

# Management Strategies of Abandoned Channels of the Sankosh River Basin in India

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## ABSTRACT

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The fluvio-dynamic characteristics of Sankosh river and its frequent changes and abandonment of courses counts for adequate academic importance from behavioural point of view of alluvial channels in the zone of sub Himalayan margin and the areas associated with abandoned courses in the lower course of the basin have significant importance from the socio economic and environmental point of view. Therefore, the attempts has been made to bring out some unexplored facts about the Restoration, conservation and management of abandoned channels which are supposed to be more useful to socio-economic development as well as risk reduction for human habitation and sustainable use of lands of the surrounding channels areas.

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## Introduction

An abandoned channel is an inactive channel, defined as a former stream channel through which water no longer flows. They are recognized as depression in the landscape and located at the position of a formerly active channel, though typically of considerably reduced width and depth.(Willem H.J. Toonen et. al., 2012). Abandoned channels result from the process of meander cut-off and channel belt avulsion. Abandoned channels are also important elements of alluvial river systems because these abandoned channels provide huge resources for habitation. But, abandoned channels are facing different kind of problems due to huge population pressure, land use change, climatic change and environmental change day by day. So, appropriate management and restoration mechanism is required to be implemented to regain and protect abandoned channels of the Sankosh River in the study area.

### Objectives:

- To find out various problems associated with abandoned channels in the study area.
- To implement appropriate management and restoration mechanism to regain and protect of the abandoned channels in the study area.

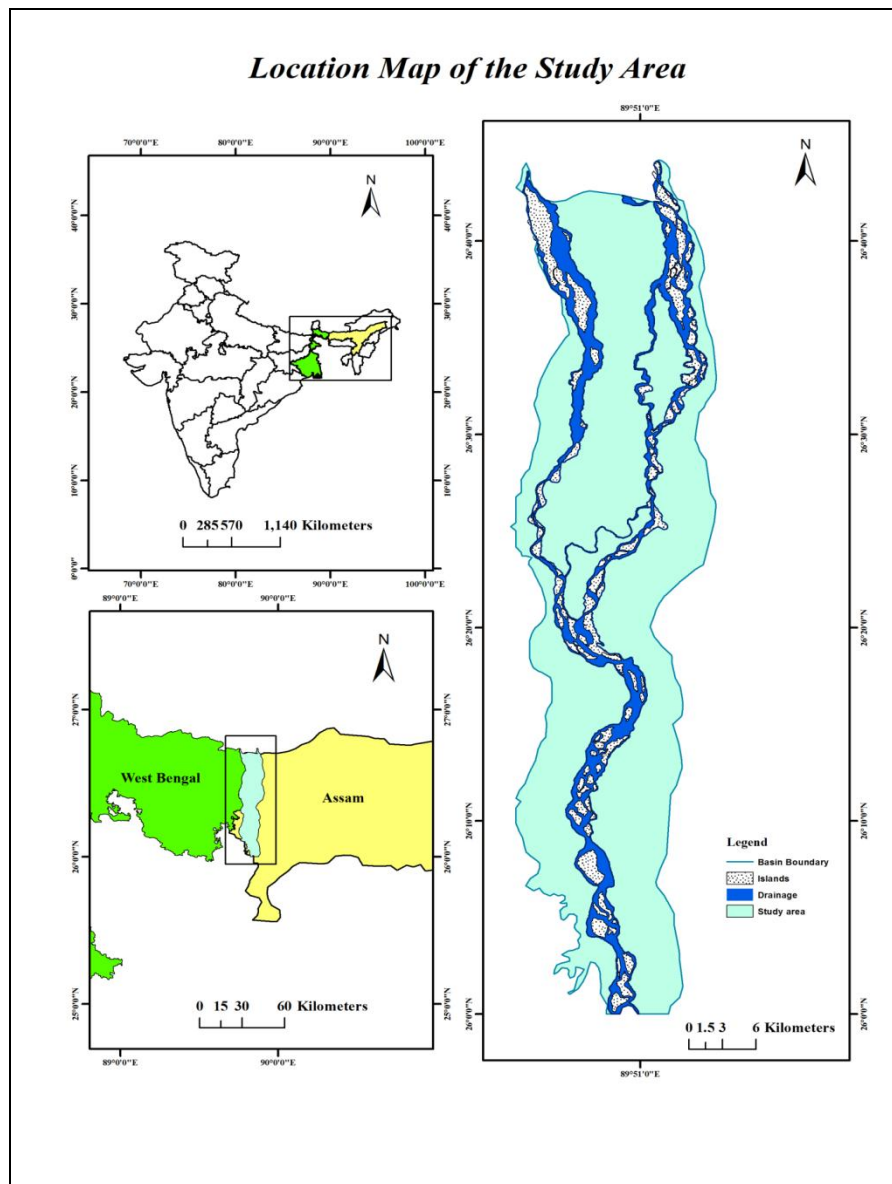
### Methodology:

Empirical and quantitative techniques of geomorphology will be applied according to the requirement. Various relevant

maps will be prepared by using geo-spatial techniques on the Remote Sensing and GIS platform. Quantitative and qualitative conclusions will be derived from systematic compilation processing and classification of information (generated by sample survey) and data.

### Study area:

Sankosh River is one of the major rivers of North Bengal and Assam in India. This river system has covered up its mountaineer parts of Bhutan, flown through undulating plains of North Bengal and Assam and finally entered into Bangladesh to find its confluence in Brahmaputra River. In Bhutan, it is called as the Puna Tsang Chhu, Sankosh in India and Gangadhar in Bangladesh. The northern limit of the study area started at 26°44'24" North latitude where it creates boundary between India and Bhutan, and the Southern limit ends with the boundary sheared between Bangladesh and India at 25°58'48" North latitude. The longitudinal extension ranges from 89°43'48" East to 89°55'12" East. The study area is covering an area of 1012 sq.km. The portion of this river basin falling within West Bengal and Assam is constituted of lower alluvial courses having significant dynamic fluvial characteristics for which frequent changes and abandonment of courses are manifested in the channel system which counts for adequate academic importance. Such changes of the river system have also sufficient social importance from the socio-economic point of view.



### Management strategies and recommendations of abandoned channels:

Abandoned channels are recognized as important elements of alluvial river system (Julian, P. et al. 2008) these abandoned channels provide huge resources for habitation of some organism having much economic value such as the cultivation of fishes and other aquatic resources. Moreover, abandoned channel areas and the substrate can be used for agricultural production of necessary crops and can also be used as the source of irrigation.

But, abandoned channels are facing different kind of problems due to huge population pressure, land use change, climatic change and environmental change day by day. In this regards, some major problems of abandoned channel of Sankosh River basin can be broadly summarized as,

- I. Shrinkage of channels area
- II. Hydrologic alterations, which includes changes in the hydrologic structure and functioning of channel by direct surface drainage, de-watering by consumptive use of surface water inflows, unregulated draw down of

unconfined aquifer from either groundwater withdrawal or by stream channelization for various human activities.

- III. Increased sedimentation, nutrient, organic matter, metals, pathogen and other water pollutant loadings from wastewater discharges.
- IV. Overexploitation of channels products
- V. More insidious chemical occurrences and deposition of pollutants into these water bodies mainly by both from the agricultural pollution, baths of different type's domestic animal.
- VI. Change in characteristic channel flora and fauna (exotic) as a result of change in the adjacent land uses deliberately or naturally, changing water quality, etc.

Based on the major findings of the study and above mentioned problems keeping in the mind, appropriate management and restoration mechanism is required to be implemented to regain and protect abandoned channels of the Sankosh River in the study area. In this regard, some important proposed

recommendations and management strategies are discussed in the following heads.

**Conceptual Framework for management of abandoned channels:**

This study summarizes the number of article and literature review regarding management of abandoned channel with several examples over the World. Abandoned channels need a collaborated investigation involving natural, social and interdisciplinary study aimed at understanding the various components, such as, monitoring of water quality, socio-economic dependency, biodiversity and other activities as an essential tool for formulating long term conservation strategies (Kiran et al., 1999).

In developing countries i.e. India have some different scope of effort emboldens, analysis and management of abandoned

channel due to high human population growth and economic development. By this drivers there have emerge some pressures including resource exploration, expansion of built up area, agricultural development, shifting livelihood pattern which make some changing scenario about physical, biological and socio-cultural attribute. This is urgent to take some necessary action or management to reduce ecological degradation of abandoned channels and reserve the socio-economic condition of the local people. In this context we need long term actions and conservation after sustainable use of abandoned channel and its restoration. It is most important to give main concern about systems that would have misplaced without any appearance of interference. A framework is to be developed with the objective that level of interventions required for prioritisation (Committee on Restoration of Aquatic Ecosystems et al, 1992).

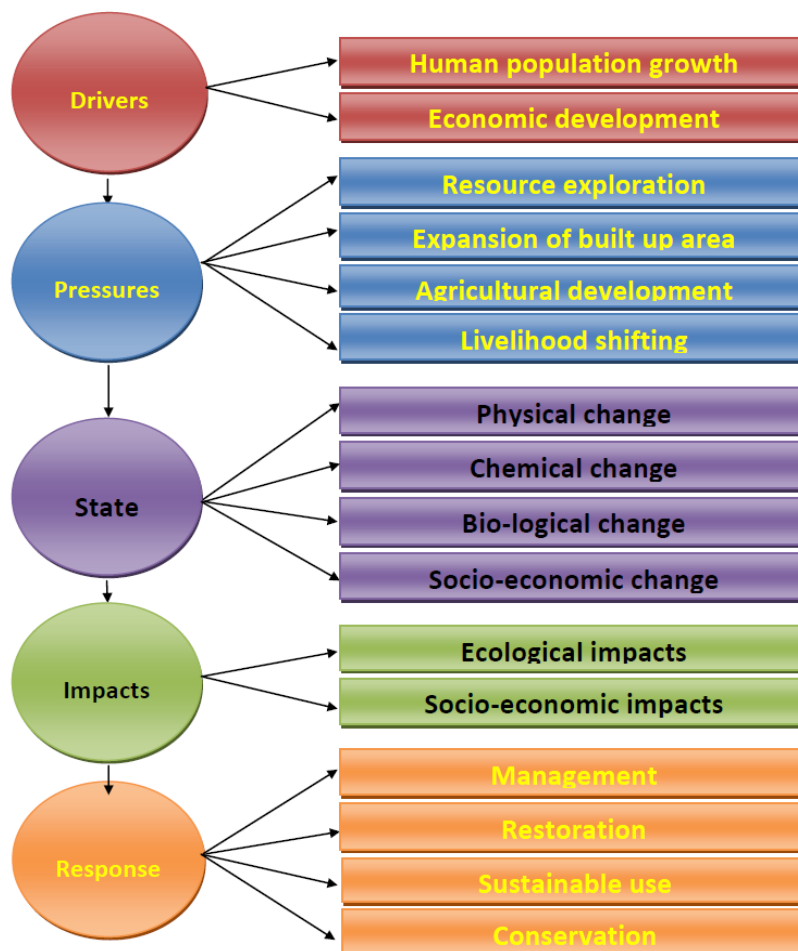


Figure: Conceptual frameworks for management of abandoned channel

**Guidelines for Abandoned Channels Management:**

The watershed management program generally involves activities to protect, restore, manipulate, and provide for the functions and values emphasizing both quality and acreage by advocating sustainable usage of them (Walters, C. 1986). Management of channel ecosystems requires an intense monitoring, increased interaction and co-operation among the various agencies (state departments concerned with

environment, soil, natural resource management, public interest groups, citizen groups, agriculture, forestry, urban planning and development, research institutions, government, policy makers, etc). There have some valuable guiding principle given below to manage, restore and conserve the abandoned channel.

- I. Such management goals should not only involve buffering channels from any direct human pressures

that could affect the channels normal functions, but also in maintaining important natural processes that operate on them that may be altered by human activities.

- II. Channel management has to be an integrated approach in terms of planning, execution and monitoring requiring effective knowledge on a range of subjects from ecology, economics, watershed management, and planners and decision makers, etc. All this would help in understanding channels better and evolving a more comprehensive solution for long-term conservation and management strategies.
- III. In this context it summarizes that there are multiple formation and problems are associated with all abandoned channel but it need some management effort which provide benefits to local people and long-term effectiveness.

### Restoration:

Abandoned channels are important elements of alluvial system. These channels can provide habitat for wildlife, biodiversity of aquatic habitat and huge natural resources for the livelihood of the local people. But there are some important problems such as shrinkage of abandoned channel area, reduce of water level, increase of non-point source pollution that can affect aquatic environment and resources of the abandoned channels. Moreover, these problems are also adversely impact on the socio-economic life of the local people inhabited surroundings of the studied abandoned channels. So, restoration of abandoned channels is essential to solve the above mentioned problems and to preserve them in the study area.

Restoration can be defined as returning to a pre-disturbance physical state (Burchsted 2006). In this regard *While, Wohl et al. (2004)* said that river restoration as assisting the recovery of ecological integrity in a degraded watershed system by re-establishing hydrologic, geomorphic, and ecological processes, and replacing lost, damages or compromised biological elements Different types of restoration efforts are associated with abandoned channel management. Restoration denotes re-establishment of pre-disturbed aquatic functions and the related physical, chemical and biological features (Cairns, 1988; Lewis, 1989) where aim will be emulating environmental and a self-regulating system that is integrated ecologically with the landscape and the functions the abandoned channels execute.

In this study it was typically found that most of the abandoned channel along the main stream i.e. River Sankosh has formed due to cut-off (Chute cut-off and Neck cut-off both) and avulsion also. In this regard there have some management practices to restore the abandoned channel. In this context engineering solution consist of Construction of weir, Hydraulic Dredging, Connectivity with main river are most impactful restoration methods to conserve the abandoned channel and beside of it some Agronomic method by BMP include Agriculture-stream buffers and bank stabilization,

preventing neck cut-off, erosion control are very important. In all of this cases all type of restoration have valuable benefits and effectiveness for the entire abandoned channels.

### Hydraulic Dredging:

Hydraulic dredging is an important restoration process or operation of excavating materials from a water environment for the purpose of improving existing water features. It helps to reshaping land and water features to alter drainage, navigability and use of aquatic resources for socio-economic development of the local people inhabited surrounding of the abandoned channels. It is also acted as to suck up and filter the bottom to remove contaminant and increase the depth of water level of the abandoned channels. Moreover in concern of environmental sensitivity, hydraulic dredging seems to be the more effective method to restore abandoned channels in the study area. Furthermore, the abandoned channels are experiencing undue macro-phytes and algal bloom, thus restoration strategy has been constructed to remove the organic, nutrient rich sediment and deepen experienced through Collins Lake is an oxbow lake along the Mohawk River in Scotia, New York through hydraulic dredging in 1977 and 1978 (Snow et al. 1979). It is best used for abandoned channel restoration technique. In this regard it is mentioned that Kamandanga beel and Khalishamari beel need to operate hydraulic dredging to restore the depth of water level and aquatic environment in the study area.

### Connectivity with Main River:

The hydrological connectivity of these studied abandoned channels usually decreases in time due to fast and complex sedimentation processes occurring in the upstream entrance and downstream exist of the abandoned channels in the study area. In this regard, numerous restoration projects can be applied to reconnect the upstream and downstream ends of abandoned channels to the main river to re-establish connectivity and enhance the quality of ecological habitat. (Holubova et.al., 1999; Simons et.al., 2001; Baptist and Mosselman, 2002; Yokoyama et. al., 2004). It is also mentioned that the morphodynamical behavior of the entrance and exit of the abandoned channels plays significant role in the success of such reconnection method in the study area.

Moreover, it notices that erosional and depositional processes are taking place in the exit of an abandoned meander or any avulsed abandoned channels where the exit is connected to the main channel, but the upstream entrance is closed. In such condition this method suitability applied to re-connect abandoned channels with Main River to restore them. Here Nayachhara and other avulsed abandoned channel can be mentioned to reconnect their upstream entrance with Main River.

### Best Management practices (BMP):

The main objective of Best Management Practices (BMP) is to implement edge-of-field practices and agronomic methods

including conservation of tillage and winter cover crops to reduce non-point source pollutants from agricultural run-off (Cullum et al., 2006; Knight et. al., 2002). In relation to this restoration program, BMPs helps in correcting point and non-point sources of pollution wherever and whenever possible and to restore aquatic environment including natural resources in the study area. This program along with the implementation of rules, regulations and planning strategy for wildlife habitat and fishes helps in arresting the declining water quality and the rate in loss of abandoned channels. It is also mentioned that intensive planning, leadership financial support and active involvement from all levels of organization (governmental, NGOs, citizen groups, research organizations etc.) are required to achieve the goal of this restoration program in the study area.

In the study area, BMPs can be applied in Khalishamari abandoned channel (Chute cut-off) to reduced sedimentation, nitrogen, phosphorous with the implementation of agronomic methods including crop rotation.

**Planning of buffer zones:**

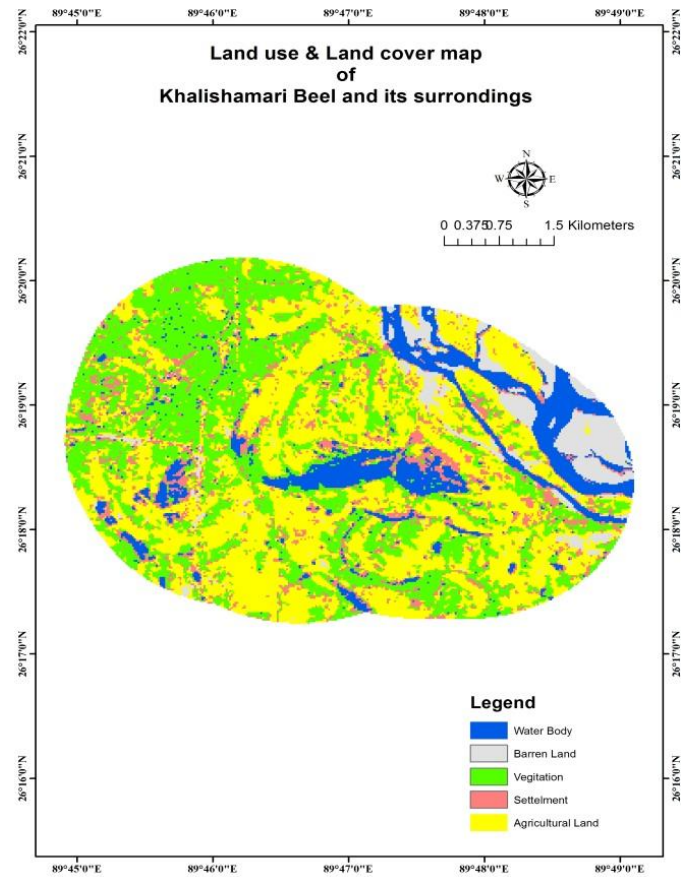
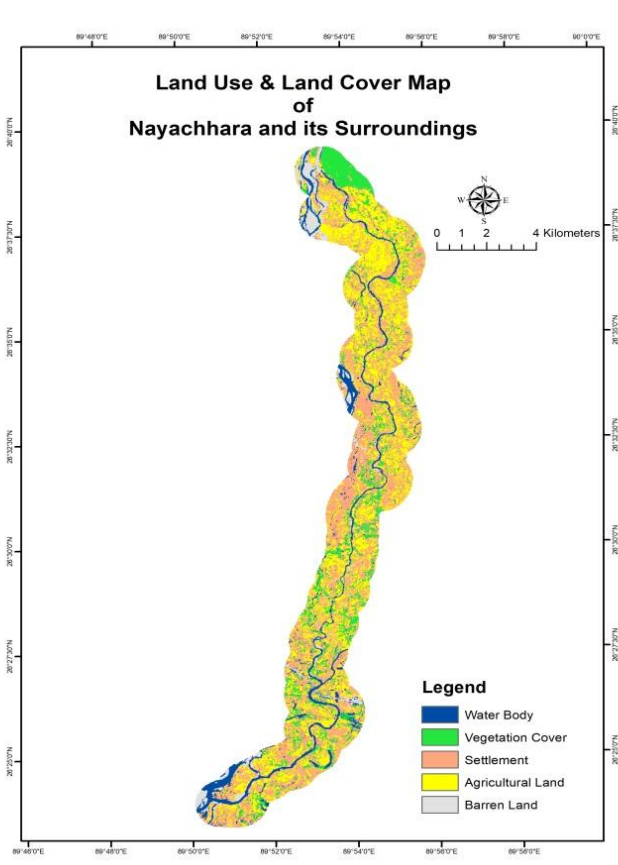
Creation of buffer zones limiting anthropogenic activities around the selected sites of the abandoned channels along the river Sankosh could revive their natural functions. In this

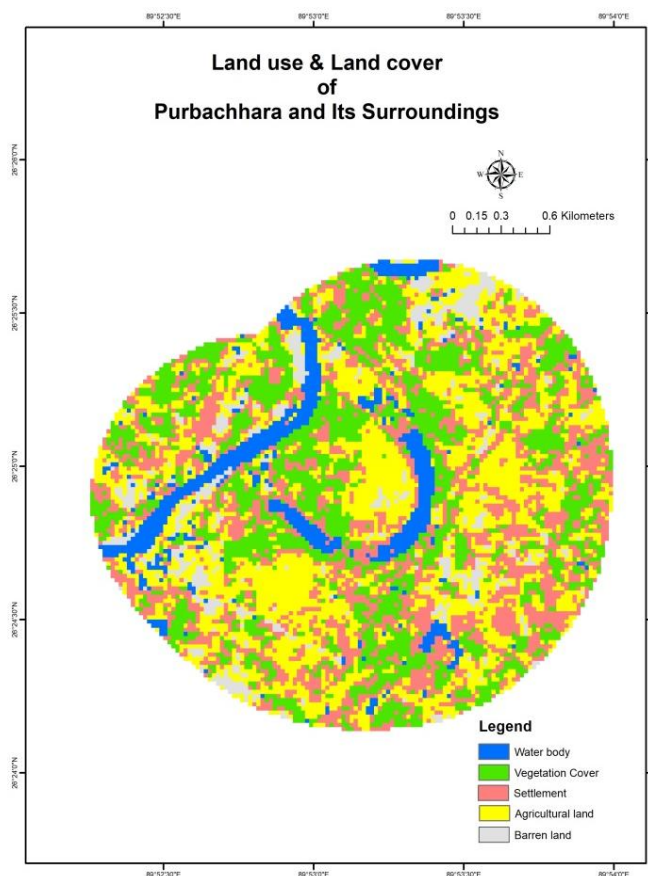
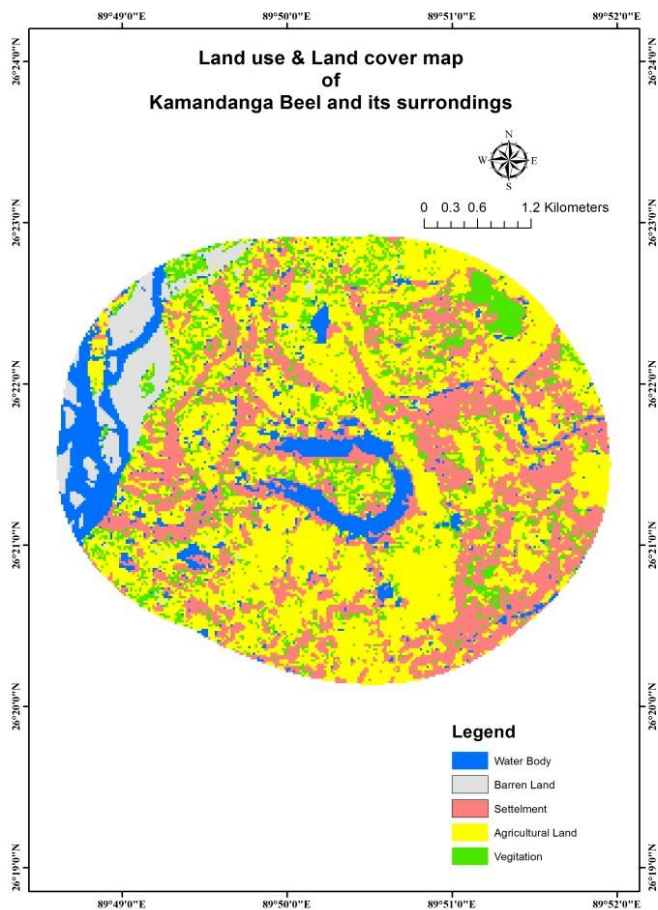
regard, Castelle et al., 1994 has mentioned some important criteria for determining adequate buffer size to protect various abandoned channels and their aquatic resources. These are as follows:

- Identify the functional values by evaluating aquatic resources within the abandoned channels in relation to their economic cost.
- Find out the magnitude and source of disturbances, landuse and identify the possible consequences of identify the possible consequences of such stress in long term perspective.
- Buffer characteristics such as vegetation density, structural complexity, soil condition and other condition are taken to be as consideration.

During the field study it is observed that some areas of Khalishamari beel especially north-western part are occupied by local people for their agricultural land and settlement. In this regard buffer zone can be played an important role to restore the surrounding or peripheral areas of these abandoned channels. On the other hand, western part of Kamandanga beel is also settles them. So, creation of buffer zones can reduce agricultural land and settlement human impacts by limiting easy access and acting as a barrier.

*Identified abandoned channels and their status in the study area*





**Remedial measures for conservation of abandoned channels:**

Conservation is the term associated with manipulation of an ecosystem to ensure maintenance of all functions and

characteristics of the specific ecosystem. So the balance of ecosystem of any particular water body is usually accompanied by irreversible loss in both the valuable environmental functions and amenities important to the society.

**Table: Summary of problems and prospects of abandoned channels**

Abandoned Channel	Parent River	Type	problems	Restoration	Benefits and Effectiveness
<i>Khalishamari beel</i>	River Sankosh	Natural chute cut-off	<ul style="list-style-type: none"> <li>• Sedimentation</li> <li>• Excessive Agriculture</li> </ul>	<ul style="list-style-type: none"> <li>• Construction of weir</li> <li>• Hydraulic Dredging</li> <li>• Agriculture-stream buffers and bank stabilization</li> </ul>	<ul style="list-style-type: none"> <li>• Prevent flow as secondary channel and flood control</li> <li>• Agriculture and fishing</li> </ul>
<i>Kamandanga beel</i>		Natural Neck cut-off	<ul style="list-style-type: none"> <li>• Built-up encroachment</li> <li>• severe erosion due to neck cut-off</li> </ul>	<ul style="list-style-type: none"> <li>• Prevent neck cut-off</li> <li>• Erosion control</li> </ul>	<ul style="list-style-type: none"> <li>• Agriculture, Livestock grazing and fishing</li> </ul>
<i>Purbachhara beel</i>		Natural Neck cut-off	<ul style="list-style-type: none"> <li>• Excessive Agriculture</li> </ul>	<ul style="list-style-type: none"> <li>• Agronomic method by BMP</li> </ul>	<ul style="list-style-type: none"> <li>• Agriculture, Livestock grazing and fishing</li> </ul>
<i>Nayachhara beel</i>		Natural Avulsed channel	<ul style="list-style-type: none"> <li>• Seasonal dewatering</li> </ul>	<ul style="list-style-type: none"> <li>• Construction of weir</li> <li>• Connectivity with main river</li> </ul>	<ul style="list-style-type: none"> <li>• Agriculture, Livestock grazing and fishing</li> <li>• flood control</li> </ul>

Source: Data compiled by Author.

In this context a detailed study of channel management, conservation and its implications are required for socio economic development and as well as from the biological and hydrological perspective.

In this regard, it is summarized that some important measures must be taken for the conservation of studied abandoned channels. These are as follows:

**Firstly**, to determine the sedimentation rates and evolutions along the main stream by collect sediment core samples.

**Secondly**, to analyse topographical maps, satellite images and aerial photographs over different time period.

**Thirdly**, need to assess the aquatic resources i.e. flora and fauna specially and maintains its biological importance.

**Fourthly**, the study area surrounded by abandoned channels needs monitoring about water quality to improve biological diversity and identifying the sources of pollution.

**Fifthly**, restoring the riparian agricultural land adjacent to abandoned channels to reduce inundation and sedimentation and provide bank stabilization.

**Sixthly**, According to Morken and Kondolf, 2003 to restore the abandoned channel in addition a short term fix might be providing connection to the main stream by previous path i.e. nearby abandoned channels plug bar.

**Seventhly**, to identify the functional and economic values by evaluating natural resources generated by abandoned channels in terms of the economic costs and its benefits.

**Eighthly**, the study needs some conservation strategies to protect and restore the abandoned channel as its possessing appearance.

### Conclusions

Abandoned channels are also important elements of alluvial river systems because these abandoned channels provide huge resources for habitation. But, abandoned channels are facing different kind of problems due to huge population pressure, land use change, climatic change and environmental change day by day. Therefore, the attempts has been made to bring out some unexplored facts about the Restoration, conservation and management of abandoned channels which are supposed to be more useful to socio-economic development as well as risk reduction for human habitation and sustainable use of lands of the surrounding channels areas.

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