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Influences of Inlet-Outlet System in Santijan Stream of Nagaon, Assam (India): Degradation Issues and Geo-Environmental Challenges

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ABSTRACT

The present study explores the stream Santijan and emphasises its substantial livelihood potential and the various management issues in the upcoming days. Many streams, rivers and other riverine ecologies are rich in many biological diversities. However, due to the increasing amount of human creations may create a drastic change in the stream character. This study will provide some data and information to the upcoming researchers in the field of dying streams and their connectivity with feeder channels in the Brahmaputra Valley. This study will reveal the context of the degradation of the stream, and accordingly, the government and allied agencies concerned will come to know about the serious issues related to the stream. Thus, this study will also arouse public awareness to save the stream.

Keywords: *inlet-outlet system; water-logged areas; geo-ecology, degradation; Santijan*

Introduction

The natural environment gets degraded due to an increase in the world's total population (Huang and Nanson, 1997) and many human-induced activities (Singh, and Mishra, 2014). As a result technological advancement, which create a drastic effect on the physical features of the earth's surface, like- water bodies, forest cover, agricultural land, plant and animal kingdoms etc. (Szocs *et al.,* 2017). Among the natural features, the water bodies specially the rivers, streams, wetlands, suffer the most from the human -induced activities (Raymahashay, 1973).

Assam is a state of rivers. Mainly the mighty river Brahmaputra and Barak are the two important rivers of Assam which create two major valleys. This study is confined to the Santijan stream which falls in the central Brahmaputra valley in Assam. The inflow and outflow routes of water to the Santijan stream are connected with Brahmaputra River by some feeder channels, which control the ecology and fluvial-geomorphology of the stream (Bhuyan, and Deka, 2024). Besides natural factors, the anthropogenic factors are no way less important for causing degradation to river or stream and their ecology (Bhuyan, 2016). Embankments (locally called Mothauri) constructed without proper planning and capture the land of stream channel leading to transformation into fisheries or agricultural fields (Deka and Bhagabati, 2015) which act as the major ways of human interference leading to decrease in stream bed areas and amount of water (Beschta and Platts, 1986). The connectivity of the small stream with the main course of the river may also be adversely affected by human encroachment.

In some portion of the study area, Santijan seems to be a waterlogged or wetland area (Figure 6). Therefore, now Santijan is locally known as 'Santijan

Beel'. The growing intensity of human use of land, water and aquatic resources of Santijan has posed a serious threat to its ecology and biodiversity status. It has been observed that a variety of plant and animal species are on the verge of extinction which obviously calls for some strategic measures to protect and conserve the stream. In view of the human-induced factors faced by the Santijan, there arises an urgent and immediate need to save the stream from being further degraded. Thus, the present study is taken up as a research problem.

Materials and Methods

Study area

The study area is situated in the historically and culturally famous village called Batadraba (Bordowa) where Mahapurush Srimanta Sankardeva was born. The study area falls in the district of Nagaon, Assam under the Dhing Revenue Circle at a distance of 20 km. from the Nagaon town. The study area covers an area of 81.96 sq km with latitudinal extension of 26°21′12" North to 26°28′33" North and the longitudinal extension of 92°28′59" East to 92°35′10" East. The study area surrounded by villages like Meleka Dhing, Sonaibera Gaon, Sola Pathar, Rampur Satra and Kadamani Gaon in the North, Haidubi Pathar, Keri-Meri, and Batamari village in the North-East, Bhumura Guri in the East, Dhania Bheti Pathar, Dhania Bheti Gaon and Kuji Satra in the South and Dhupa Guri Gaon and Batadraba in the West. Its location with reference to Nagaon District, Assam and India is presented in Fig. 1. The entire Santijan has a total length of 13.3 km.

Study method

The stream named 'Santijan stream' has been chosen for study as because it is historically known and presently the stream is getting gradually degraded due to various types of human interference. The relevant secondary data are collected from various secondary sources like- cadastral maps obtained from the D.C. Office of Nagaon District to find out the course of the stream. Based on toposheets from the University of Texas Libraries during 1955 and Survey of India toposheet 2005 to show the inlet and outlet system of Santijan.

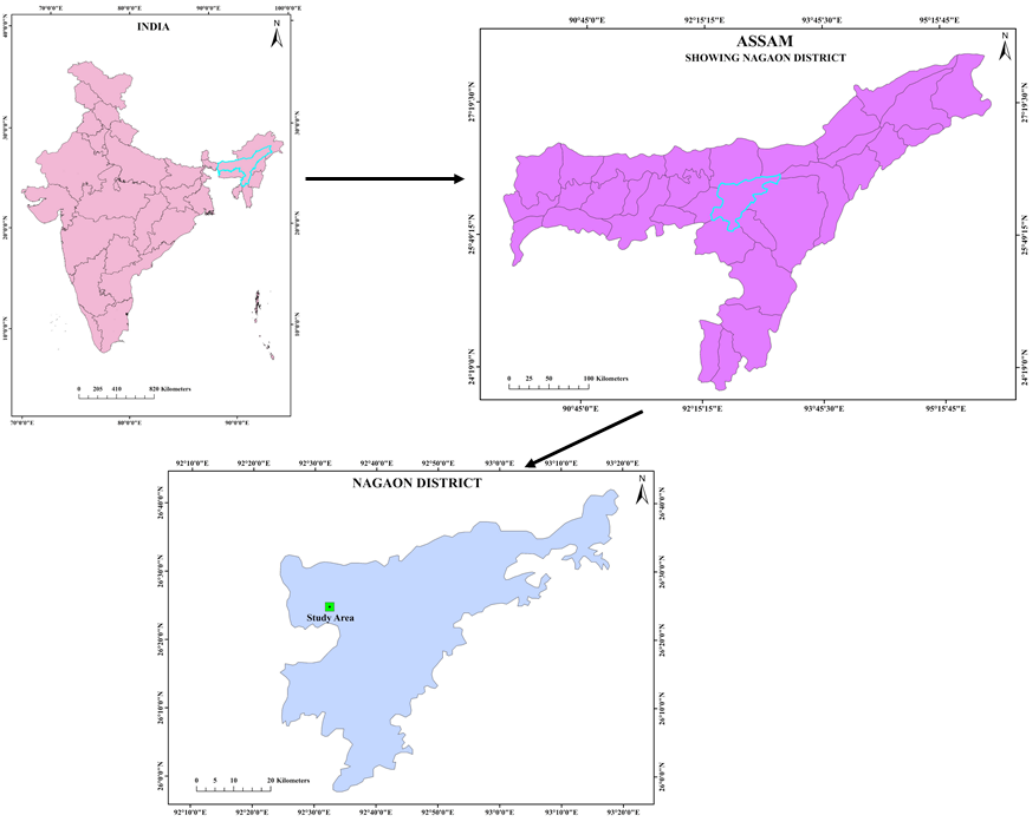

Fig. 1. Location map of the study area along with its location with reference to Nagaon district, Assam and India.

To know the problems of the degrading stream, some review of relevant literature has been done. In this context different books, academic journals, research publications, articles have been consulted. For better understanding, assessment, analysis and formulation of the problem, data and information have been collected with the help of GPS survey, personal interviews, field observation and discussion with the villagers and inhabitants. During the field work carried out in winter and summer seasons, the required data, facts, information, photographs are documented for further analysis.

After the collection of data and information from both primary and secondary sources, it has processed and tabulated using different statistical and computer-based methods (Microsoft office excel, Microsoft Word), Advanced methods like GIS and Remote Sensing are used to prepare maps and to formulate the proper strategies for conserving Santijan.

Fig. 2. During field survey.

Results and Discussion

Inlet and Outlet system of the Santijan

The inlet system of Santijan during the year 1955 was totally different from that of the year 2005 as vivid from the Figures 3 and 4. In the earlier year Santijan got water from the stream Rasuti Jan which was also connected to the Mora Leteri river. But due to the increase of human activities and associated extensive anthropogenic interferences and natural activities the connecting channel of Santijan has diverted its course from Rasuti Jan to Mora Leteri river. Therefore, since 2005 onwards Santijan has been receiving water directly from Mora Leteri river flowing in the north side of the study area (Fig. 5 and Fig. 6). As can be seen from the map of 1955 the water entered into Santijan and the last point of the inlet system of it was near the village Batadraba. Moreover, the upper portion of the inlet system of the Santijan has changed and last point of the inlet system got connected with marshy and swampy areas of villages like Dhania Bheti Pathar and Dhania Bheti Gaon.

As regards the outlet system of Santijan, some significant changes have also been observed. In 1955 the outlet system of Santijan was on the southern most portion of the stream near the village Batadraba. That portion of Santijan was also connected with Goroimari *Beel* which is not under the present study area. The stream which was interlinked with many *beels* (wetlands), receives flood water of Brahmaputra during rainy season. The surrounding wetlands and the stream have joined together and flowed from north to the south-west direction of the study area.

But, the outlet system of Santijan as seen from the year 2005 to till present has changed significantly. The confluence point of the stream is now found connected with Mora Leteri river flowing down from north to south along the villages Haidubi Pathar, Batamari, some parts of Bhumura Guri and Batadraba. The stream then gets merged with marshy, swampy areas and ponds and fisheries of Dhania Bheti Pathar and Dhania Bheti Gaon. Due to the blockage caused by the marshes, swamps, ponds and fisheries of the localities Santijan has lost its old outlet course which existed during 1955 and connected with Goroimari *beel*.

That is why, it can be said that now the mouth of Santijan or the last outlet point, the Santijan gets

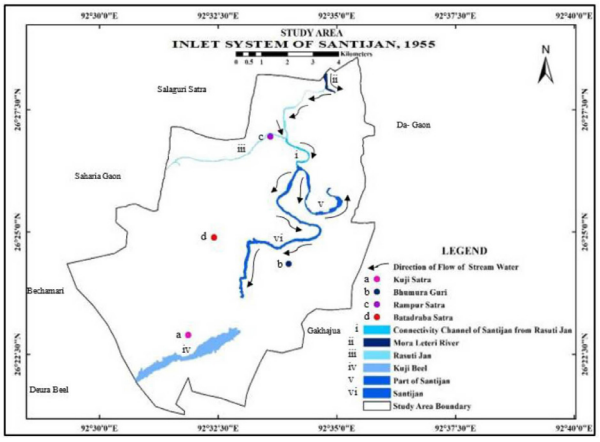

Fig. 3. Inlet system of Santijan, during 1955.

merged with the ponds, fisheries, marshes and swamps localized near the villages of Dhania Bheti Gaon and Dhania Bheti Pathar.

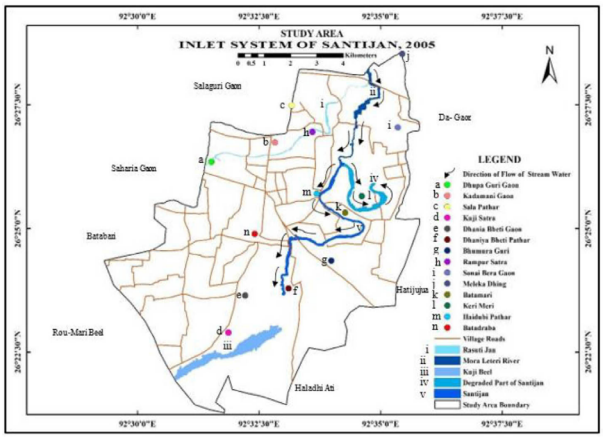

Fig. 4. Inlet system of Santijan from 2005 to till the present.

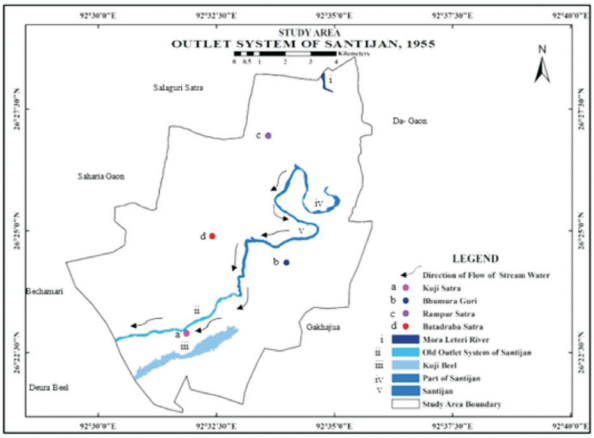

Fig. 5. Outlet system of Santijan, during 1955.

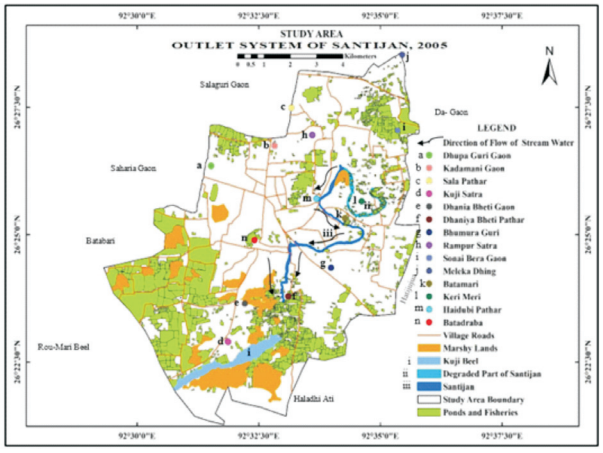

Fig. 6. Outlet system of Santijan since 2005 to till present.

Fluctuation in Hydro-Ecological Characteristics

With the help of Google Earth Pro and the GPS survey the values of altitude and length are calculated. From the data base of altitudes and length from its source to the mouth we see that the channel gradient or the slope of the particular stream is smooth not rough. The highest elevation on its source or the upper course (the connecting point with Mora Leteri river under the Meleka Dhing revenue village) is only about 67 meters and in the middle course it is nearly 62 meters and lastly in the mouth or lower course it is nearly about 60 meters (under the Dhania Bheti Pathar revenue village). The erosional and depositional activities are less because it is a small stream and the discharge of water is very less. After the year 2005, due to the human interventions the flowing capacity of this stream is also goes down. The physiography also falls under the flood plain area of Brahmaputra River that is why the longitudinal profile of the stream is also very smooth.

On the same way, Water level of a particular river or stream also depend upon the availability of water in that particular water body. An attempt has been made to analyse the depth and water level fluctuation patterns in Santijan during winter and summer seasons. For this purpose, three locations across the stream are selected. From the figures it is seen that there are some differences in the water depth and water level fluctuation in the winter and summer seasons in Santijan. With the help of line graph the differences in width, depth and the changing water level in season wise are presented (Figures 7 and 8).

Many aquatic species are also found in Santijan. It is important to mention here that about 4/5 decades ago when the embankments were not constructed there was river dolphin in this stream. The

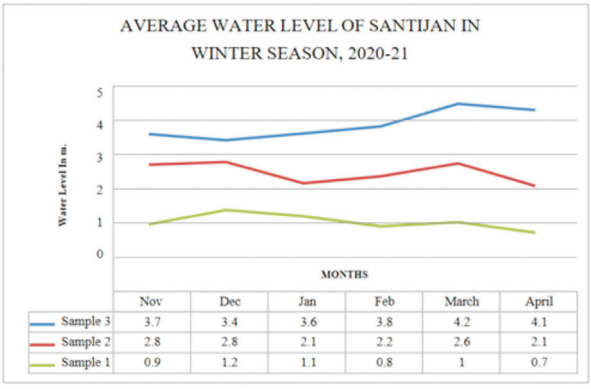

Fig. 7. Average water level of Santijan in winter season, 2020-21.

Table 1. Average Water Level of Santijan in winter season, 2020-21.

Months	Average Water Level in m.		
	Sample 1	Sample 2	Sample 3
Nov	0.9	2.8	3.7
Dec	1.2	2.8	3.4
Jan	1.1	2.1	3.6
Feb	0.8	2.2	3.8
March	1	2.6	4.2
April	0.7	2.1	4.1

Source: Field survey carried out by the student.

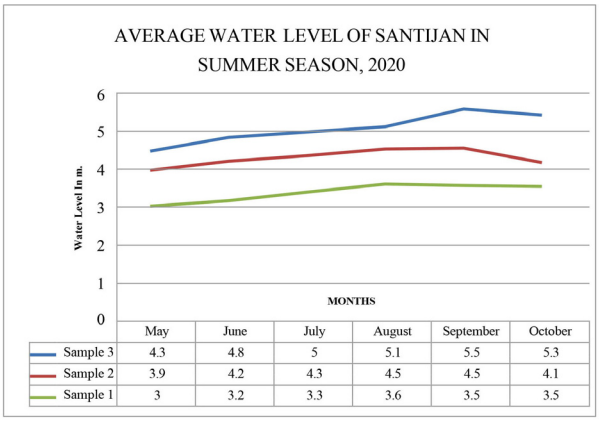

Fig. 8. Average water level of Santijan in summer season, 2020

Table 2. Average Water Level of Santijan in summer season, 2020.

Months	Average Water Level in m.		
	Sample 1	Sample 2	Sample 3
May	3	3.9	4.3
June	3.2	4.2	4.8
July	3.3	4.3	5
August	3.6	4.5	5.1
Sep	3.5	4.5	5.5
Oct	3.5	4.1	5.3

Source: Field survey carried out by the student.

embankments have divided the feeder channels which connected the Santijan stream with the Brahmaputra. But, there is only the underground flow between the Brahmaputra and the connecting feeder channels due to which Santijan stream does not dry out much in the winter or during dry seasons. In recent years, the Santijan has been heavily interfered by human activities which have transformed this living stream into a dying stream. Long years ago tortoise were also found in the stream, but presently these are not available in the stream. Moreover, when the embankments were constructed and the connectivity of the stream with the river Brahmaputra is delinked, the species earlier available are now not found there. On the other hand, due to overpopulation on the two banks of the stream and increasing water pollution, many aquatic plants like *Kolmou (Ipomoea aquatica), Dhekiya (Diplazium esculentum), Pani kaduri (Alternanthera philoxeroides), Leheti xak (Hydrolea zeylanica)* are disappearing day by day. But in recent times there are seen only Pani Meteka *(Pontederia crassipes)* due to waterlogged condition. There are also not to be seen any migratory birds which were abundantly seen ten years back. About a decade ago, many migratory birds like *Sorali Hanh (Dendrocygna javanica), Dauok (Amaurornis phoenicurus),* Gonga Siloni (Chroicocephalus ridibundus), *Raj Hanh (Anser anser), Konamusori (Ardeola grayii)* were also found swimming, playing and collecting food in Santijan, which is now a memorable scene only. Some types of fish species which found in the Santijan- *Xol* (Channa maurulius), *Patitmutura* (Glossogobius giuris), *Puthi* (Puntinus sp), *Mowa* (Amblypharyngodon mola), *Bami* (Anguilla bengalensis), *Gagol* (Mystus cavasius), *Naro* (Labeo bata), *Neriya* (Clupisoma garua), *Selekona* (Chela atpar), *Tura* (Macrognathus aral), *Koliya Jaro* (Labeo calbasu) are rarely seen in recent years.

Bio Degradation and Conservation Issues

During the present times, the land use and land cover in and around the stream Santijan and surrounding villages have changed drastically due to highly growing population. The human beings were directly and indirectly dependent on the riverine environment and natural resources. In earlier times, it was a natural process. But due to the change of economy and population the depending process has changed. Due to the over population in the area, people are established their household infrastructures and enlarged their families on the stream bank side areas because of the fertile soil for the agricultural activities. Some of them are also using the stream as an economic source for their income utilizing its channel and modifying the channel flow. Some are creating water-logged areas on the channel, especially for fisheries. As a result, the impacts are seen in the stream ecosystem. Several key areas of human impact on the stream ecosystem are likepollution, flow modifications, exotic species, resource harvesting etc. Results of the human interfer-

ence faced by the stream Santijan are at a high amount. It has faced enormous changed specially on its bank side due to the creations of ponds and fisheries. Some areas of the banks are also converted to agricultural field due to modification and converting channel to the other route. While taking consideration from 1955s to the present-day situation, it seems that there are drastic changes on the banks through conversion to agricultural lands, waterlogged areas and so on. In earlier times, people did not know about the advance techniques for the diversion of channels etc. and used some naturally available tools and technology to meet their needs and ecofriendly adjustment with the riverine ecology. Due to the use of the naturally available tools and methods the stream had not faced any drastic change and other fluvial problems. But now, the scenario has totally changed due to use of technological and advanced tools. In some portions of the stream, the people have used JCBs for digging the artificial ponds and fisheries for profit-making commercial purposes on the both sides of the banks. Some have used plastic bags and other technology for the construction of embankments to expand their agricultural lands. Some farmers have used high amount of fertilizers in their agricultural land situate on the both sides of the bank, which are very harmful for the aquatic species present in and around Santijan stream. In the past, there were no such interventions and as a result, the flood entered easily to the agricultural fields and also easily going out. Due to this process the agricultural fields could maintain the fertility of the soil.

In Santijan, there is rampant human encroachment for the purpose of exploitation of fishes and other bio-resources directly or indirectly. They use to catch fishes with the help of various types of plastic and nylon nets. With these nets fishes from very small to large are caught. That is why, day by day many species of fishes are going to be endangered in Santijan.

Conclusion

The foregoing discussion entails a detailed description of the mechanism of inlet and outlet systems in Santijan stream of Nagaon, Assam. The particular stream faces many anthropogenic activities like human encroachment in the both bank sides, making improper embankments, fisheries, use of pesticides and insecticides in the agricultural fields near to the stream, the unwise practice of fishing by nylon nets which are threatened condition to the stream ecology and biodiversity. To resolve these types of alarming condition of the stream there must be happen public awareness programmes in the native villages. It is the time to make collective participation and efforts at community level to conserve it by all means and mitigate the upcoming threats to the stream. The Government of Assam, other NGOs and stakeholders should take some important steps for its development and conservation policies at ground level.

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Conflict of interest

The authors declare no conflict of interest.

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