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Impact of Tidal River Management on the Livelihood Pattern of Local People: A Case Study of Gaurighona Union, Keshabpur Upazila, Jessore

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Abstract

In Bangladesh a vital portion of natural river system is supported by south-west coastal zone. Khulna Jessore Drainage Rehabilitation Project was initiated to manage the entire coastal zone but failed drastically. It became a great failure for building embankment around the polder area by trapping water and the consequences are flood, water logging, long term salinity etc. in affected area. To get rid of these consequences, people have taken steps to cut the polders for allowing tidal flow and accumulating alluvium inside the polders. This technique of raising land level is known as Tidal River Management (TRM). As a result, in the long process, the reduction of water logged area and emergence of new land have direct influence on the status and quality of people's life and livelihood. This impact and consequences are analyzed through this study in Beel Bhaina and its adjacent most affected villages of Agarhati and Bharat Bhaina in Keshabpur Upazila, Jessore. TRM practice impacted positively on settlement and displacement issues, income, communication, business, shrimp sector, water logging problems, but at the same time, created negative impacts on agriculture sector. Some hazards, like salinity, river erosion and draught have become more frequent in the area.

Introduction

Bangladesh is a resourceful country and it is rich in fresh water source and depends highly on agricultural production. This agriculture production is now being reduced for increasing sea level rise. In Bangladesh about 8,000 hectares of waterlogged lands exist in Khulna and Jessore areas (BARC, 1991). If the sea level rises due to global warming, more areas of Bangladesh will undergo water logging and more land will become unavailable for crop production.

Keshabpur Upazila of Jessore District is facing problems due to its high vulnerability to water logging for last seven years. Almost eight months in a year most of the areas of the Upazila remain inundated (Adri and Islam, 2010:33). The region is monotonously flat, having low elevation. According to available statistics on coastal zone, majority of the land is within one meter from mean sea level, a significant proportion of which again falls below high-tide level (Islam, 2005:161). Keshabpur Upazila is mainly tidal floodplain and strongly influenced by tide, salinity and rainfall. This Upazila people are highly

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dependent on the natural resource for their livelihood. Agriculture and fisheries are the most important economic sectors, employing the major population and feeding them and aquaculture practice is an alternative livelihood option for rural households. The region is densely populated, and most farm families cultivate the scarce land resources intensively, resulting in land degradation and reduced productivity.

Tidal River Management (TRM) is an eco-technological concept and designed to solve the water-logging problem while at the same time improving the environment (Amir et al., 2013:175). In South West region, the river system is highly responsive and carry large amount of sediments. Local people build polder to trap the water inside this polder. The polders have caused a siltation in the channel beds which, in time, especially in rainy season has resulted in serious water logging. This Continuous water logging has brought serious damage to agriculture, forestry, fisheries, livestock and physical infrastructures. To solve this problem, local people practically forced the authorities to adopt their suggested solution of 'public cuts' of the polders to reduce water logging. Institutionally, it was termed Tidal River Management (Nowreen et al, 2014:265). TRM concept is that beels are to act as tidal storage basins which allow natural tidal flows up and down in the river system (Paul et al., 2013:129).

One recent initiative has been taken to cope with this problem by local people which is TRM. There are many impacts which can be acted as both positive and negative changing with monetary value, time value, political biasness etc. Migration, income, communication and accessibility, diversified income sources, food production and cropping technique, aquaculture, housing pattern, land ownership etc. in which the inventory is long enough to explain the changes through the adaptation of TRM. Given the situation, the objective of this research is to find out existing scenario of TRM, the impacts on livelihood pattern and associated problem arising with it. So the study become helpful to gather knowledge how this coping technique can influence people's life and their degree of influence.

Research Methodology

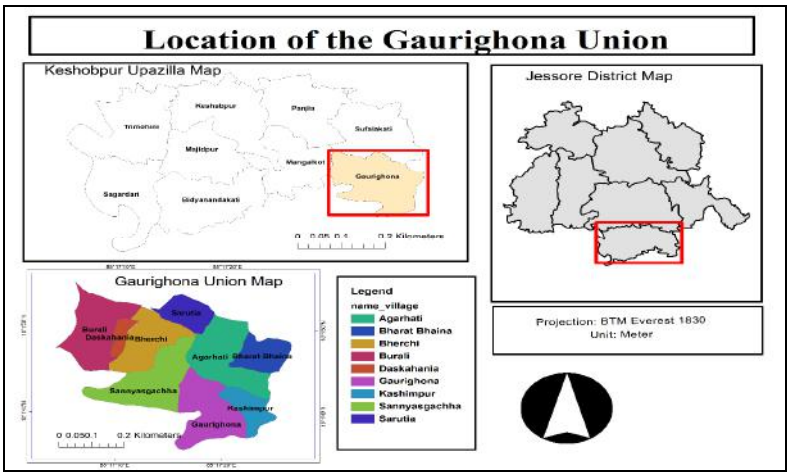
Study Area Selection

Gaurighona is situated from Keshabpur Sadar Upazila Parishad on a road of 16 km and at the side east of Chuknagar. Gaurighona Union Council, the southern end of this village is located on the banks of the river Buribhadra. Gaurighona having 9 wards and Agarhati is situated in ward 9. Agarhati and Bharat Bhaina village is one of the well-known parts of Keshabpur upazilla because of Tidal river management. The project area is situated on beside of Bharat Bhaina north-south and east of the Hari river and Shahpur of Raghunathpur, the west-Bherchi village. Total area is 2964 and in Agarhati and Bharat Bhaina total population is 2986 and 1444 respectively (BBS, 2011)

Methods of Data Collection

There are many practices took place to develop the theme of coping with flood and reduction of resource loss and also regain of resources. Government takes initiative process to overcome the situation like flood risk management program, tidal river management program etc. It is very important to gather enough knowledge before taken any type of initiatives. Data is collected from both primary and secondary information.

Primary data were collected on the basis of project objectives. Primary data collections are based on two ways questionnaire preparation and local people participation. Using stratified sampling, it is found that the sample size for household questionnaire survey could be 284. For this study, a total of 100 households were surveyed due to shortage of resources and manpower. Secondary data have been collected from different published documents of government and also from different private organizations except that case studies, journals, websites, and different maps of government organizations. Data that are collected from primary and secondary sources are analyzed.



Source: Researchers contribution, December, 2015

Figure 1: Location of Gaurighona Union

Results and Discussion

Tidal River Management (TRM)

Tidal River Management (TRM) is a people's concept which is an indigenous knowledge based system to control water and river basin management in the southwest tidal region in Bangladesh (Kibria and Islam, 2006:16). It is very important to know about TRM practice in the Beel area and from the people of adjoining areas. Without knowing any actual information about TRM practices, people cannot take any initiatives. Of the people of Agarhati and Bharat Bhaina area, 79% know TRM and about 21% do not know about TRM. It means that most of the people live in the Beel area are after 19 years from the implementation of TRM. Table 1 shows the area and population of affected villages.

Table 1: Population, Area, Household and Density of Affected Villagers

Village Name	Population	Area	Household no.	Population Density (sq.km)
Agarhati	2986	158 acres	730	809
Bharat Bhaina	1444	432 acres	364	

Source: BBS, 2011

Involved Authority in TRM

Table 2 provides the information of different authorities who support TRM practice in Beel Bhaina area and also opposed KJDRP project and TRM. It also provides the whole time period of TRM practice and authorities, which are involved from beginning to end and who are not.

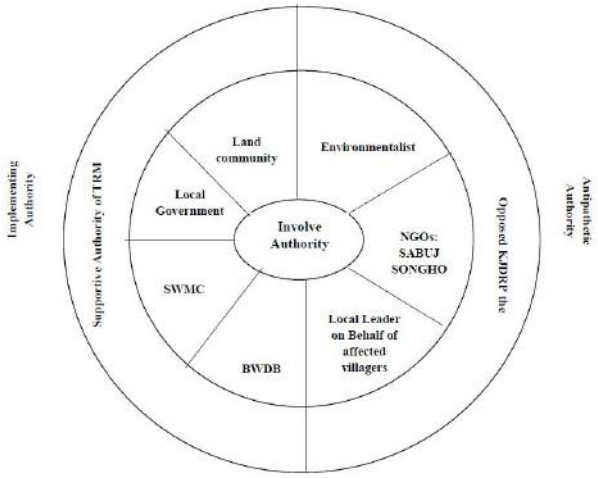
Table 2: Different Authorities Who Are Supportive Involved in TRM Practice

Authority	Supporting type	Time Period	Month	Status of service
BWDB (Bangladesh Water Development Board)	Structural support	January, 1998 to current time	On going	Currently in Operation
SWMC (Surface Water Modeling Centre)	Monitoring and evaluation of TRM	February 2000 to April 2002	27 months	Not in operation
Local Government	Financial Support	October, 1997 to current time	On going	Currently in Operation
Local Community	Physical initiative	Public disconnected polder late October 1997	1 day	Not in operation
LGED (Local Government of Engineering Department)	Still Operation for improving service facility	June 2015 to current time	On going	Currently in Operation

The different authorities that support and oppose TRM are mentioned here 9Figure 2). The supporting authorities are Bangladesh Water Development Board (BWDB), SWMC (Surface Water Modeling Centre), Local Government Engineering Department (LGED), local government and local community. BWDB gives structural support of TRM. SWMC monitors and evaluates the TRM operations. Local government provides financial support. Local community takes physical initiative during the project time. LGED provides different service facilities in current time. The opposing authorities are Local Leaders on Behalf of affected villagers, NGOs named, SABUJ SONGHO and environmentalists.

Impact on Local Community

Some groups of people are beneficiary and some are sufferer because of TRM (Figure 3). The beneficiary groups are some village people and commercial shrimp culture. The village people get benefit because the TRM reduces the water logging problem than earlier and the river navigability also increases because of it. The commercial shrimp culture people are benefited for TRM by saline water increase, which helps to produce



Source: Researchers contribution, December, 2015

Figure 2: Involved Authorities in TRM

more shrimp and the market gain. The sufferer groups are land owners of Beel Bhaina and adjacent villagers. Land owners are sufferers, because TRM increases the saline water intrusion to lands and for this reason, agricultural production is lost and the water logging problem is reduced, but not removed for the whole period. The adjacent villagers get suffered because of river erosion. River erosion problem increases after TRM being practiced.

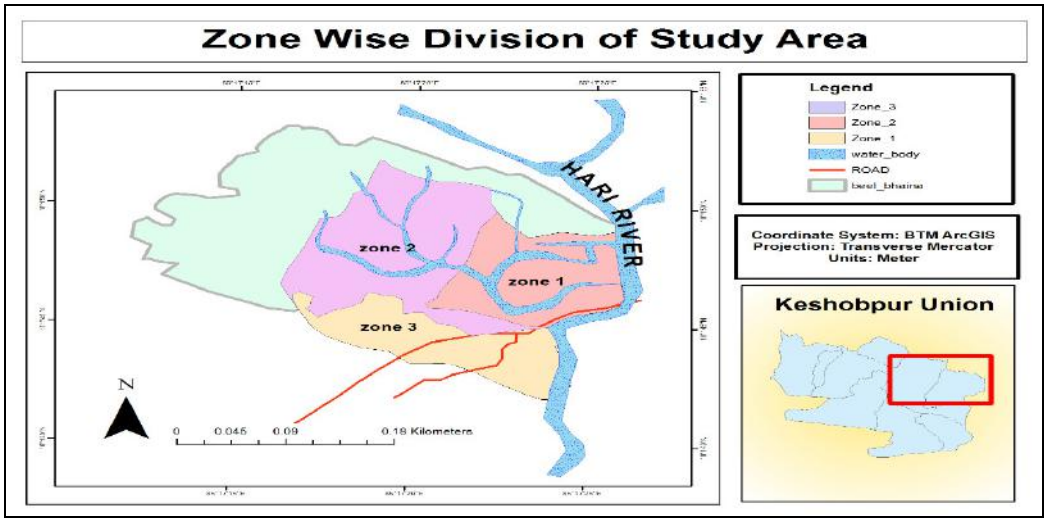
Source: Researchers contribution, December, 2015

Figure 3: Beneficiaries and Sufferers Group of Local Community

Table 3: Division of Zones Based on Different Characteristics

Zone	Rename Zone	Characteristics	Problems
Most affected Zone	Zone1	• Zone 1 is selected according to severity of effectiveness by TRM. This zone is highly server affected of TRM than other zones. • Beside river	• High possibility of tidal surge • This also cause the sedimentation
Moderately affected Zone	Zone 2	• Zone 2 is selected according to severity of effectiveness by TRM. This zone is moderate server than other zones.	• In Hydrology Flow Direction Map showing that the elevation of this zone is low which causes water logging • Through long time water logging this also cause saline water intrusion
Least affected Zone	Zone3	• Zone 3 is selected according to severity of effectiveness by TRM. This zone is fewer servers than other zones.	• This zone is outside the Beel area but this doesn't provide any support of not being affected. This area is also affected for River Erosion

Source: Researchers contribution, December, 2015



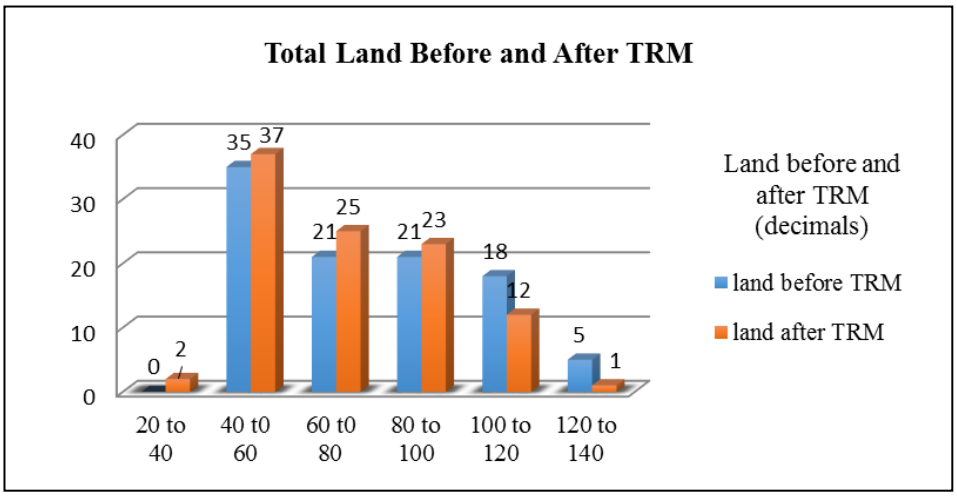
Source: Researchers contribution, December, 2015

Figure 4: Zone wise division of study area

Impact of TRM on Livelihood Pattern of the Study Area

Land Ownership

Land is an important issue for any kind of development. In any development, there are some difficulties related to land. Some people loss their land and some people gain some amount of land. Figure 5 shows the percentage changes of total land amount before and after TRM.



Source: Field Survey, December, 2015

Figure 5: Total Land Percentage Before and After TRM

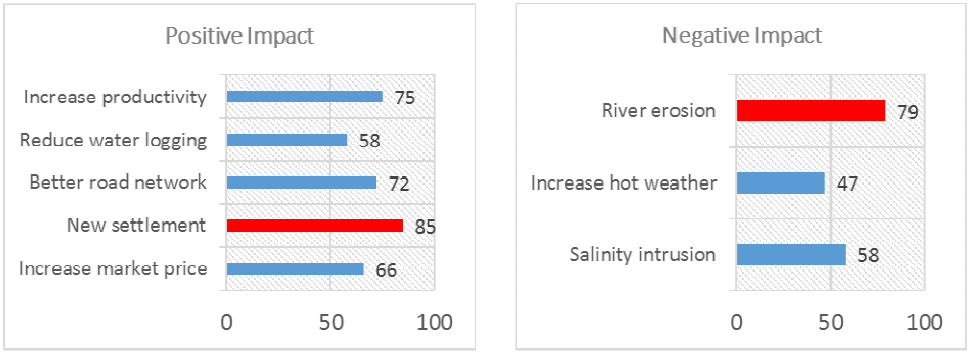
The total land is divided into six ranges. The second range of 40 to 60 decimal lands before TRM was 35% and after TRM, the amount increases to 37%. Most of the people have their land in between 40 to 60 decimals.

Land Acceleration

For land acceleration, new settlement has been provided the place of highest positive impact in the present condition (Figure 6). The reason behind the increasing new settlement is the condition after TRM. Before TRM, people have to move from own place to another and create new temporary locations. But taking long time, water logged area become free of water and people move back to their land. River erosion problem gets the highest negative response. This impact is seen most of the time and lots of people loss their land.

Land Transition

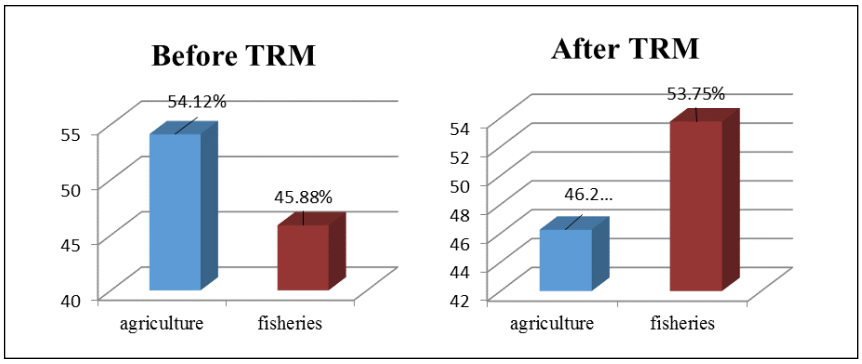
Land has been decreased in both terms of cultivation. There are many reasons behind these changing patterns. Sometimes, the change occurred due to water logging. When people's land goes under water and they are not able to use the land, they try to convert their cultivation from agriculture to shrimp. These problems forced indirectly people to sell their land which helps to reduce the land amount.



Source: Field Survey, December, 2015

Figure 6: Positive and negative impacts of affected area on the basis of people's ranking.

Around 56% people showed that they did not have any change in their land amount. The data only showed that agriculture land is being reduced. Sometimes, land becomes upgraded. The up gradation amount of land does not add any differences. It is limited to 4 to 5 decimal and only 6% people said their land increased since the implementation of TRM. The reason behind this increase is not always about TRM. Only 3% people said that the increase is being for TRM. They grab new emerging land and build their settlements. It is definitely a positive sign. The increasing rate is almost similar in agriculture and Shrimp. Impacts have been differing in nature in both matters of assessment. For shrimp farming- positive and for agriculture- Negative



Source: Field Survey, December, 2015

Figure 7: Percentage change of cultivation before and after TRM.

The inverse relationship is found between agriculture and fisheries. That means after TRM the percentage of agricultural land decreases and the percentage of fisheries land increases. After TRM many people convert their type of cultivation from agriculture to shrimp.

Impact on Overall Socio-Economic Condition of TRM

Because of TRM, the impact on overall socio-economic condition changes. Table 8 shows the overall socio-economic condition of village like settlement pattern, commercial space, communication pattern, cultivation pattern etc.

Settlement

As high as 69% people claim that their settlement pattern was changed for TRM and 31% people said there was no change. In the affected area, 19% people have their settlement in Pucca type but after TRM, the amount is increased into 41%. In matter of pucca housing, there is Zone 1 having 11% before and after it increases to 23%. Another data provides info that kutcha housing is decreasing to 12 to 5%. Within Beel area, there are 41% people having their settlement. Impact on settlement is positive.

Commercial

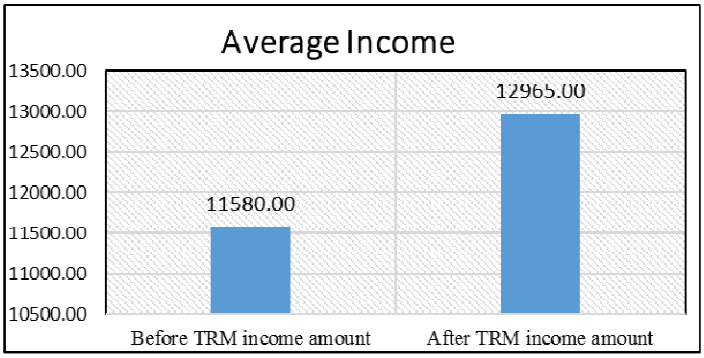
Commercial space of Bhyum Bazar is present in this zone. There is no effect of TRM on this zone. There is being shift in the place of Bazar. Before TRM, the bazar was present near the Zone 1(most affected zone) and after TRM, it is being shifted to Zone 2 (moderately affected zone). Within Beel area, 6% small purchase of land of commercial use is present. Impact is positive.

Communication

In previous time period, people move through boat and there is a lacking of good road network. But after TRM project, there is a construction of bridge and also road network developed. Before TRM, 81% people face problem and after TRM, 78% people claim that they do not face any difficulties. Impact is positive.

Income

Within Beel area, impacts on people's income have both positive and negative effects. 58% people said their income has been increased and 42% people said their income is negatively impacted. Income is a very important issue for any kind of development. Because of TRM, many people's income is being changed. There are slight variation of total average income of two different time periods. This is clear understanding that income has been highly impacted. Before TRM, the amount is TK. 11580.00 and after TRM, the amount of average income is TK. 12965.00 in which the increased amount is TK. 1385.



Source: Field Survey, December, 2015

Figure 8: Average inocme amount before and after TRM

This increasing amount is for changing occupation from agriculture to shrimp. So the benefit is not limited only for shrimp farmer, but also for reduced water logged area inside the agricultural land. So overall impact is positive for the whole affected area. That

means most of the people face positive and negative impacts on income change in Beel area.

Occupation

A study found that 76% people had impacts for TRM. Both positive and negative impacts were seen in the affected areas. Around 74 acres in these two villages had total cultivation land before practicing TRM and after the implementation of TRM to till now, the amount of land increased to 80.5 acres. This increasing amount is not limited to agriculture to agriculture or shrimp to shrimp. There is conversion between occupations.

In the matter of shrimp farming, 41% shrimp farmer said that their land amount did not have any change after TRM. But this amount is lower than the response of agricultural change. 51% peoples land has been increased which is 384 decimal of land. This increasing land mostly comes from agriculture practice. But the amount of that losing amount of land is not noticeable and mostly changes for other social factors like loss of income or loss of productivity, poverty or urgency of money.

Impact on Accessibility in Service

The accessibility of service facility is important in any village area. Before TRM, people of Agarhati and Bharat Bhaina face accessibility problem but after TRM, the problem is reduced.

Table 4 shows the accessibility problem faced by village people and on basis of people's response before TRM practice. It shows that 82% people do not get real market price of products before TRM which is the highest. The lowest 63% people responded that their transport system highly depends on river base that is why they face many problems.

Table 4: Accessibility problem people face before TRM

Issues	**Response(percentage)**
Don't get real market price of product	82
During rainy season road become unusable	74
Poor transportation	71
Loss of time	67
Highly depended on river transport	63

Source: Field Survey, December, 2015

Table 5: Reduction of accessibility problem after TRM practice

Issues	**Response (percentage)**
Easy to transport market goods to haat	83
Variety of transport mode	78
Construction of bridge	74
Easy accessibility to service	67
Less time	61

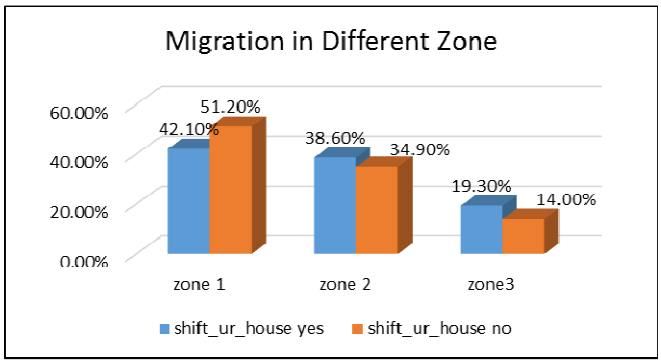
Source: Field Survey, December, 2015

The accessibility problem reduces because of TRM. Table 5 shows that 83% people responded that the transportation problem is reduced because of this. For this reason, people easily reach the market in time and the transport of market goods also easy and 61% people responded that they need less time to transport. The problem of travel is being decreased than before.

Impact on Migration

Migration is common process in TRM. When people cut the polder of Beel Bhaina area the whole area went under water which was a temporary situation. Soon after the land have been risen, reduced the water logging.

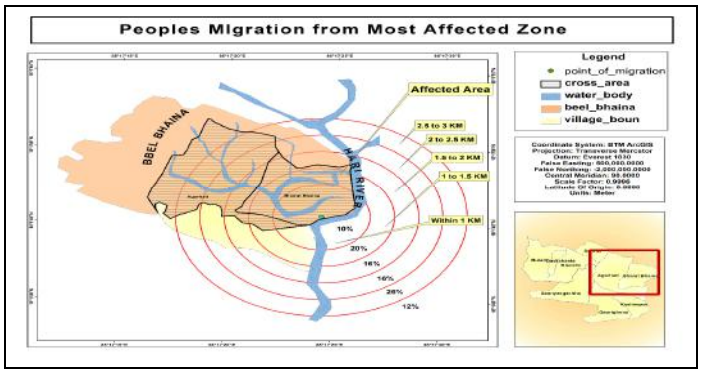
People then move back to their land. Under the changed hydrological situation, many tidal channels outside the polders started experiencing abnormal sedimentation blocking the drainage paths of the polders. Prolonged water logging inside the polders were so severe in some cases the people of the area had the only option of migration (Shampa and Pramanik, 2012:2). Most of migration has been taken place in Zone 1. It is obvious that this zone has been renowned as most effected zone. In Zone 3 there have the lowest number of migrated people. It is assumed that zone 3 is not mostly relevant to water logging problem. There is another problem which emerging with TRM. The problem is River Erosion. After TRM Around 61 % People shift their location within different radius. People were move from their location to new location around within 3km. highest percentage of migration took place in these radios. Then 2nd highest is within 1.5 km. in the figure, it is clear that the migration took place to the adjacent village Agarhati. Reverse migration took more than 2 years. Around 18% people claimed that.



Source: Field Survey, December, 2015
Figure 9: Migration of people in different zones

Migrated people move from distance from zone 1 to with other places. The below map will explain the details. Highest migration took within 3 km and 26% people migrate. That means most people migrate within the radios of 3 km.

From Group discussion, it is found that except TRM, poor people migrate mainly in monsoon when they have no agricultural work besides fishing. People have no choice rather than migration to search work. It should be mentioned that seasonal or temporary migration is not improving their economic condition.



Source: Researchers contribution, December, 2015
Figure 10: Identify the most migrated area from zone 1

Impact on hazard

Assessment of People's opinions is giving for different kind of hazards. In study area it is important to find out the most effected hazard which could possibly affect the people. So water logging problem gets the highest responses. For TRM practice people mostly feel water logging and salinity problem is emerging. This problem is supposed to reduce after implementing TRM but problem is still present. Third problem is River Erosion which induces after TRM. This causes loss of land in huge amount than before. Lots of people claimed there are being affected by losing land. For changing the topographical condition and reducing the amount of wet land, there is some place which faces drought problem now and then. Especially in the month of April to June, Flood is also found for tidal surge but the amount is not as noticeable.

Table 6: Hazard severity problem ranking

Criteria	Description	Remarks		
Peoples opinion	Assessment of People's opinions is giving for different kind of hazard problems	0-10=1 11-20=2 21-30=3 31-40=4 41-50=5	51-60=6 61-70=7 71-80=8 81-90=9 91-100=10	10= Highly importance, 1= Low importance
Affected area	different amount of affected area to different kind of hazard problems	0 to 5000 sq.m=1 5001 to 10000 sq.m=2 10001 to 15000sq.m=3		3= Highly Affected area, 1= Low affected area
Time duration	different time duration of different kind of hazard problems	1 month-4 month=1 5 month-8 months=2 9 month-12 months=3		3= Long term affected, 1= Short term affected
Income loss	the range of income loss with the percentage of people's number.	TK.500-1000=Less Loss=1 TK.1001-2500=Moderate Loss=2 TK.2500-5000=High Loss=3		3= High amount of loss, 1= Low amount of loss

According to importance of criteria, the weight has been provided. People's opinion has been collected primarily, affected area is collected with Focus group discussion and secondary data collection, and time duration is collected with focus group discussion and at the last loss of income collected with questionnaire analyzed data.

Table 7: Weighted according to priority basis

Criteria	**Weight according to priority**
Peoples opinion	40
Affected area	30
Time duration	20
Loss	10

So the final scoring has been provided with numerically to find out the top most important hazard. Final Scoring= Peoples opinion*40+ Affected area*30+ Time duration*20+ Loss*10

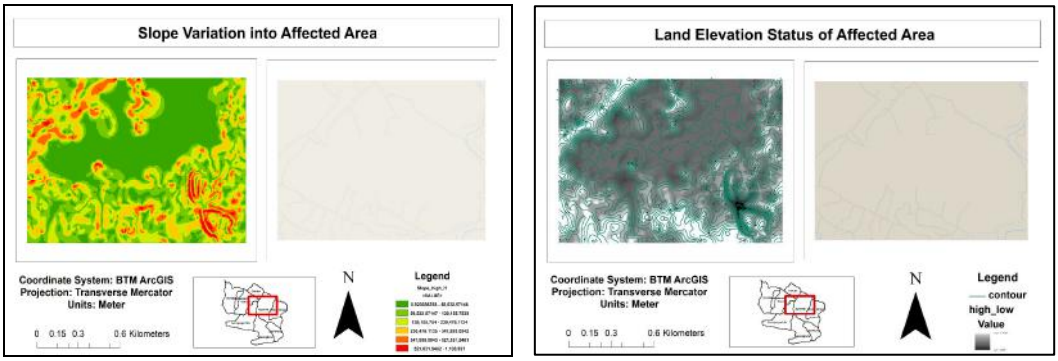
From the calculation it is found that the final score is highest for Water logging and lowest for flood.

Table 8: Scoring on problem based on different criteria and ranking

	Peoples opinion	**Affected area**	**Time duration**	**Loss**	**Score**	**Ranking**
Water logging	10	3	1	2	530	1
River Erosion	8	1	3	1	420	3
Salinity intrusion	9	2	3	3	510	2
Flood	5	3	1	2	330	5
Draught	6	2	2	1	350	4

Findings

Water logging in middle part is still present because of slope variation. The middle part of the Beel is 1 to 2m elevation. Maximum average land elevation is 1 to 5 m. Flow was come from upper side of the river; this upper side is accommodating another Beel, named Beel Khuksia. Beel Khuksia is still on the processing so there is still plenty of water logging which may turn this water to Beel Bhaina. In Beel area, the elevation has been only emerged the point of river water entrance and its some adjacent areas.



Source: Researchers contribution, December, 2015

Figure 11: (a) Green color reflects lesser slope and red color reflect greater higher slope.

That means in the middle portion land height is low and around the area land height is high, (b) Black color reflects the lower elevation and white color reflect higher elevation.

- Terrain website is also provided Elevation increases around 0 to 4-5m than previous elevation. This encourages people to build new settlement. Pucca housing is being double and kutcha housing is decreasing than before.
- Agarhati Village contain the larger number of people who affected by TRM than Bharat Bhaina. But the study shows that whole Bharat Bhaina Village is under Beel Bhaina boundary.
- Agriculture and shrimp farming is having an inverse relationship in changing their usage after TRM.
- People were move from their location to new location around within 3km. This migration has been occurred for avoiding water logging. After TRM Around 61% People shift their location within different radius.
- The amount of respondent outside Beel area also affected by River Erosion. Water logging and Flood is reduced but salinity, river erosion increased. For changing topographical condition and reducing wet land, some place faces drought problem now and then.
- Water logging problem getting highest response among all kind of hazard not only in public response but also other secondary issues of assessment.

Ultimate Results

Table 9: Positive and Negative Results

Criteria	**Impact (√)**	
	Positive	**Negative**
Land Use		
Settlement	√	
Commercial	√	
Agriculture		√
Social Factors		

Criteria	Impact (√)	
	Positive	Negative
Migration	√	
Communication	√	
Cultivation		
Agriculture		√
Shrimp	√	
Economic Factors		
Income	√	
Occupation		√
Market	√	
Environmental Factors		
Weather		√
Hazard	On the Basis of Problem Severity in Decreasing and Increasing	
	Decreasing	Increasing
Water logging		√
River Erosion	√	
Salinity intrusion	√	
Draught	√	
Flood		√

Conclusion

TRM is a long term process as it is affects the local people for a long time period after implementation of TRM. TRM is considered as people's traditional wisdom, tidal approaches seem to be an effective and sustainable way. TRM practice in Beel Bhaina impacts the local people's livelihood greatly. There is both positive and negative is present. At the ultimate results, there are 16 issues related to livelihood have been considered to assess the impact. But only six of them come out as negative and others appear as positive. So the impact of TRM is positive. With TRM there are some associated problems but these problems need attention to sustain the whole process of TRM.

There will be different types of impact on livelihood pattern for TRM practice. By considering all types of problems that people face for TRM, some recommendations are made below to recover the problem.

- Review previous practice of TRM
- Beel should cut in systematic way for covering maximum area.
- Try to include all kinds of people's opinion.
- Monitoring timeline has to be increased to get the information about uplifting of land inside Beel area.
- Construction process should implement by the local people.

- Tidal surge should be made by naturally. The tide must be allowed to enter and return to sea freely.
- In river basin at a time only one Beel should be used as tidal basin for TRM.
- Government should provide more financial support for affected people.
- Consultation and agreement process must be clear between concerned communities and affected landowners.
- Affected people should get proper compensation.
- Saline water intrusion should reduce.
- Provide crop compensation that could save the people from changing their occupation agriculture to shrimp.

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