Assessment of riparian buffer zone of Chandni Nalla-A stream in Narmada Basin, India

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ABSTRACT

Riparian buffer zones are the linear bands of permanent vegetation along a river or stream. These zones in any aquatic ecosystem provide organic matter to the water body used as food by the organisms living in and also provide thermal protection to the aquatic organisms likes fishes, benthic animals etc. In recent years these areas are dwindling and causing serious ecological problems in streams and rivers. The present study was aimed to assess the condition of riparian buffer zone and floodplain area of Chandni Nalla a tributary of River Narmada in the central zone which joins from right bank. To achieve the target a rapid on-foot survey was carried out on the left and right banks of the stream. The survey revealed that the riparian buffer zone was dominated with agricultural practices on the both banks covering 80% land followed by a little percentage of vegetation covering 10% and 11% land on the left and right banks respectively, pasture land covered 5% land approx and 3% land was under erosion. This shows that the riparian buffer zone of the Chandni Nalla is in disturbed condition and less vegetation along the stream banks may cause degradation of stream ecosystem and the aquatic life.

Keywords: Riparian buffer zone, Chandni Nalla, Section, On-foot survey.
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INTRODUCTION

Rivers play a great role in providing natural resources and are also known for their role in providing transportation, energy, diffusion of wastes and recreation (Naiman and Bilby, 1998). Now a days, they are influenced through various activities occurred by humans in form of settlements, conversion of forest land into agricultural land and many more which affects the quality, character and behavior of its catchment area which cause adverse effect on flora and fauna (Raven *et al.,* 1998). Riparian zones are the important interfaces between terrestrial and aquatic ecosystems. Vegetation found in this zone plays an important role to manage and balance various abiotic and biotic factors as well as provides a number of ecosystem services such as reducing the sediment run off and many more (Fisher *et al.,* 2000). It also provides organic matter to the stream water which acts as a source of nourishment for the aquatic organisms by supplying plant detritus as food source which is helpful to support healthy aquatic ecosystems (Hynes, 1963). Destruction of riparian buffer zones reduce wildlife habitat and corridors (Sweeney *et al.,* 2004), which put direct effect on stream including loss of organic inputs (woody debris, leaf litter and dissolved organic carbon), reduction of shading which effects stream temperature and reduced buffering from pollutants (Naiman and Décamps, 1997). Keeping this in mind present investigation was planned during which assessment of riparian buffer zone of Chandni Nalla was carried out to observe the cause of degradation through human interferences, this study has its own significance because in the central zone of River Narmada this tributary holds a vital position in terms of quality and quantity of its hydro-biological attributes. Floodplain areas are permanently wet area and can be distinguished from land subject to temporary, albeit sometimes prolonged, inundation

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resulting directly or indirectly from a rise in river level and tend to be highly productive ecosystems and have long been utilized for production of food and fiber and harvest of wild plants and animals. The floodplain is often desirable for farming and livestock production (Vyas *et al.,* 2012). During the survey, floodplain areas of this tributary were studied separately to know how much these areas are degrading through human interventions.

MATERIALS AND METHODS

Study area
Chandni Nalla is a seasonal stream which lies in the central zone of River Narmada and its catchment covers two districts i.e. Sehore and Raisen of Madhya Pradesh, India. The stream joins River Narmada near Hirani village from right bank (Figure- 1). The total length of stream from origin up to the confluence is 29.35 kms. It lies in the foot hills of Vindhyan *(Vindhyachal)* range and some of its watershed area comes under forest land cover. Base map of the study area is shown in Figure- 2.
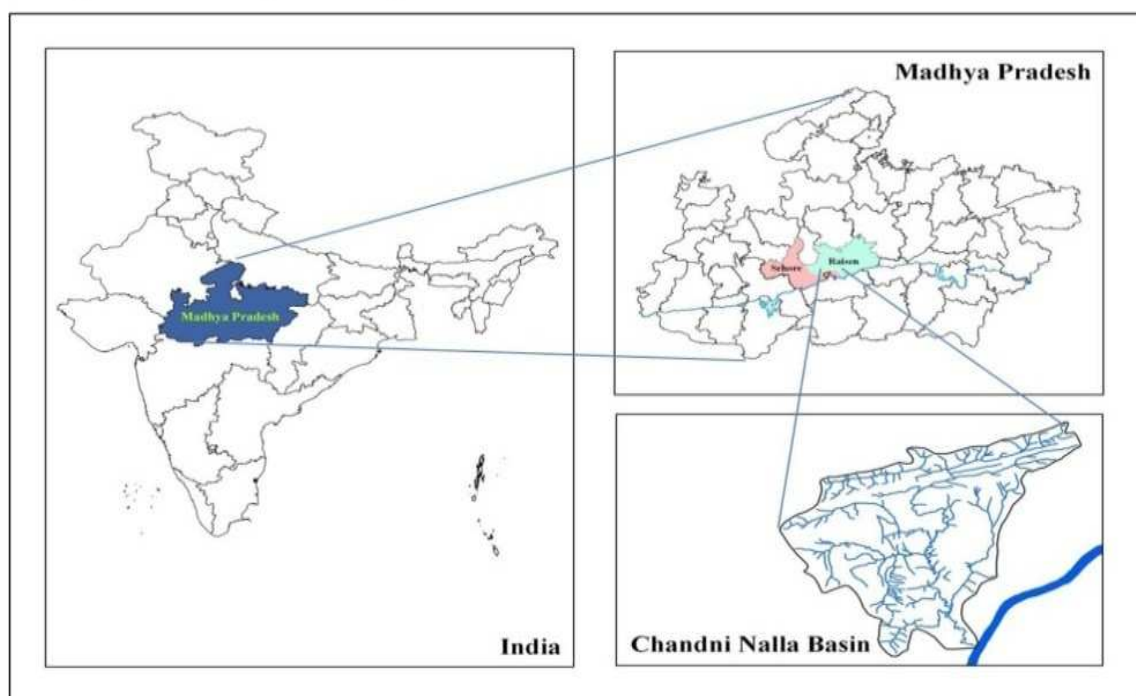
Figure- 1: Location map of the study area

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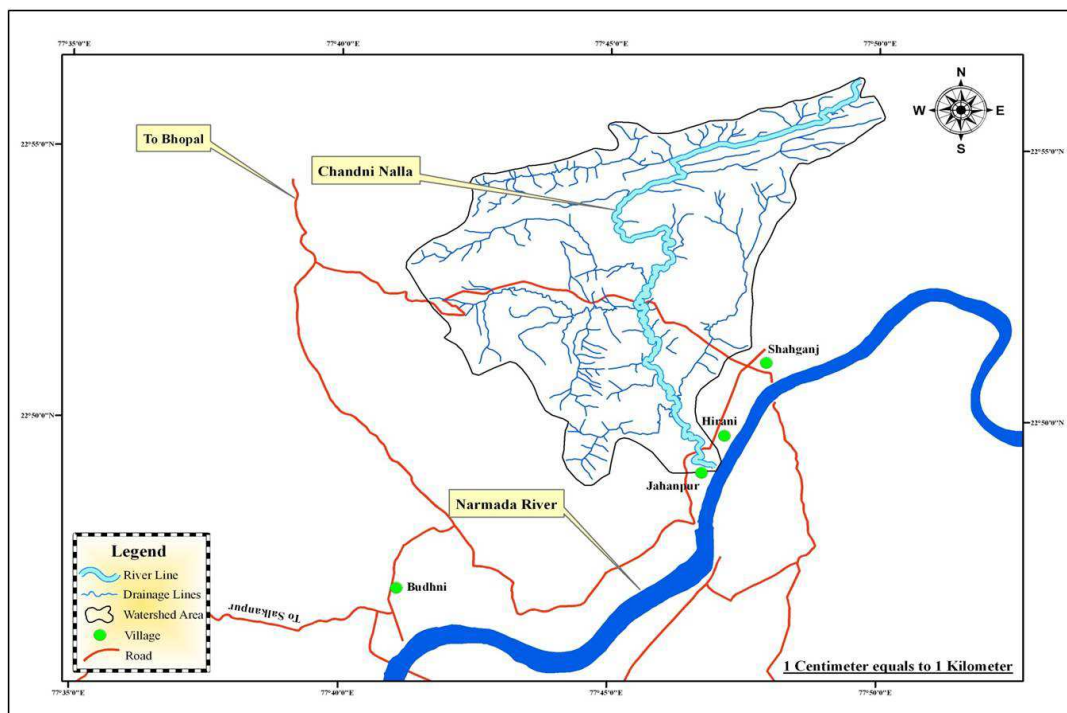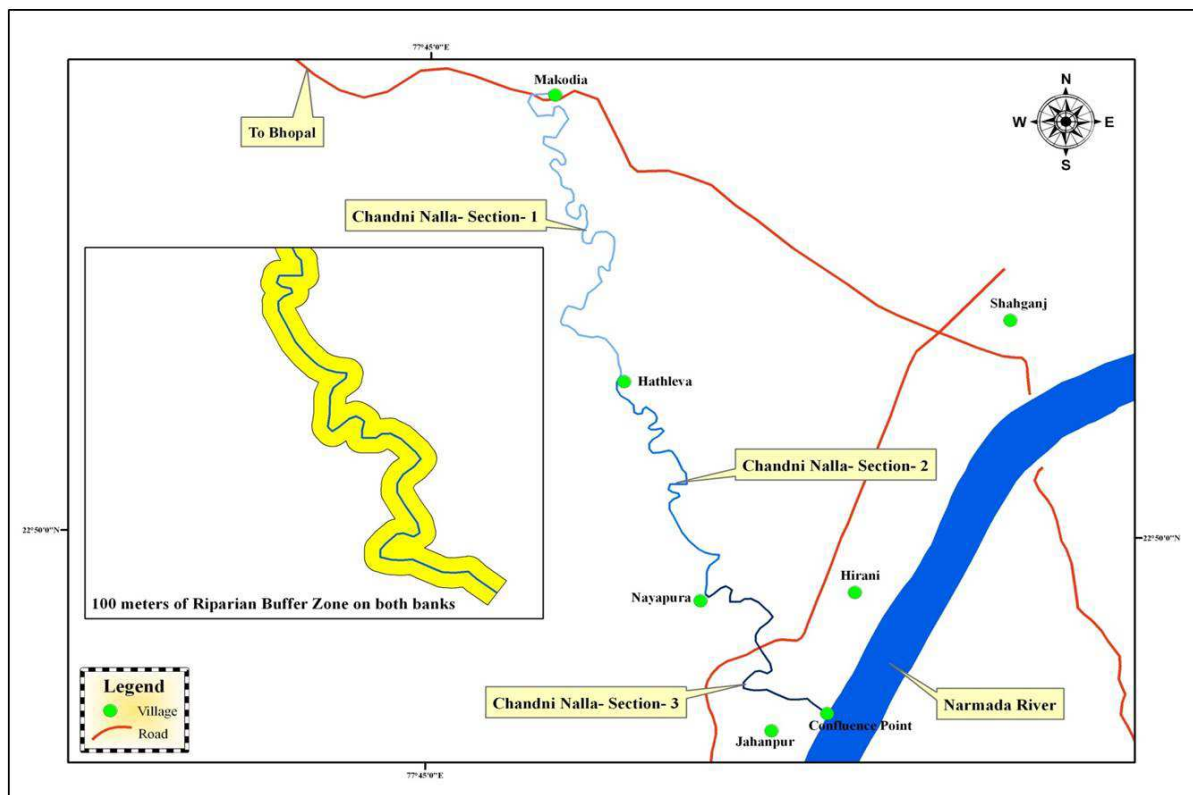**Figure- 2: Base map of the study area**

Figure- 3: Riparian buffer zone and sections of the study area

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Assessment of riparian buffer zone and floodplain areas
The width of riparian buffer zone remained always a topic of debate for the scientists; recommended buffer width for the rivers and streams varies. For the present study, the buffer width was kept as 100 meters and all the results were calculated keeping the same width of riparian buffer zone (Vyas *et al.,* 2012). A rapid on-foot survey was conducted to assess the status of riparian buffer zone and floodplain areas on right and left banks. For the investigation of the study area, majorly it was divided into three sections (Table- 1) (Figure- 3) but for making survey easy all major sections were further divided into many subsections.

Table- 1: Sections of the study area

Section	From	To	Distance in kms
1	Makodia	Hathleva	5.22
2	Hathleva	Nayapura	3.179
3	Nayapura	Confluence	2.575

Section 1 is the longest section among all which was spread between Makodia and Hathleva villages. Length of this section was 5.22 kms. This section was divided into 12 sub-sections for ease of the survey and separate field data sheets were filled for each sub-section and for each bank i.e. left and right.

In the study area section 2 lies within Hathleva and Nayapura villages which cover length of 3.179 kms. To do the survey this section was divided into 11 sub-sections and separate field data sheets were filled to observe the status of riparian buffer zone and floodplain areas for left and right banks of the stream.

Section 3 is the shortest section in the study area expanded from Nayapura village and confluence point with River Narmada covers length of 2.575 kms. To do the survey this was divided into 9 sub-sections and separate field data sheets were filled for left and right banks to observe the status of riparian buffer zone and floodplain area.

Thus, a total of 10.974 km stretch of the stream was surveyed during the present investigation. For the survey, a field data sheet was prepared to record the various parameters and separate sheets were filled for different sub-sections and for each bank. Different parameters studied during the present study are given in table-2.

Table- 2: Parameters studied during the study

S. No.	Parameters
1.	Agricultural Practices
2.	Vegetation
3.	Soil Erosion
4.	Pasture Land
5.	Human Interference
6.	Barren Land
7.	Forest Land
8.	Floodplain areas

Equipments used
During the present investigation equipments like- camera, range finder, measuring tape, clip board, GPS etc. were used.

RESULTS AND DISCUSSION

Observations found after the assessment of riparian buffer zone and floodplain areas of Chandni Nalla are described and discussed below:

Section- 1: The mean channel width was recorded as 12.75 meters whereas mean full stream width was recorded as 28.58 meters. The study revealed that on the left bank the agricultural practices were dominant which covers 73% land area followed by 15% of vegetation cover while forest land was absent.

On the right bank, again agriculture was in dominant position by covering 74.5% land followed by vegetation at second dominant position whereas, barren land holds least position by covering 0.5% land (Figure- 4).

Figure- 4: Status of riparian buffer zone in section- 1
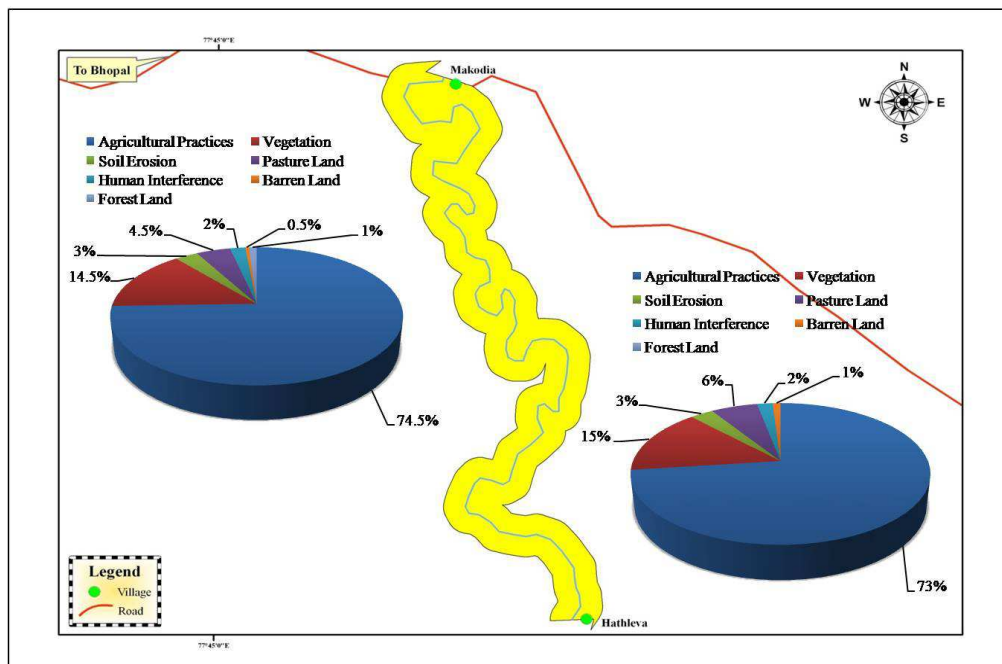
In section- 1 floodplain area was found in normal condition and no agricultural activity or any kind of human interventions were observed.

Figure- 5: Status of riparian buffer zone in section- 2

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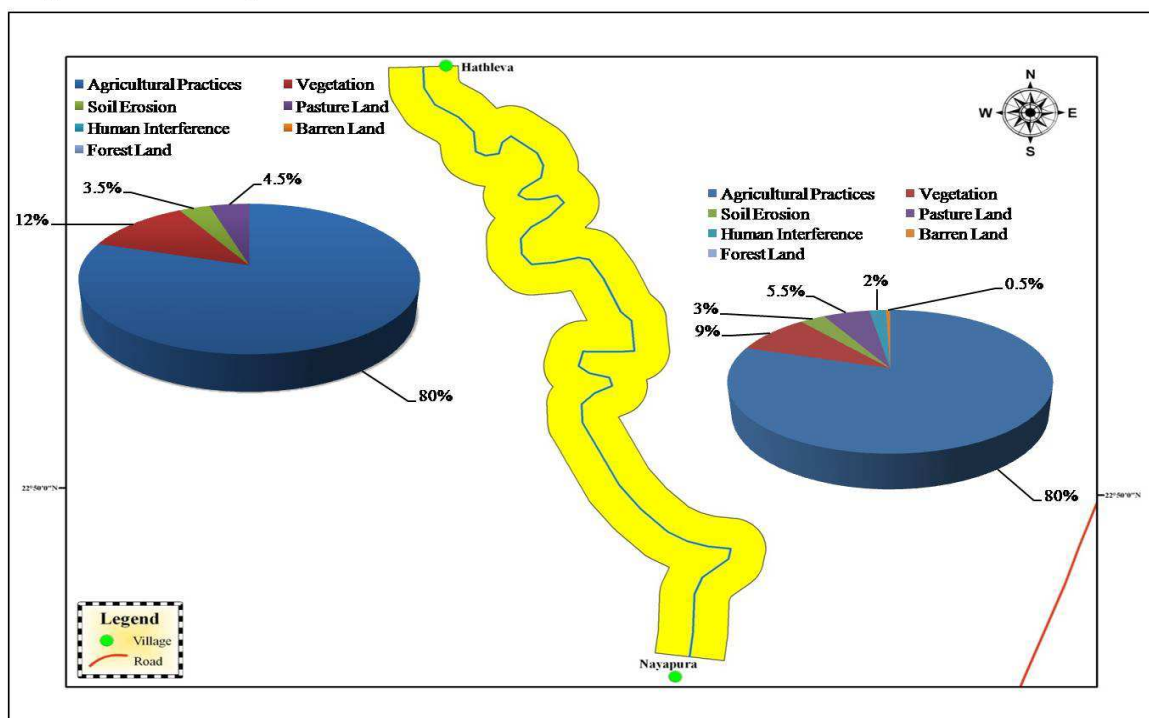
Section- 2: This section of the study area starts from the village Hathleva and lasts till Nayapura. Mean channel width in this section was recorded 11.3 meters while full stream width was recorded 35.5 meters respectively. During the study, at left bank agricultural activities was found in dominant condition which covers 80% while vegetation covers 9% of the total area whereas, barren land covers least area of 0.5%, meanwhile no forest land was observed in this section (Figure- 5).
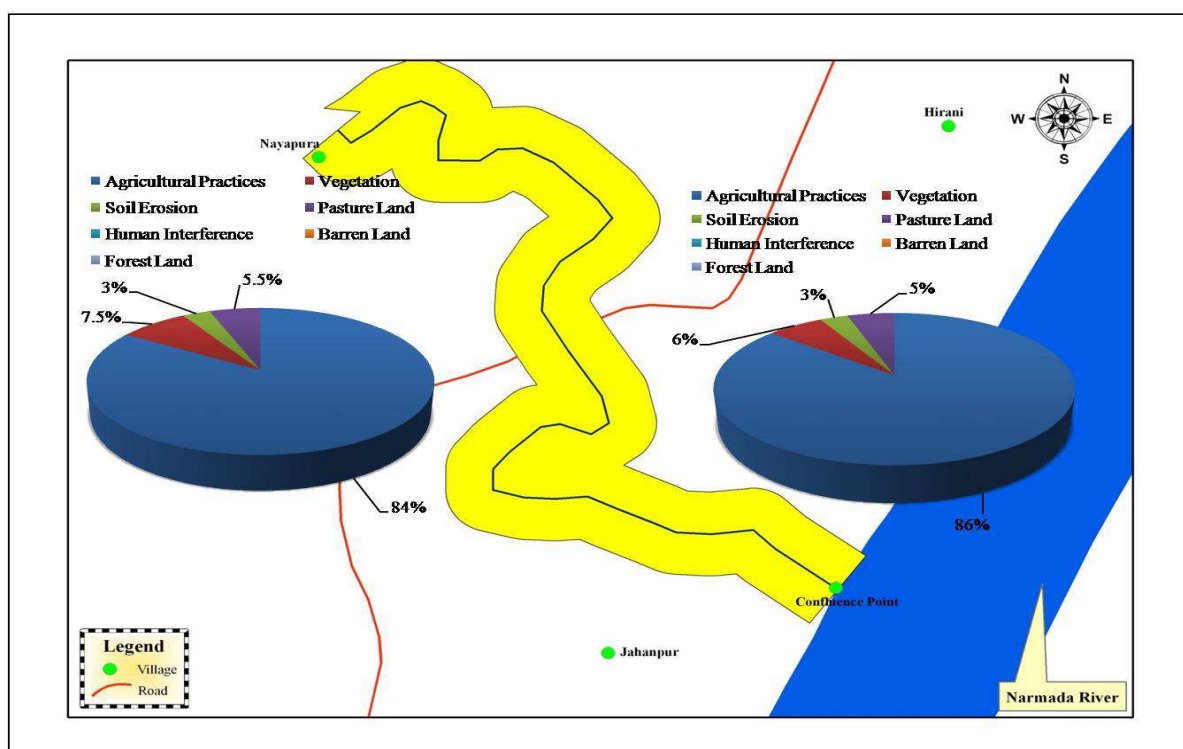
On the right bank, agricultural activity was found in dominant condition which covers 80% while vegetation covers 12% of the total area. Meanwhile, forest land, barren land and human interference were absent (Figure- 5).

Normal floodplain area was observed in this section.

Section- 3: This section of the study area is somewhat smaller than others and starts from village Nayapura and ends upto confluence point with River Narmada. Mean channel width of stream at this section was 16.25 meters while mean full stream width of stream was 44.87 meters. It was observed that agricultural activities was found in dominant position with 86% land, vegetation covers 6% land while soil erosion covers 3% area whereas, no forest land, barren land and human settlement were observed on the right bank of this section.

On the right bank of this stream agricultural activity was found in dominant position by covering 84% of area, vegetation land covers 7.5% and soil erosion covers 3% of the area. Meanwhile, no barren land, forest land and human settlement were observed here (Figure- 6).

Figure- 6: Status of riparian buffer zone in section- 3

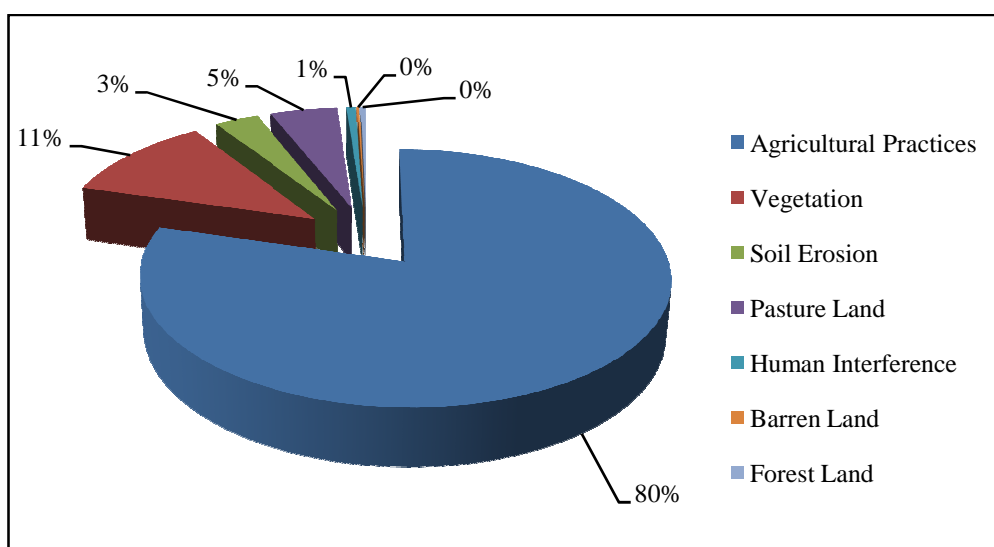Some agricultural activities were observed in floodplain area of this section.

Overall status of left bank- Observations made after a long extensive survey it was found that agricultural practices are in dominant position on the left bank of Chandni Nalla which covers 80% of the total area whereas vegetation land covers 10%, meanwhile forest land was absent on this bank (Figure- 7).

Figure- 7: Overall status of riparian buffer zone on the left bank
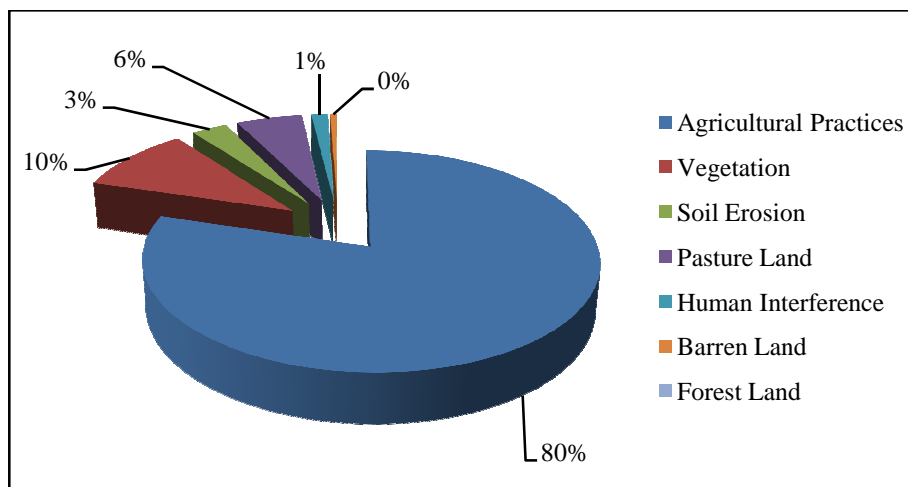
Overall status of right bank- Almost same situation was recorded on the right bank of Chandni Nalla where agricultural practices was found in dominant condition which covers 80% of the total area while vegetation land covers second position with 11% of total area and other parameters cover least position in the area (Figure- 8).

Figure- 8: Overall status of riparian buffer zone on the right bank

Over all status of floodplain area- During the investigation it was found that floodplain area of the section- 1 and section- 2 were with normal pattern, while in section- 3 human interference and agricultural activities were noticed on both banks.

Agricultural practices
In the study area, agricultural practices were found in dominant condition on both banks of the stream from beginning to the end of the survey and about 80% land of the riparian buffer area of the left bank and 80% land of the right bank was dominated with the same. People grow seasonal crops like gram, wheat, rice, tomato etc. in field. Narumalani *et al.,* (1997) reported the critical condition of the riparian buffer area of Iowa River where more than 44% of the area was under agricultural land.

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Vegetation
During the study, vegetation was found on the second dominant position in all the three sections of the study area. About 10% land on the left bank and 11% land on the right bank was covered with vegetation. Vyas *et al.,* (2012) reported 3% and 17% vegetation on the left and right bank of River Narmada respectively during the study on a selected reach of the same.

Pasture land
During the study, at different places cattle grazing were noticed in riparian buffer zone. Grass and other herbs were present in pasture land. On the left bank 6% pasture land and on the right bank 5% of pasture land was recorded. Clerci *et al.,* (2011) reported 6% of grassland in European riparian zones and 26% pasture land were reported by Meynendonckx *et al.,* (2006) in Scheldt river basin.

Soil erosion
This natural process has always been accelerated by the human activities, mainly due to falling of the trees along the banks of the rivers and streams. In the present study, during the investigation 3% soil erosion was recorded on the left bank and 3% on the right bank. 30% soil erosion (annually) was reported by Naiman *et al.,* (1993) on agricultural lands of North and South Platte rivers.

Barren land
A barren landscape or land is dry and bare, and has few plants and no trees. The soil of these lands is poor which doesn't support plant growth. During the investigation, small area of 0.50% of barren land was found on the left bank and on the right bank 0.17% barren land was recorded. Reed and Carpenter, 2002 investigated six south Wincosin streams *viz.,* Garfoot Creek, Brewery Creek, Pheasant Branch, Yahara River, Otter Creek and Silver Creek and reported 0.5%, 0.7%, 2.3%, 3.8%, 0.4% and 2.4% barren land respectively.

Forest land
During the present investigation, the forest lands were not noticed in the study area. In two sub-sections of section- 1 very small area of forest was found which is negligible. Thus, in average only 0.33% forest land was recorded on the right bank of the study area and no forest land was seen on the left bank. Clerci *et al.,* (2011) reported 69% forest land in European riparian zones.

Human interference
In the study area, the villages are not much closer to the stream thus a minimum human interference was noticed in it. The investigation revealed 1% and 1% human interference on the left bank and right bank of the study area respectively. Apan *et al.,* (2002) reported 35% to 36% woody vegetation of the riparian buffer zone was cleared by mankind in the Lockyer valley catchment of Queensland, Australia from 1973 to 1997 for different purposes like pasture and agriculture.

Floodplain area
During the present study, floodplain area was studied separately for each section. During the investigation, no major activities were found in the floodplain area. Meanwhile, only in section- 3 agricultural activities were noticed on the both banks. Similar findings were observed by Tockner and Stanfold (2002) in rivers of Europe and North America and reported that 90% of the floodplain areas were being cultivated and are functionally extinct.

CONCLUSION

After a long intensive survey of the riparian buffer zone it was observed that the riparian buffer zone of the stream is disturbed on a large scale and was dominated by the agricultural practices and a very little vegetation was observed along the buffer zone which may be a cause to the degradation of the stream ecosystem and the aquatic life. Less vegetation along the stream banks is a cause for soil erosion thus is undesirable ecologically and economically.

Following recommendations can be introduced for the restoration of riparian buffer zone of Chandni Nalla.
➤Trees should be planted to stabilize river banks with their network of roots, reducing soil loss due to erosion and controlling sediment as a result.
➤People of the nearby villages and the owners of the agricultural fields should be educated about the benefits of such ecosystems (riparian buffer).

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➢ An agro forestry programme/campaign or drive should be initiated or started for the plantation of trees along the banks of the stream.

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