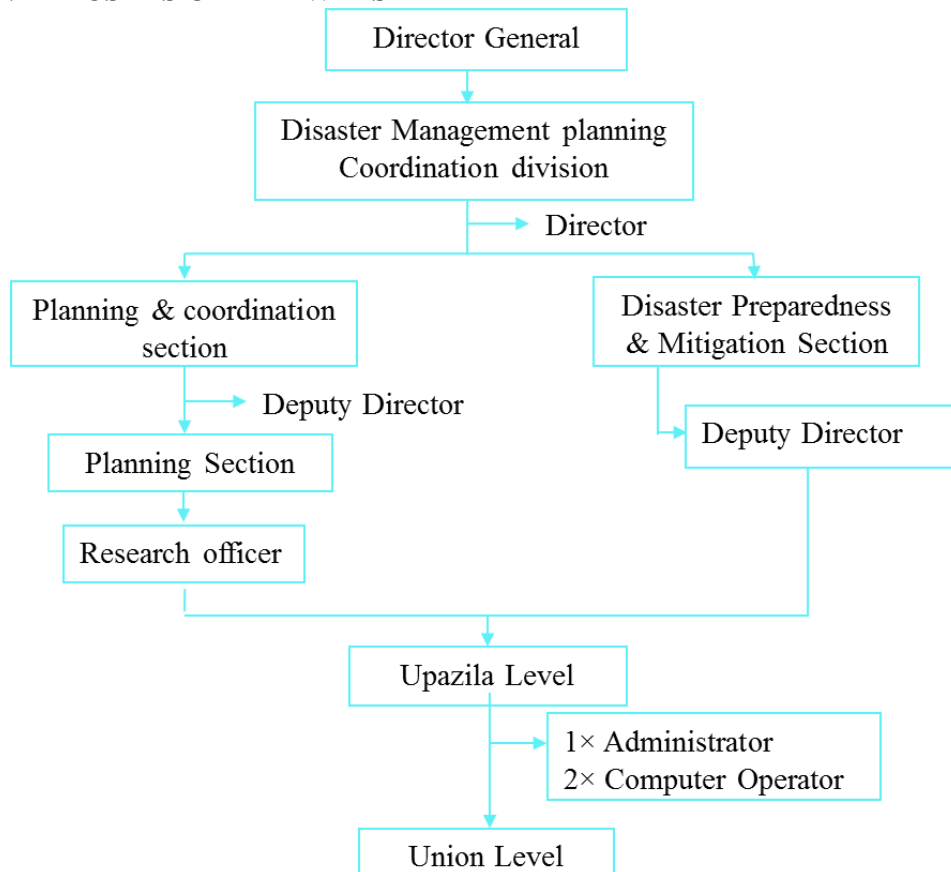


Fig. 3: Organogram of Disaster management Bureau who may use the website

Government

The government authorities can manage & use the website for decision making. They can use this website to-

- Make decisions related to disaster management
- Disseminate warning quickly
- Managing a disaster
- An inventory of activities which could be open for all to see name of the agencies and officials, dissemination flow chart.

NGO's & Donor Agencies

- NGOs can show their work & support.
- An inventory of activities which could be open for all to see name of the agencies and officials, dissemination flow chart.

People (From all over the World)

- People, either living in this country or any foreign country, will get all updated news about a following disaster from this site.
- Various researchers can also be helped getting all the information from this site.

CONCLUDING REMARKS

Cyclones are such a natural phenomenon for Bangladesh which recurs almost every year with a varied intensity. In this research a web based non-structure procedure has been followed to analyse and mitigate the damage of a probable disaster like cyclone. This web based system is also helpful in determining rapid damage assessment in the study area. Furthermore, it will help to disseminate information to the emergency service providers and also it provides capabilities for efficient data mining. It is the premise of this study that web based system can be a useful tool in for hazard-identification and analysis for implementing mitigation strategies. The current research is a step forward towards the development of a fully operational web based DSS for disaster management Koyra upazila for further adaptation and implementation by administrators. The disaster management approach for Koyra upazila consisting of prevention, reduction, mitigation, relief and rehabilitation has been prepared through the development of an accurate and comprehensive web base database. Web based DSS will provide required information and maps showing affected areas, road, lifeline structures, demographics and other baseline data to assist in search and rescue, relief, and rehabilitation in a timely manner. In addition, efficient management of the website is also discussed in this research. The web based disaster management system can be used as an integrated administrative and decision support system to respond to the immediate humanitarian and disaster relief operations pre, during and after the disaster. Bangladesh is a country of resource scarcity where structural measurements against disaster are very expensive and not always cost effective solutions. Therefore, non-structural measurement should be emphasized against floods or cyclones such as, well developed early warning system, forecasting system etc. Using web based potentiality, which can response effectively in pre, during and post disaster period. Taking cyclone as a common phenomenon for Bangladesh this type of non-structural measurement should be accentuated for better response.

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EFFECTS OF SOLAR ENERGY USE ON RURAL COMMUNITY: A STUDY OF BOYARJAPHA VILLAGE IN PAIKGACHHA UPAZILA

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ABSTRACT

Renewable energy is of great importance for today's world which is generally produced from natural sources. Countries like Bangladesh has to use this energy to meet their energy demand. Day by day the demand of electricity is increasing in stormy pace but our resource is limited. So using renewable resources i.e. solar power to meet the demand of electricity is highly necessary especially rural and remote areas. This paper examined the nature and extent of solar energy in Boyarjapha village of Paikgachha Upazila of Khulna district to analyse the effects of solar panel in their daily life. Many positive impacts of solar power were found out such as better quality lighting, education, entertainment, communications, business, increasing working hours, women empowerment, increasing awareness etc. There are a few bad effects of solar energy too. But Government intervention is a must to ensure better quality results in coming future. Similarly, government has to take serious steps to advertise solar electricity in remote areas of Bangladesh

Keywords: Renewable Energy; solar energy; women empowerment

INTRODUCTION

The fact that, Bangladesh suffers from an acute crisis of energy, is more due to lack of appropriate resource management rather than the endowment of its energy resources. In terms use of energy from renewable sources, the country could not make any mentionable break-through, excepting in the Solar Photovoltaic Home System (SHS) for off-grid electrification of remote rural areas and to some extent. For several years, Government of Bangladesh has embarked upon a program of Power Sector reforms. These include bringing the entire country under affordable and reliable electricity supply, increasing the energy sector's efficiency, including electricity supply to remote rural areas of the country. Such measures, it has been argued, would bring the country on the road to energy security and sustainability. Important steps in this direction, include wider scale tapping of renewable sources of energy and implementing measures for energy efficiency and energy conservation so that maximum people gets the benefit of energy and electricity. Total energy consumption of Bangladesh is 237.32 PJ in 1995 (Azad, 2006). The total annual per capita energy consumption of the country in 1995 was estimated at 8.467 GJ (Mamun, 2009) The shares of commercial energy (coal, oil, gas and hydropower) and biomass fuels were estimated at 3.203 and 5.264 GJ, respectively (Mamun, 2009). Almost all rural households use open *chula* (stove) for cooking and these stoves are usually fed by dry leaves, fuel wood, agro-wastes, and rice husk and cow dung. Many affluent rural people use kerosene stoves, gas stoves (fed by LP gas) and electric heaters (where electricity is available) for cooking. Some households use imported coal and a few have locally constructed biogas plants for the purpose. About 4% of the rural people depend on kerosene for lighting after dusk and a substantial number of farmers use diesel for running pump machines to irrigate lands (Banglapedia, 2008).

Only a few towns/cities of the eastern part of the country have a supply of piped gas. A vast majority of the country's urban and rural households thus depend on fuel woods, the annual consumption of which is about 40 million tons, for cooking (Banglapedia, 2008). This is causing fast depletion of the forest reserve of the country and has become a threat to the ecological balance. It is expected that Renewable Energy Technologies (RET's) can play a significant role in the far-flung remote locations of Bangladesh. As Bangladesh is a tropical country, sunlight is available here all the year round. There are many originations providing solar systems in Bangladesh.

METHODOLOGY

For the purpose of this research, Boyarjapha village of Paikgache upazila was selected which is one of the remotest area in the upzila. People use solar energy for their daily purposes. About 50% people of this village use solar energy. Several NGOs work here with solar energy. So this area is suitable for the research. The total population of the village is 1202. Among them 599 are male and 633 are female. Population growth is 1.8%. In ward no. Birth rate is 2.25 and death rate is 1.25 (BBS, 2008). The total number of household is 246. It is estimated that about 36% households have joint family and 64% households have single family. The average family size is 5.2. The total area of Boyarjapha village is 531 acres. This area covers mainly residential, agricultural and other uses. Both primary and secondary data were collected through intensive field survey and from the involved NGOs and other organizations.

Opportunities of Solar Energy in Bangladesh

Renewable energy is energy generated from natural resources- such as sunlight, wind, rain, tides and geothermal heat- which are renewable (naturally replenished). In 2006, about 18% of global final energy consumption came from renewable, with 13% coming from traditional biomass, such as wood-burning. Hydroelectricity was the next largest renewable source, providing 3%, followed by solar hot water/heating, which contributed 1.3%. Modern technologies, such as geothermal energy, wind power, solar power, and ocean energy together provided some 0.8% of final energy consumption (Unique. 2007).

Existing Energy Consumption Pattern

Conventional fuel consumption per head is 16.5 litre of petroleum per year % (Biswas et al. ,2007) Cow dung, leaves, Trees, Agri- residue, Kerosene are used for cooking purpose. Kerosene is widely used for lighting at night. Candle light is also used for lighting.

Problems of Existing Energy Practice

People cut down trees for woods. Woods are widely used for cooking purpose. People destroy forests to collect wood. Decreasing agricultural productivity: Cow dung is good manure. The women also use cow dung for their cooking as fuel. It may decrease agricultural productivity Air pollution: Air is polluting from the burning of fossil fuels. Fossil fuels emanate CO₂. CO₂ is the main gas to pollute the air. It is also the responsible for greenhouse effect. Health hazard: Smoke is dangerous for health. It causes different diseases. For example, bronchitis, asthma, heart diseases etc. Fire hazard: The traditional energy is not safe. Fire hazard is a common incidence in rural area due to unsafe energy use. Time wasting: To collect fuels (Cow dung, leaves etc.) children and women waste enough time. The traditional cooking procedure is also lengthy.

Reasons for choosing solar energy in Bangladesh

Bangladesh is situated between 20.30 - 26.38 degrees' north latitude and 88.04- 92.44 degrees east which is an ideal location for solar energy utilization. Daily average solar radiation varies between 4 to 6.5 kWh per square meter. Maximum amount of radiation is available on the month of March-April and minimum on December-January. There is a good prospect of harnessing solar power in Bangladesh. In a recent study conducted by Renewable Energy Research Centre, it is found that average solar radiation varies between 4 to 6.5 kWhm-2day-1. Maximum amounts of radiation are available in the month of March-April and minimum in December-January. Following map has illustrated prospect of solar radiation in Bangladesh (Reein, 2008).

PRESENT SITUATION OF POWER SUPPLY

The present situation is not satisfactory. Lot less is being produced in terms of demand. Sometimes the existing power station fails. Then the people suffer a lot. The existing condition of the power stations is very poor. The condition of the stations situated in Ghorasal, Shahjibazar, Sikalbaha and Khulna is the most vulnerable. These stations can fail any time. It is called 'forced outage' in the electricity terminology.

Table 1 shows the load shedding in major urban areas in Bangladesh. Gas and diesel are used extensively to generate power. These are non-renewable resources. So these resources must be

protected. There are some gas fields in our country. The total recoverable reserves of natural gas in 22 known gas fields are 439 Gm³ of which 110 Gm³ was produced up to June 2000 (Mamun et al., 2009). It may be finished within 2050 (Reein, 2008). Diesel is exported and it is very expensive. The price of the oil is increasing day by day. The country has substantial bituminous coal deposits in the north western region at Barapukuria and also more coal fields bear potential for large scale mining of them are under active consideration of Government for exploration. Though there is a power station in Barapukuria but its maximum production capacity is 170MW (Reein, 2008).

Table 1: Power demand in major urban areas

Major Urban areas	Maximum demand(MW)	Load Shedding(MW)
Dhaka (DESA)	3000	177
Chittagong	860	85
Khulna	890	99
Rajshahi	825	107
Comilla	675	62
Mymensingh	442	44
Sylhet	300	51
Barisal	175	20
Rangpur	400	56
Total	7567	701

Source: BPDB, 2016

Rural Electrification Board (REB) responsible for electrifying rural Bangladesh. Today there are 70 operating rural electric cooperatives called Palli Bidyuit Samity (PBS) (REB, 2008). But the condition of the Palli Bidyuit Samity is worse than the Bangladesh Power Development Board (BPDB). The situation of the rural area is worse than the urban area.

Conceptual Framework of the Study

Figure 1 shows that there is some initial investment for solar system. With the help of solar energy, the socio-economic development will be achieved. The socio-economic development ensures rural development. Then the income of the people will be increased. When the income increased then the people is able to buy new solar system. It is a development cycle and solar energy is the driver of this cycle.

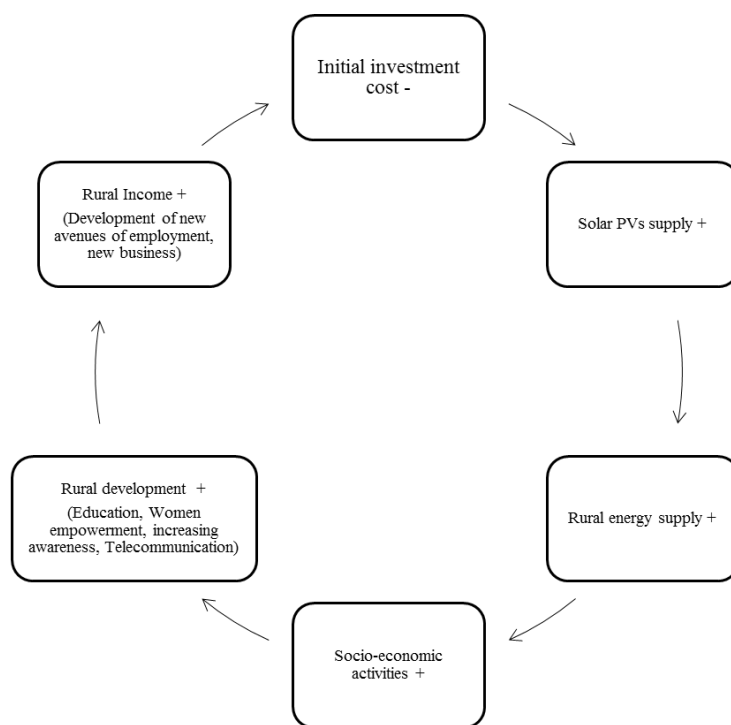


Fig. 1: Conceptual Framework

of the people will be increased. When the income increased then the people is able to buy new solar system. It is a development cycle and solar energy is the driver of this cycle.

RESULTS AND DISCUSSIONS

Nature and extent of solar energy use, effects of solar energy on rural livelihoods and the factors influencing the use of solar energy in the study area was analyzed throughout the research analysis.

Occupational Distribution of the Household Head

People of different occupations live in the village. The number of farmers is decreasing and the number of businessmen is increasing. The businessmen group is the richest group. The businessmen are mainly related with shrimp farming (99%). Teachers, some fishermen (55%) and some farmers (40%) earn more than BDT 5000.

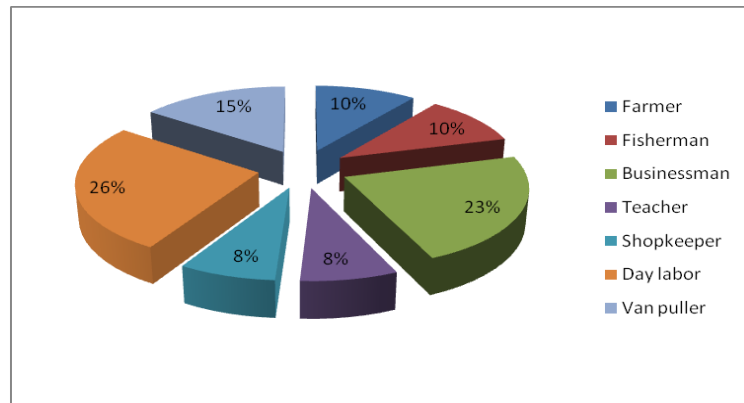


Fig. 2: Occupation of the household head

Income Distribution of the Villagers

There are seven types of occupations found in the village. Most of the businessmen and teachers are in good position. Some farmers and fishermen earn a good amount of money. Mainly the businessmen start the use of solar energy in the village. The day labors, van pullers and the small shopkeepers are poor. So they are unable to buy the solar system. The people who earn more than BDT 5000 are able to buy the solar system. Figure 9 shows that about 53% people of this village earn less than BDT 5000. Rickshaw pullers, van pullers, shopkeepers, some farmers (60%) and some fishermen earn less than BDT 5000. So they are deprived to get the facilities of solar energy.

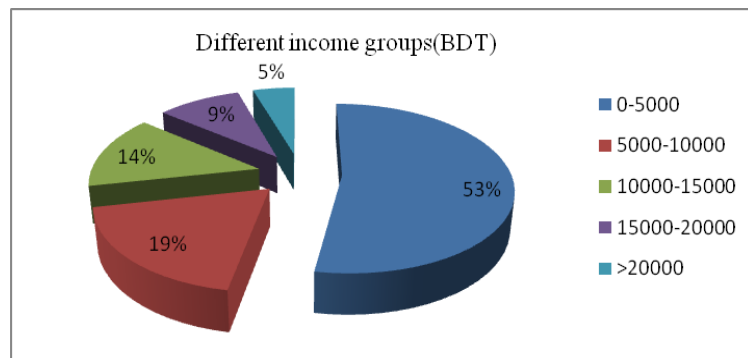


Fig. 3: Income distribution of the villagers

USE OF THE SOLAR ENERGY

Solar system is very popular in this village. about 46% people of the village use solar system. 113 Households use solar energy. The use mainly depends on the income. The people don't have solar system very keen to buy a solar system. Hundred percent non solar users want to buy solar system. They always try to manage money for the solar system.

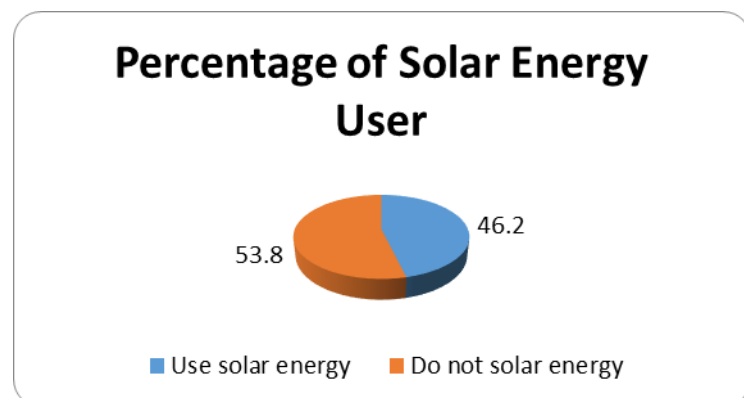


Fig. 4: Percentage of solar energy users

Price of the Solar System

Ninety-three percent of the total respondents said that the price of the solar system is very high. The rest 7% people came from the businessman group. Their income is more than BDT 200000 per month. It is very difficult for the rural people to afford solar system. The total price fluctuates between BDT 22500 to BDT 65000. The power of these solar systems varies between 30 watts to 120 watts. The rich people and rich large families usually use high price solar system. The price varies from NGO to NGO.

Table 2 shows the price of different solar system according to the capacity. It also shows the number of user of according to the capacity. There is no user of 10 watts to 20 watts. Most of the people use 30 watts to 50 watts powered solar system. The number of user is inversely related with high power and high price.

Table 2: Price of the solar system according to the capacity

Capacity of the system (watt)	Price (BDT)	User
30	18000 –18500	36
40	22500- 23000	22
50	27000 –27500	23
60	31500- 32000	8
65	33500- 34000	5
70	36500- 37000	3
75	38500- 39000	7
80	40000- 40500	3
85	42500- 43000	5
120	62500 - 63000	1
130	65000-65500	2

Source: Author, 2015

There are mainly two types of down payment services. These are 15% of the total price and 25% of the total price. Down payment of the solar system fluctuates between BDT 3500 to BDT 9000. The provision of down payment is very difficult for low income people. The monthly installment of solar system fluctuates between BDT 470 to BDT 900. So it is also very difficult to provide money for monthly installment.

Institutional Support

There are five NGOs provide solar system in the village. Grameen Sakti is the pioneer to provide solar energy in the village. Other NGOs providing solar energy are BRAC Foundation, Srizony Bangladesh, Thengamara Mahila Shabuj Shangha (TMSS) and Palli Daridra Bimochan Foundation. The NGOs give Warranty for solar panel 20 years, battery for 5 years and charge controller for 3 years five years' warranty for the solar system. The NGO workers provide free monthly checkups during payments of installment. The NGOs also train the people so that they can take care of their systems.

Table 3: Number of clients according to the NGO

NGO	User
Grameen Sakti	38
BRAC Foundation	24
Srizony Bangladesh	23
TMSS	17
Palli Daridra Bimochan Foundation	11

Source: Author, 2015

IMPACTS OF SOLAR SYSTEM

There are a number of positive sides of solar system according to the local people. Those positive impacts are discussed below-

Better quality and uninterrupted lighting

Better quality lighting occupied the first rank. Most people give it the first priority. The people say better quality lighting make easy their daily work after evening. The people of all ages facilitate by the lighting from solar system. Women are enjoying hazardless and hassle free lighting systems in their daily life. On the other hand, the users are freer from the threat of health and fire hazards.

Educational development

Most of the rural off-grid schools don't have electricity. Solar energy can be used by these rural schools for different amenities. Modern benefits will not only attract more students, but will also retain quality teachers and staffs currently unwilling to be posted in the off grid areas. In the evening, the school

facilities can be utilized for other social services like adult education, health education or recreational activities.

Provide more opportunities for entertainment

Entertainment is part of the life. Before using solar energy, the people were depending mainly on the cinema halls which are situated in the Paikgachha Upazila. The women mainly deprived because it is not easy to go to the Paikgachha sadar. Which is about 10 km away from the village. Though there are a few number televisions found in the village but those are not accessible for all. Moreover, it was very difficult task to see the television by charging battery. It was really very costly. But now television is available here. There are 101 TVs and 48 VCDs found in the village.

Development of New Avenues of Employment

Electrification of micro enterprises in the off-grid areas can increase income or create new job opportunities for the rural poor which has been observed from the experience of Grameen Shakti which is a leading NGO involved in the RET sector. There are some other NGOs related with solar energy. Many people work in those NGOs. There are 5 new shops were built after coming the solar energy in the village. The economy of this village is stronger than the previous time. The people use torch to guard the gher. Previously they use the torch run by battery. Now torch is charged by solar energy. So there is no cost of buying battery.

Increased Working Hours

Solar energy helps to extend the business hours. Most of the rural markets are closed after the sunset and people do not do business after dusk. But with the help of the bright light of SHS, many shopkeepers are doing business till late night and thus their income is increasing. The working hour of women also increase. They also have enough time to take care of the family.

Women Empowerment

The women are getting the opportunities to earn extra income by utilizing their time after evening by sewing. Some of the women of the village sewing after night and earn money. There are three poultry farm in the village. They are sewing at the evening under the bright light. About 31 women earn money by sewing. There is a sewing club named “Jagrato Mohila Samity” in the village. There are 28 members of this club. The average income of the member of the club is about BDT 700. They also are saving money by sewing own and the family member’s cloths.

Increasing Social Awareness

Though the awareness occupied the last position but it is very important. The awareness is increasing through television. For example, the people said about the Sidr. The people knew the warning of the catastrophic cyclone. Many people went to the cyclone center and take necessary steps to save their property. The people of the village mainly watch BTV. BTV gives enough information about health care. Awareness is also increasing towards the pregnant women and the female child. Women education is increasing due to awareness.

RECOMMENDATIONS

Despite some negative impacts, solar energy has brought many positive changes in the lives of the people of study area. In order to have a far better result following recommendations have been made-

- The price of the solar system has to be reduced
- New technologies have to be invented- present technology used in the area produce little amount of energy with high cost- Both govt. and NGOs have to invest money to innovate new technology
- Need necessary government involvement. Especially government has to do something for the poor
- Women involvement in solar energy use must be increased-Without the vigorous participation of the women rural empowerment through solar energy may not completely succeed.
- Have to use solar energy in school to educate the students about modern technology.
- Solar energy can be used to electrify the cyclone center in the study area.
- Solar energy should be used for cooking purpose.

- Use of germanium in amorphous silicon-germanium thin film solar cells- provides residual power generating capacity at night due to background infrared radiation

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CONCLUSIONS

The main conclusions of the research may be presented in a short form. Energy is very important for attaining the goal of development of a country. The solar energy has huge prospects in Bangladesh. This paper has mainly focused to find out the nature of solar energy use and its impacts on rural life in southwest Bangladesh. There are many villages in Bangladesh with no electricity. Solar energy can improve the condition of those villages putting less pressure on government on energy sector.

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POTENTIAL AGRICULTURAL LIGNOCELLULOSIC WASTE MATERIALS FOR BIOCONVERSION

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ABSTRACT

Characterization experiment for ash content, lignin content, cellulose and hemicelluloses content were carried out of some agricultural wastes of wheat straw, sugarcane stem and mustard plant through the laboratory analysis to evaluate the potentiality for bioconversion. The highest cellulose content of $45.67 \pm 1.29\%$ of dry matter was obtained from sugarcane stem followed by $32.56 \pm 1.96\%$ from wheat straw and $26.20 \pm 0.67\%$ from mustard plant. Therefore, sugarcane stem might be the potential substrate for bioconversion.

Keywords: Agricultural waste; lignocellulosic; potential; bioconversion; value added product

INTRODUCTION

Lignocellulosic material is composed of carbohydrate polymers (cellulose, hemicellulose), and an aromatic polymer (lignin). The presence of high amount of Cellulose and Hemicellulose certify one biomass having capability of producing bio-fuel. Lignocellulose in the form of forestry, agricultural and agro-industrial wastes is accumulated in large quantities every year. These materials are mainly composed of carbohydrates of plants are in the form of lignocellulosic which are made up of mainly cellulose, hemicellulose, pectin, and lignin. Lignocellulose is generally found, for example, in the stems, leaves, husks, straws and cobs of plants or leaves, branches, and wood of trees. The herbaceous material, agricultural residues, forestry residues, municipal solid wastes, waste paper, and pulp and paper mill residues etc can also be said the lignocellulosic materials. Agricultural wastes and in fact all lignocellulosics can be converted into products that are of commercial interest such as ethanol, glucose, single cell protein, organic acid and enzymes (Bari, et al., 2010a; Kassebullah, 2006).

Lignocellulosic agricultural wastes are among the causes of environmental pollution. Their conversion into useful products may ameliorate the problems they cause. There are various lignocellulosic agricultural wastes like millet husks, banana peels, wheat bran, rice husk, wheat straw, coir waste and saw dust were selected for the cellulase production (Jadhav, *et al.*, 2013; Masutti, *et al.* 2012). Cellulase are a group of enzymes that breakdown cellulose into glucose monomers. Cellulase enzyme has importance due to major role in industrial applications. It is used for bio-remediation, waste water treatment, food processing, drying of beans, food supplement, protoplast isolation, plant virus's investigations, metabolic and genetic modification studies, ethanol production and also for single cell protein (Ali and Saad, 2008; Shah, 2007; Alam, 2005). Organic acid like citric acid has also produced from palm oil empty fruit bunch (EFB) (Alam, et al., 2010).

Now-a-days when environmental pollution is a great concern; agricultural waste is one of the major causes of this problem. The elimination of this problem is possible by their conversion into useful products. Moreover, by Solid State Fermentation, it is possible to produce enzymes, organic acids, bio-pesticides, bio-surfactants, aroma compounds, degradation of toxic compounds, bio-transformation, and nutritional improvement of crops. However, huge quantities of agricultural wastes are producing every year in Bangladesh. Therefore, the aim of this study is to characterize some agricultural wastes to evaluating the potentiality of using as raw materials for production of any value added production through bioconversion.

METHODOLOGY (SECTIONS)

Abundantly produced agricultural wastes in and around the Rajshahi city such as wheat straw, sugarcane stem, mustard plant were considered for characterization. The samples of were collected from RUET campus and prepared by cleaning, drying, grounding, and sieving (Bari, et al., 2010b). Acid insoluble lignin was determined according to TAPPI T222 om-88 test method and acid soluble lignin was determined according to TAPPI Useful Method UM-250. The total lignin content was estimated with the sum of acid insoluble and acid soluble lignin contents. Alphacellulose (true cellulose) content was determined according to TAPPI T203os-61 (TAPPI, 1961) test method. The quantity of hemicellulose was estimated by subtracting the quantity of alphacellulose from the quantity of holocellulose. Holocellulose content was determined according to method developed by Wise et al. (1946). Residual ash content was also determined by burning at 550°C in a furnace.

RESULTS AND DISCUSSIONS

The justification of new material as a potential substrate for any bioconversion product depends on its chemical and physical characteristics. The vision of this study was to characterize the selected agricultural wastes materials.

Lignin is a constituent of the cell walls of almost all dry land plant cell walls. It is the second most abundant natural polymer in the world, surpassed only by cellulose. Of the polymers found in plant cell walls, lignin is the only one that is not composed of carbohydrate (sugar) monomers. Lignin is polymer consisting of phenyl-propane units. The lignin contents of tested lignocellulosic materials are presented in Fig. 1.



Fig.1: lignin content of different lignocellulosic materials

The lignin which is a complex chemical compound and an integral part of the cell walls are varying from 13±0.7% to 18±0.4%. The highest value is for mustard leaf and the lowest for sugarcane stem. The contents of lignin of these materials are small compared to woody substances. It is the most abundant organic polymer on Earth after cellulose, employing 30% of non-fossil organic carbon and constituting from a quarter to a third of the dry mass of wood.

Cellulose is a natural polymer, a long chain made by the linking of smaller molecules. It is a long chain of linked sugar molecules that gives wood its remarkable strength. It is the main component of plant cell walls. Generally the cellulose content of wood varies between the ranges of 40-50%. But some lignocellulosic materials can have more cellulose than wood. Cellulose is a homo-polysaccharide composed of D-glucopyranose units linked to each other by β -(1→4) glycoside bonds. The molecules are completely linear and have a strong tendency to intermolecular hydrogen bonds. This leads to bundling of cellulose molecules into micro-fibrils, which in turn form fibrils and finally cellulose fibers (Christiane, 2005). The results of cellulose contents are shown in Fig. 2.

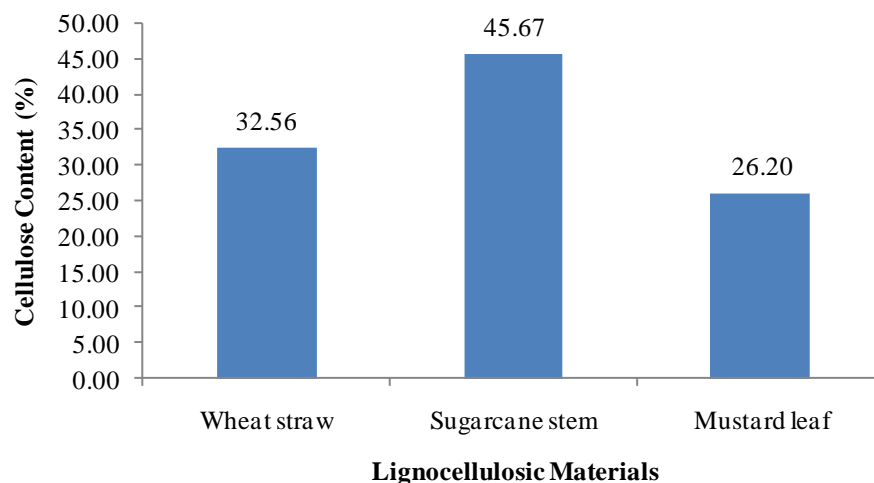


Fig. 2: Cellulose content for different lignocellulosic materials

It is evident from figure that the highest content of cellulose is obtained in sugarcane stem while the lowest is in mustard leaf. The cellulose content of $45.67 \pm 1.3\%$ is very encouraging value because the cellulose is a major part of lignocellulosic material which is almost 50% of the total material.

The α -cellulose which is called true cellulose is composed of polysaccharide $[(C_6H_{12}O_6)_n]$. The fraction or quantity of this constituent is important for any metabolic product by microbial bioconversion. The contents of α -cellulose are shown in Fig. 3. The highest quantity of α -cellulose obtained was $44.68 \pm 1.36\%$ of dry sugarcane stem which is 1.5 time and 2 times of α -cellulose obtained from wheat straw and mustard plant, respectively.

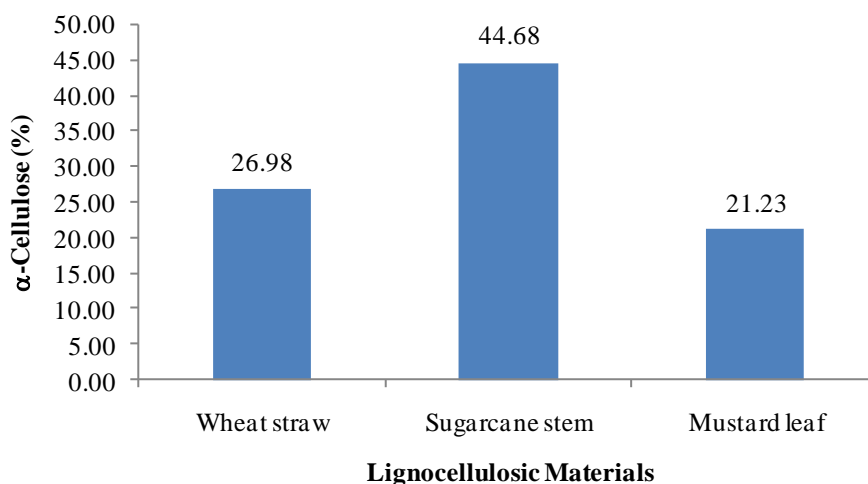


Fig. 3: α -cellulose content (%) of different lignocellulosic materials

Hemicellulose (also known as polyose) is any of several hetero-polymers (matrix polysaccharides), such as arabino-xylans, present along with cellulose in almost all plant cell walls. While cellulose is crystalline, strong, and resistant to hydrolysis, hemicellulose has a random, amorphous structure with little strength. It is easily hydrolyzed by dilute acid or base as well as myriad hemicellulose enzymes. Unlike cellulose, hemicelluloses consist of different monosaccharide units. In addition, the polymer chains of hemicelluloses have short branches and are amorphous. Because of the amorphous morphology, hemicelluloses are partially soluble or swell able in water. Among the most important sugar of the hemicelluloses component is xylose. Their anhydrous-glucose units are linked by β -(1, 4)-glycoside bonds. Fig. 4 shows hemicelluloses contents.

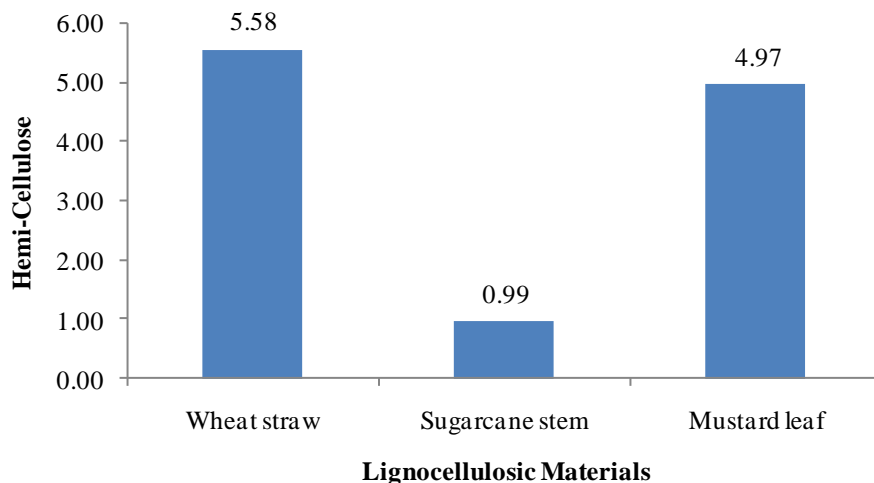


Fig. 4: Hemicellulose content of different lignocellulosic materials

The hemicellulose contents of wheat straw, sugarcane stem and mustard leaf are obtained as $5.58 \pm 0.16\%$, $0.99 \pm 0.1\%$ and $4.97 \pm 0.17\%$, respectively. Therefore, amorphous part is very less in sugarcane stem compared to wheat straw and mustard leaf. In these situation additional initial sucrose might be required for the initial growth of microbes for bioconversion.

Ash is the inert portion of any lignocellulosic materials that will not contribute in bioconversion product. Less amount of ash content is desirable for any material to be used for bioconversion as substrate. Ash contents of wheat straw, sugarcane stem and mustard leaf are presented in Fig. 5.

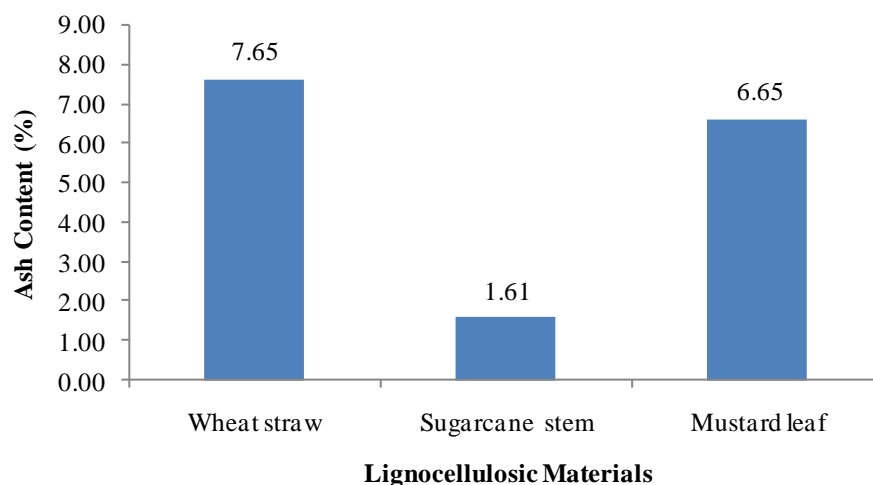


Fig. 5: Hemicellulose content of different lignocellulosic materials

It is found from the result that the ash (inert material) content of sugarcane stem is very low compared to wheat straw and mustard plant which contain $7.65 \pm 0.70\%$ and $6.65 \pm 0.26\%$, respectively while $1.61 \pm 0.18\%$ for sugarcane stem on dry weight basis.

CONCLUSIONS

From the result it is clear that wheat straw and sugarcane bagasse contain comparatively high amount of cellulose or hemicellulose and low amount of lignin. On the other hand mustard leaf contains low amount of cellulose and hemicellulose and comparatively high amount of lignin. Usually for the production of bio ethanol, cellulase enzyme, fermented sugar can be produced in the presence of high amount of cellulose and hemicellulose. So it can be said that, Wheat straw and sugarcane bagasse can be

used in the production of bio-ethanol, cellulase enzyme and fermented sugar. On the other hand, as mustard leaf contain high amount of lignin it can be used for producing lignin per-oxidase enzyme.

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APPLICATION OF GREEN ROOF IN REDUCING TEMPERATURE OF RESIDENTIAL BUILDING IN CHITTAGONG CITY

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ABSTRACT

Energy consumption in the building sector is increasing gradually and in Bangladesh it is expected to increase further due to increase in standards of living. To make the surrounding environment sustainable green roof is playing an effective role. Green roofs, also known as 'living roofs' are known as roofs that are intentionally fitted or cultivated with vegetation. Green roofs are popular for their environmental benefits to cities, as they mitigate urban heat island effects, reduce the energy consumption of building. This paper presents an analysis of thermal performance between two selected buildings where one building occupies green roof and other one occupies conventional roof. This analysis shows a certain variation in indoor temperature of these two buildings. This study will help to understand why installation of green roofs are effective on contemporary buildings to control the temperature of buildings and to reduce the energy consumption.

Keywords: Green roof; energy; environment; temperature

INTRODUCTION

One of the most growing concerns of future buildings is the reduction of energy consumption in all their life phases (Lu et al., 2015). The United Nation Environment Program estimates that buildings consume about 40% of the world global energy, 25% of global water, 40% of global resources (Asdrubali et al., 2015). So for a sustainable environment the concept of sustainable building design is getting popularity day by day. Green roof is a vital component in design sustainable building. Green roofs are considered to be an effective solution to improve internal and external environment at the building and urban levels (Ferrantea et al., 2015). To extenuate the heat gain and minimize the cooling load for mechanical air conditioning green roof is an effective solution (Rashid et al., 2010). The practice of green building in Chittagong as well as in Bangladesh is very rare. Still people have a little idea about the concept of green building and the energy consumption of building. Aim of this study to evaluate the potential of reducing the indoor air temperature by applying green roof and maintain a comfort temperature throughout day and night in humid climate of Chittagong city.

METHODOLOGY

In this study, brief literature study on previous related researches was done. To measure temperature and show the variation of temperature of two buildings one with conventional and another with green roof was selected for this study. Both of the selected buildings are in khulshi area of Chittagong City.



Fig. 1: Selected study area

Physical measurement of temperature was done by Temperature and Humidity meter.



Fig. 2: Temperature and Humidity meter

Temperature for both external and internal were recorded at every one hour. Then the data were averaged for every six hours. Indoor air temperature was recorded inside the test room and the position of the device was 1.5m above the floor level. Outdoor temperature was recorded in the outdoor environment, and the position of the device was 3m above the rooftop surface. After collecting all the data, a graphical representation is made to show the variation of temperature between the two selected buildings.



Fig. 3: Green roof application on the selected building

RESULTS AND DISCUSSIONS

Data collected physically from the study area are plotted in a graph to show the variation of temperature between conventional and green roof which is shown in Fig. 4

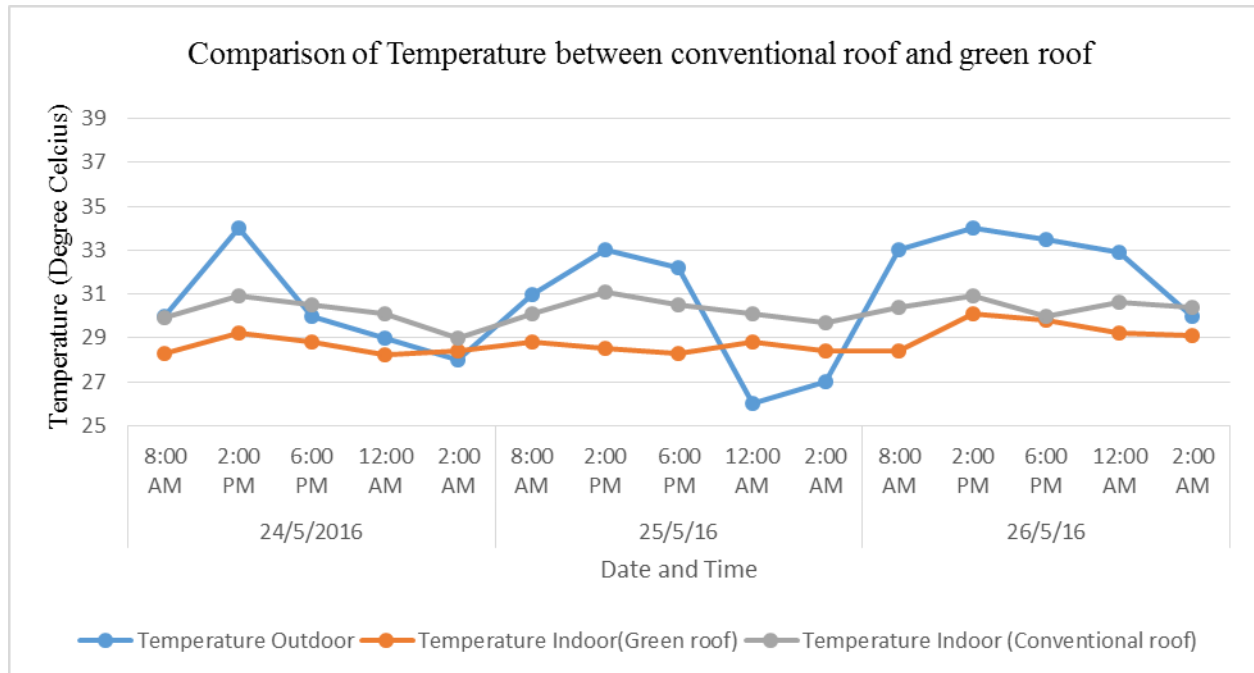


Fig. 4: Comparison of temperature between conventional roof and green roof

The comfort zone analysis for Bangladesh especially during the summer season is between 24°C to 32°C. According to the graph the indoor temperature of the residence is staying with in this comfort temperature range. From the figure it is also clear that the temperature of building with green roof has a lower value than the conventional one. The average temperature variation is 1.46°C. This study shows that green roof plays an effective role in reducing room temperature and also minimize the energy consumption of the building. A better planning of green roof can reduce more temperature and maintain a convenient room temperature.

CONCLUSION

The result shows that the green roof application helps to reduce the indoor temperature of a building as well as maintain a comfortable temperature with respect to the outdoor temperature. This research work also provides that, building with green roof can provide a sustainable, energy saving, comfortable and healthy environment.

ACKNOWLEDGMENTS

In the name of God, the most gracious, for giving us the courage and determination to complete this study. We are also thankful to Dr. Tahsin Manzoor Tushin, MBBS, Chittagong Medical College, Chittagong for his help in this study.

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A COMPARATIVE ANALYSIS ON AVAILABLE SERVICE FACILITIES AND THEIR DEFICIENCIES USING THRESHOLD AND LOCATION QUOTIENT METHOD: A CASE STUDY ON DIFFERENT WARDS OF KHULNA CITY.

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ABSTRACT

Bangladesh is one of the most densely populated country in the world. Her cities are experiencing the rapid population growth. As the population growths increase so fast that there are considerable lacking in providing public services comparing with the demand. This paper explained the gaps of different service facilities of different wards of Khulna city by comparing the existing and required facilities. First the study identified the existing service facilities of the selected ward. The threshold population method and location quotient method was used in this paper to identify the surplus and deficit of service facilities of the selected wards. The study found that some of the areas are developed comparatively to others. Finally on the basis of findings few recommendations were provided.

Keywords: Deficit; location quotient method; threshold population method; surplus

INTRODUCTION

Bangladesh is one of the world's most densely populated country with a population of 150 million (Islam, 2013). The country is facing a rapid spread of urbanizations in recent time. People from rural areas come to the urban area for the sake of a better living condition and job opportunity. That makes the urban area overcrowded and keeps pressure on urban services like school (Rahman & Salauddin, 2009), health facilities (Jahan, 2000), park and open space (Rahman, 2014) and many more.

As a divisional city and economic hub of south-western region, Khulna is no exception to this rapid urbanization. In Khulna the urban population is growing due to rural- urban migration. This rapid growing urban population creates pressure on the public services like school, playground, health facilities, marketing facilities, security etc. and thus disparities create within the city (Jahan, 2000). This disparities varies between planned and unplanned areas of the city. The aim of this research is to explore the existing condition of different service facilities like primary school, health facilities, park, open space and security condition of selected wards of Khulna city and find out which wards have over saturated service facilities and which are deprived of by using threshold population and location quotient method.

Objectives

This research have two broad objectives for which the development of this study progresses.

- To identify the existing condition of the service facilities in the study area.
- To find out the surplus and deficit of existing facilities in the study area.

METHODOLOGY

Methods

Threshold Population Method

A threshold population is the minimum number of people needed for a service to be worthwhile (Goodal, 1987). Threshold population are calculated by simple linear regression method. Equation of linear regression is $Y = a + bX$. Threshold population $P_t = (ad-bc) / (d-b)$ Where, P_t = threshold

population, Ag = without facility at this & greater level, PS = with facility at this & smaller level, a = Intercept of Ag, b = Slope of Ag, c = Intercept of Ps, d = Slope of Ps, Y = Population midpoint.

Location Quotient Method

A location quotient is a way of measuring the relative contribution of one specific area to the whole. $L.Q. = (x_i/n_i) / (x/n)$. Where, x_i = number of facility i in a given block, n_i = population of the concerned block, x = number of facility i in Khulna city, n = Total population of Khulna city. If $LQ < 1$, then particular facility is less, if $LQ=1$, particular facility is exactly sufficient and if $LQ > 1$, particular services are exceed (Rahman & Salaudinn, 2009).

Study Area

Khulna is the 3rd largest city and second largest port city in Bangladesh. Total area of Khulna City Corporation (KCC) is 47 sq.km consisting of 31 wards (BBS, 2011). Among 31 wards few wards are well planned, some are semi-planned and most of wards are unplanned and as a result their services varies. In this research most important services for Khulna city were selected for analysis. Five wards were selected as study area in which ward no. 24 are well planned because of available service facilities. The ward no. 19 is a semi-planned area as all service facilities are available but not sufficient. The ward no 4, 11, 31 are totally unplanned area and the people of this area are totally deprived of their basic services.

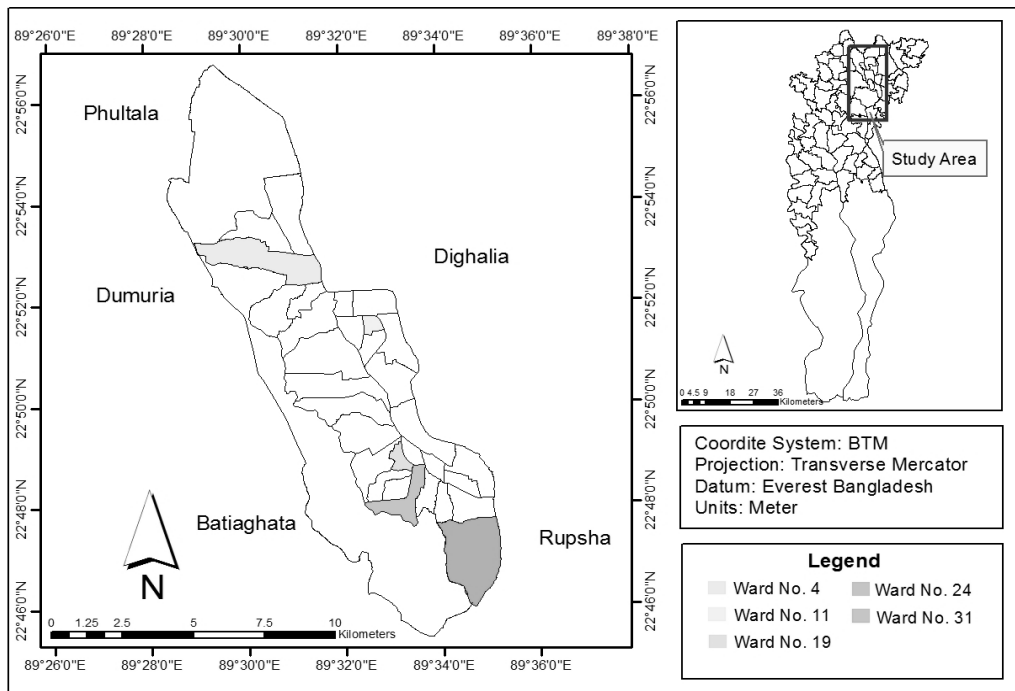


Fig. 1: Study Area Map (Source: Authors Construction in GIS)

Tools

Here ArcGIS and Microsoft Excel software were used to find out threshold population and location quotient calculation. Most of the data needed for the calculation were collected from KCC and BBS and few were collected through field survey.

DATA ANALYSIS AND INTERPRETATIONS

Existing Service Distribution

In Khulna City, Service facility are not well planned in the whole ward of Khulna city. Generally better service facility are concentrated in the central ward. The following table is representing the existing service distribution of the study area:

Table 1: Ward Wise Population Distribution and Existing Service Facility

Ward No.	Primary School	Clinic	Park and Playground	Police Station	Existing Population
4	2	0	3	0	19961
11	0	1	0	0	22373
19	4	2	2	1	30558
24	5	3	1	3	49889
31	7	0	0	1	43889

The above table presents that the selected service facilities are more or less available in ward no. 19 and 24. But the people of other study area like ward no 4 are deprived of proper health facilities and safety. The situation is awful in ward no. 11 as there is no primary school, clinic and police station. In ward no. 31 there are no hospital, park and playground but there are enough primary school and one police station though this is not enough for large number of population's safety.

Location Quotient Method

For calculating Location Quotient (LQ) method existing service facility of the ward and total facility of the whole city is needed. By calculating LQ it is seen which service facility is enough for existing population and which are not. For maximum service facility the LQ value is less than 1 and it can say that existing service facility of Khulna city is not enough for cover existing population. Health facility in those five ward are less. Police camp and primary school facility are same scenario are seen.

Table 2- Location Quotient Method

Ward No.	Primary School	Clinic	Park and Playground	Police Station
4	0.71	0	3.7	0
11	0	0.49	1.08	0
19	0.91	0.73	1.6	0.9
24	0.7	0.67	0.48	1.7
31	1.11	0	0	0.65

Threshold Population Method

Primary School

Table 3: Gap Identification of Primary School

Ward No.	Threshold Population	Existing Population	Existing	Required
4	15544	19961	2	1
11		22373	0	2
19		30558	4	2
24		49889	5	3
31		43889	7	3

For primary school facilities, it is clear that almost all the words are providing this facility with greater number. This is because, the urge for primary education is conceptualize by people from all income range. To ensure primary education, government has provided enough educational resources in terms of primary school. That clearly indicates, the primary school service is adequate in this areas with proper spatial distribution.

Clinic

Table 4: Gap Identification of Clinic

Ward No.	Threshold Population	Existing Population	Existing	Required
4	25642	19961	0	1
11		22373	1	1
19		30558	2	1
24		49889	3	2
31		43889	0	2

In the above table, threshold population for a clinic is 25642. This number indicating that for 25642 populations, there will be at least one clinic is needed. But the spatial distribution of the service facilities are different. Some wards (19, 24) have over saturated clinic services while some of them are deprived from that service facilities. For this reason they have to travel to the other wards for getting better treatment.

Park and Playground

Table 5: Gap Identification of Park and Playground

Ward No.	Threshold Population	Existing Population	Existing	Required
4	24901	19961	3	1
11		22373	0	2
19		30558	2	1
24		49889	1	2
31		43889	0	2

From the above table it is seen that minimum threshold population for park and playground is 24901. The total population of Khulna City Corporation is 925450 (BBS, 2011). So according to threshold population calculation Khulna city needs at least 37 parks and playgrounds. That means each of the ward need at least one park and playground. But from the above table clarifies that some of the ward have more than the required one and some of the ward have lack of proper recreational facilities like park and playground. The prime reason behind that the gradual increase of population in all over the city and lack of administrative responsibilities. On the other hand though there are few park and playground, their condition is so poor because of proper maintenance.

Police Station

Table 6- Gap Identification of Police Station

Ward No.	Threshold Population	Existing Population	Existing	Required
4	26072	19961	0	1
11		22373	0	1
19		30558	1	1
24		49889	3	2
31		43889	1	2

According to threshold population calculation each of the ward should at least one police station and in some case two. In ward no 19 and 24 the number of police stations are satisfactory but unfortunately other wards are beyond the required number of police station. In ward no 4 and ward no 11, there are no police station. On the other hand, there are only one police station in ward no which is one of the largest wards of Khulna city. For this reason The common psychology of least occurrence of crime like

crime, hijacking, snatching etc. The irresponsibility of governing body and administratively unimportant area the reasons for this service deficit.

RESULTS AND DISCUSSIONS

From the above analysis and interpretations it is obvious that the existing service facilities have quantitative and qualitative differences in each of the wards. The prime reasons behind that is the locational factors. For example ward no. 4 is located far from the city centre. For this reason the people of this ward are not getting their basic services like health and security as there is not clinic and police box. The condition of ward no. 11 is much worse than any other selected wards because there are no primary school, hospital and police station. There is a clinic in this ward but the condition is disappointing. That's why the people of this ward have to go to the other area for emergency case. The location of ward no. 19 and 24 are near to the city centre that's why the service facilities are available but in some case lack of proper management is a common occurrence. The condition of ward no. 31 is pretty similar to ward no. 4 and 11 because of its locational factors and being an administratively unimportant area.

CONCLUSIONS

The analysis and discussion indicates that the services are not equally distributed. Few wards have sufficient facilities and most other are far behind the mean level of development of a city. As the population of Khulna is increasing day by day, the demand for these services will more in the coming days. Government should provide more facilities (primary school, clinic, park, playground, police box) with planning as well as necessary amenities in such a way that people of every ward get equal benefits from these. Besides Government should ensure proper maintenance and management of these facilities. Not only that alongside with government, different organizations should come forward to improve the condition of existing services. This will surely help to make the environment a livable one.

ACKNOWLEDGMENTS

We would like to convey our heartiest appreciation to our teacher Dr. Md. Monjur Morshed and Saima Rahman, Assistant Professor Department of Urban & Regional Planning, Khulna University of Engineering & Technology for his continuous guidance and inspiration during the study. We would also like to express cordial gratitude to the people who provided important assistances and moral support in the completion of this study.

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URBANIZATION AND PLANNED RESIDENTIAL AREA DEVELOPMENT PRACTICE ACCORDING TO EXISTING STANDARDS

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ABSTRACT

Due to urbanization the pressure of population in urban area is increasing tremendously. To accommodate this increased population new residential areas are built by development authorities e.g., CDA, KDA, RAJUK etc. in major cities. Several policies i.e. Private Housing Project Land Development Rules 2004, Real estate Act 2010 are adopted by government of Bangladesh to guide and control their development. Chandgaon Residential Area in Chittagong and Nirala Residential Area in Khulna have been developed for middle income people and government officials by CDA and KDA who are the main governing bodies responsible for the development control in Chittagong and Khulna. The aim of the paper is to analyse the scenarios of planned residential area development in respect of violation in construction of buildings with planning standards. The data has been analysed with the help of field survey, ArcGIS, Excel, SPSS and AutoCAD software. Finally, this study found that, these residential areas are partially mentioned different standards and facing similar type of problem.

Keywords: Private housing project land development rules; real estate act and setback

INTRODUCTION

In Bangladesh around 1142.3 people lives in per square kilometre and nearly about 35.1% people lives in urban areas (World Bank, 2010). Among the present urban population, more than half lives in the four largest cities: Dhaka, Chittagong, Khulna and Rajshahi. (Zeitlyn, 2006 and World Bank, 2010). As a result the demand of batter housing is increasing day by day. The quality of residential development has long term impacts both on the communities and on the surroundings. A planned residential area provides a better housing for shelter, recreation and gives well opportunities for social and cultural development of the inhabitants. Chandgaon residential area was developed by (Chittagong Development Authority) CDA to meet the increasing demand of housing basically for middle class people (CHWA, 2014). On the other hand the Nirala residential area is a well-known residential area in Khulna city implemented by Khulna Development Authority (KDA) to cope with the increasing demand for housing (BD-KHU-679, n.d.). The objective of this study is to find out scenarios of planned residential area development with standards e.g., Private Housing Project Land Development Rules 2004, Real estate act 2010, Neighbourhood design concept etc.

LITERATURE REVIEW

The history of designing planned residential area is too old which we can find in ancient civilization but in modern era it started in 1920 with Clarence Perry's "Neighborhood Unit" concept. A neighborhood unit is an area simply required to build up the population of an elementary school and the area will be five minute walking distance radius from the school (Kostritsky, 1952). The principle for planning residential environments should reflect a philosophy of sustainable development that values landscapes and protects their functions while supporting healthy communities for residents. (Jill Grant, 1996). Where people choose to live and the type of housing they select is influenced by a number of factors such as the cost of housing, accessibility to services and employment opportunities, preference for different neighbourhoods and lifestyle choices (Department of Transport, 2014). A residential area should be designed following the concept of universal design. Universal design is the design of an environment so that it can be accessed, understood, used to the greatest extent possible by all people regardless of their age, size, ability and disability (Ireland, 2009). The street system is a vital part of

designing a residential area. Several factors need to be considered while preparing the street plan of a residential area such as Connectivity and permeability, Sustainability, Safety, Legibility and sense of place (Ireland, 2009).

STUDY AREA

These two study areas are located in two different cities. The exact location of these study areas and surrounding areas are described below.

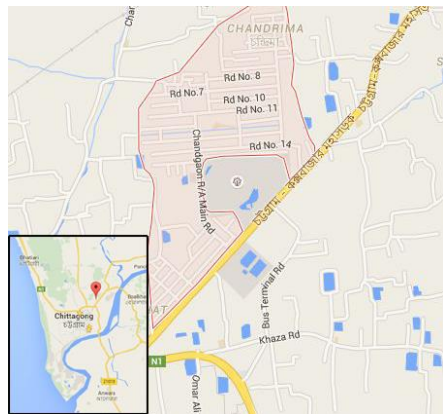


Fig. 1: Location map of Chandgaon residential area

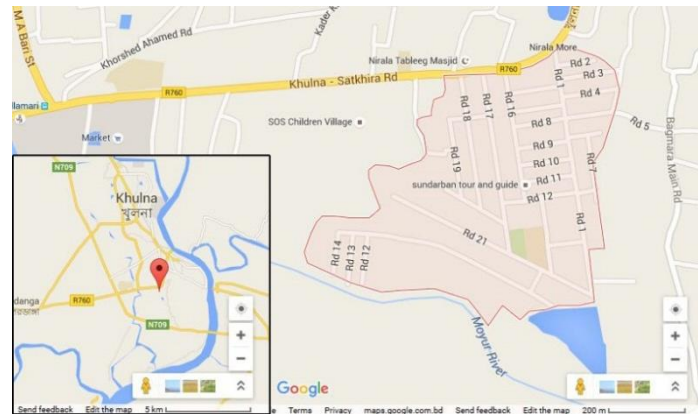


Fig. 2: Location map of Nirala residential area

METHODOLOGY

To analyse of Planning a Residential Area two areas has been selected which are Chandgaon Residential Area in Chittagong and Nirala Residential Area in Khulna City. To collected data the survey has been conducted during the field work of Chandgaon residential area under a project of departmental course and field work of Nirala residential area is done during study tour to Khulna. The study has been conducted to analysis the residential areas based on the field study of existing situation. In order to meet the demand of the study, different methodological approaches were adopted to full fill the stated objectives of this study. The basic requirement of the individual aspect of this study is to find out the problems of the residential areas and make comparisons with standards. We used two sources of data in this study. We can classify them as primary data and secondary data. Primary data and information have been collected by Reconnaissance survey and discussion with the members of abasik kollan committee of the both residential area. For the secondary data different types of literature have been reviewed that is related with the selected topics, studying the standards for residential areas and Collect data from different websites. After collecting all types of data and information's a comparison has been made between these two residential areas with the PHPLDR standards. It has helped to find out which development plan has been implemented according to standards or not. It has tended to make the criticism. With the data which are collected from Reconnaissance survey & Field survey and then analysis will started about the present conditions, facilities, special features and problems of these residential areas & can also determine the performance level of these selected areas from this analysis. According to the collected data & after analyzing data, then comes the major step of this project which is Report writing. In report, it is discussed by the findings, problems & comparison of the data collected by Reconnaissance survey & Field survey

RESULTS AND DISCUSSIONS

Lack of Maintenance Setback

The road pattern in the Nirala residential area is almost grid iron pattern which ensured maximum use of available land and facilities. The land is flat with efficient sewerage facilities which keep the land dry in the rainy season whether the rainfall in high in amount. The road condition on the outer periphery is bituminous carpeted and the condition of other road inside the residential area is bituminous carpeted but spoiled.

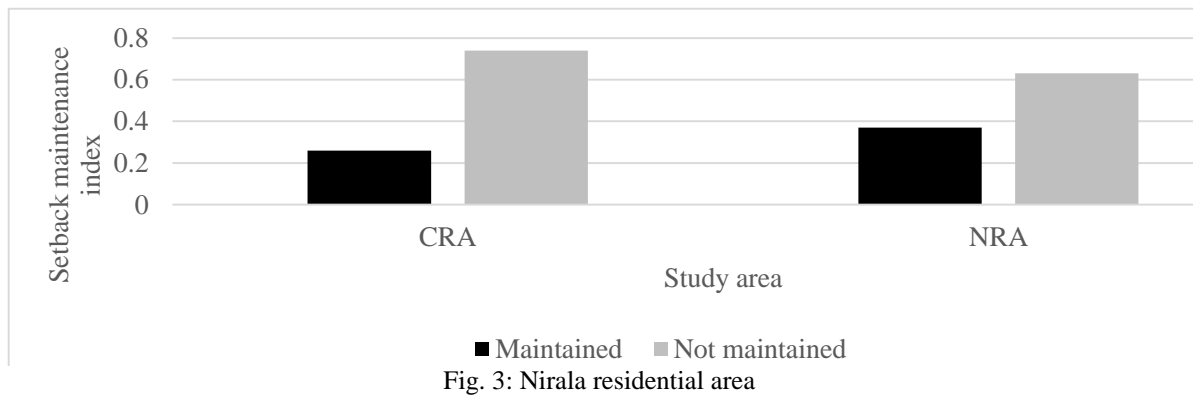


Fig. 3: Nirala residential area

Violation of structure use in residential area

The residential area was for middle income people. But to survey reveals numerous intrusions of commercial activities into the residential area e.g., shops, coaching centres, NGOs offices, sells distributors offices etc. which increasing the land value of that area and shrinking the way to afford the living space to middle income people. Even the people who stays on the built house, sells his own living space to higher income people for higher living cost. According to survey, there is also 18.53% vacant land for future development. There was a large water body in the side of the residential area which was preserved for fisheries. There about 17% area of the total area this is the ideal according to the standard for convenience and proper transportation for residence. In standard road serves 88608 populations with its 1768134.12 sq. ft. area. On the other hand, in Chandgaon residential area, Chittagong has the criteria of calm living space with sound living environment. The target group was government employees for which the living spaces were built. But there was no such strong community management team or law enforcement team which will protect the goal of the residential area project to provide the built space to target group.

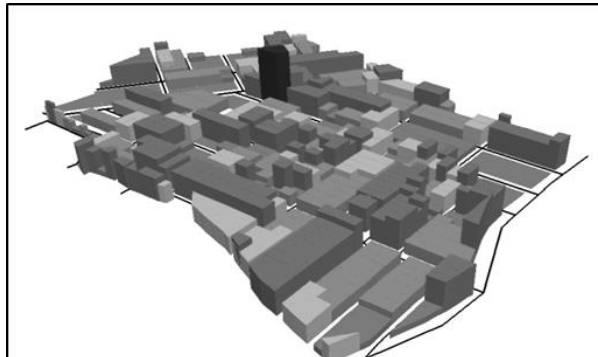


Fig. 4: Nirala residential area

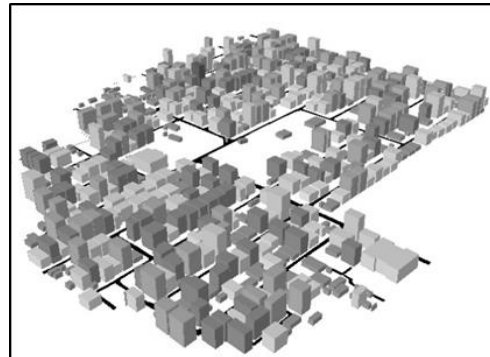


Fig. 5: Chandgaon residential area

Intrusion of economic activities on the residential area

There is need for the doctors for medical facilities, corner shops for marketing, schools and coaching centres are need to fulfil the daily need of the residential people. But the increasing number of these facilities is not safe to preserve the characteristics of residential area. When commercial activities were increased in the residential area, it has been observed that there calm environment disturbed.

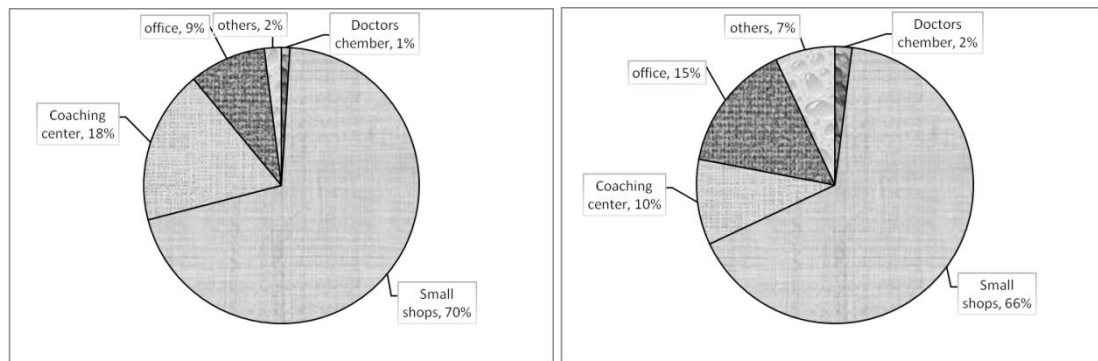


Fig. 6: Intrusion of economic activities in CRA Fig. 7: Intrusion of economic activities in NRA

Violation of standards in providing facilities according to population size

The following table describes the facilities and plot size according to the population size in respect of Private Housing Project Land Development Rules 2004. In two residential area there is seen serious violation of standards.

Table 1: A comparison between population size and standard

Infrastructures	Standard (PHPLDR,2004)	Findings in CRA	Findings in NRA
Residential buildings	3.5 katha/household for middle class	3.22 katha/household	3 katha/household
Play field	1.2 acre/15000 population	1acre/25000 population	1acre/20000 population
Recreational infrastructures (mosque, club etc.)	0.5 acre/10000 population	0.2acre/15000 population	0.3acre/10000 population
Educational	1.55 acres/15000 population	1acres/25000 population	1acre/20000 population

(Source: Field survey- 2015)

Analysing the size of the neighbourhood according to school catchment area

There are one primary, high school & one college named CDA school & college in cra. Both are situated in the sub center beside the central field. The residential unit is within 0.45 miles radius of catchment. On the other hand, There are one elementary school named Dew Drops Preparatory School and a high school named Presidency International School. Both are situated in the sub center. The residential unit is within 0.38 miles radius of catchment in nra where the principle states a minimum of 0.5 miles within catchment.

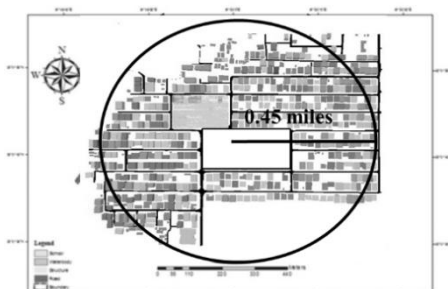


Fig. 8: School in CRA

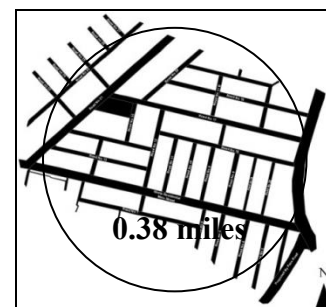


Fig. 9: School in NRA

Implementation of grid iron pattern for roads

In chandgaon residential area grid iron pattern of road has been followed which seems to be economic use of available land but arises the issues related to dead ended road and creating monotonous city environment and mostly identical road intersections. On the other hand in Nirala residential area, there found similar type of road pattern which provided communication with the area outside as well as inside the residential area.

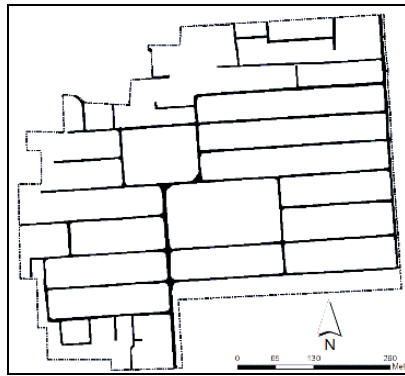


Fig. 10: Road pattern in CRA

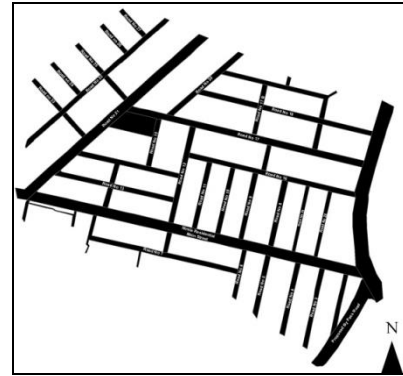


Fig. 11: Road pattern in NRA

The street plot relationship

According to subdivision rule, there has been seen that the residential building was tended to be built by maintaining 90 degree street plot relationship which made the building cost minimum and gave more accessibility to the road.

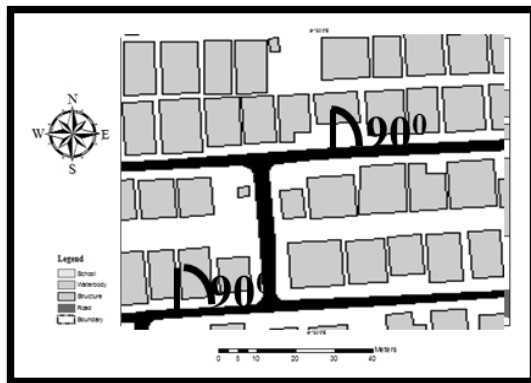


Fig. 12: Street-plot relationship on CRA

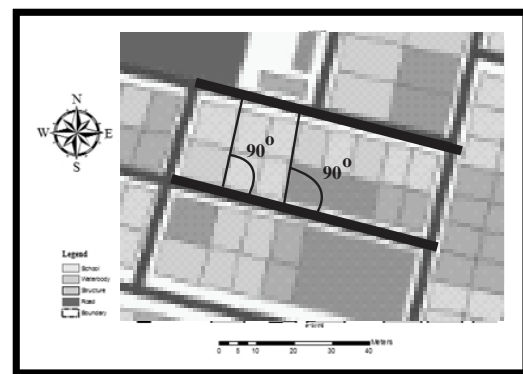


Fig. 13: Street-plot relationship on NRA

Comparison between residential areas according to population density standard

Table 2: Comparison with PHPLDR 2004 between two residential areas

	Population	Standard		Existing situation	
		Gross	Net	Gross	Net
Chandgaon Residential area	52,000	149.85	96.85	41	23.37
Nirala Residential area	20,000	57.14	37.14	67.31	37.02

Source: Field survey 2015

According to the standard, in Chandgaon residential area the gross residential should be 149.85 acres and net residential area 96.85 acres for 52,000 population. But existing gross residential area has been found 41 acres and net residential area 23.37 acres. On the other hand, in Nirala residential area, according to PHPLDR 2004, gross residential area should be 57.14 acres and net residential area 37.14 acres for 20,000 population. On the reality the gross residential area has been found to be 67.31 acres and net residential area has been found 37.02 acres which followed the PHPLDR 2004. In Nirala residential area the setback rule is maintained now having vacant plots of 150.

RECOMMENDATIONS

To promote balance urbanization process in the city area the following suggestions can be taken

- Projecting the future population for achieving a balanced growth in terms of population density.
- Planning for provision of adequate infrastructure facilities such as road, drainage, water supply etc.
- The existing standards must be followed strictly in any type of development.
- Strengthening of the institutional mechanisms, monitoring and enforcing of regulatory

- measures.
- Planning for in-built mid-course corrective measures between different government and non-government organization.
 - Futuristic planning for adjacent areas outside the residential area need to be emphasized.

CONCLUSIONS

The plan residential area plays vital roles both in the context of the economy of Bangladesh and serving the fundamental human right of shelter which actually call for the awareness and analysis regarding various pertinent issues involving the sector. Solving the existing problem and strictly maintain the standards can ensure the balanced development. Ensuring proper land use, floor area ratio, maintaining setback and other land development rules the new residential area can be made more habitable and aesthetically pleasant.

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