



## A report on anthropogenic activities in the riparian zone of River Manuni, Himachal Pradesh

Neeraj Kumar Sharma✉, Manju P. Gusain<sup>1</sup> and O. P. Gusain<sup>1</sup>

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### Abstract

Rivers are highly vulnerable to anthropogenic changes. The hill streams so far considered pristine are now being subjected to increased anthropogenic influences. The present study was undertaken to identify and assess the anthropogenic activities in the riparian zone of River Manuni, in Beas watershed. During the course of investigation anthropogenic activities like slate mining, river bed mining, water withdrawal for drinking and agriculture purpose, initiation of micro hydroelectric projects and number of miscellaneous activities have been observed in River Manuni during March 2009- February 2011.

**Keywords:** River Manuni, anthropogenic activities, riparian zone, benthic macroinvertebrates.

### Introduction

Rivers are highly vulnerable to anthropogenic changes and their flow is often manipulated to provide water for human use (Bredenhand and Samways, 2009). Anthropogenic activities are considered to be the major cause of water quality degradation. It is well known that the water quality is influenced by activities on the landscape, watershed hydrology and biogeochemical processes occurring within the streams. There is now probably no large, tropical Asian river in pristine condition (Hynes, 1989). Even the hill streams, so far considered pristine are being subjected to increased anthropogenic influences. Human activities on all spatial scale affect both water quality and quantity (Peters and Meybeck, 2000). Understanding the role of these factors as well as their spatial and temporal interactions is important for maintaining the quality of freshwater ecosystems. Throughout the world, streams have been degraded by anthropogenic stresses including channelization, removal of riparian vegetation, agricultural and industrial pollution, hydrological

alteration and other deleterious land use practices (Karr *et al.*, 1985; Litvanet *et al.*, 2007). Many of these have resulted in increased perturbations in aquatic environments. As a consequence, the biological diversity of freshwater ecosystems is experiencing much greater loss than is seen in terrestrial ecosystems (Salaet *et al.*, 2000; Dudgeon *et al.*, 2006). The freshwater biota is experiencing a biodiversity crisis brought about by multiple interacting threats i.e. habitat degradation due to in-stream alterations including dams, dredging, channelization, harmful activities along the water edges that destabilize river banks and changes in land use that affect hydrology with secondary consequences for the physical processes and the biota (Allan and Castillo, 2007). Therefore, recent research on river processes has focused on the immediate riparian zone (shoreline communities) or land use pattern and type adjacent to river (Corkum, 1999). The present study was undertaken to identify and assess the anthropogenic activities in the riparian zone of River Manuni, in Beas watershed (Himachal Pradesh, India).

### Author's Address

Department of Zoology, Govt. College Indora (Himachal Pradesh), India

E-mail: sharma.neeraj.neeraj03@gmail.com

<sup>1</sup> Freshwater Biology Unit, Department of Zoology & Biotechnology, HNB Garhwal University, Srinagar Garhwal (Uttarakhand), India

### Material and Methods

Himachal Pradesh is a mountainous state of north India with altitude varying from 350 to 7000 m asl. The present study was carried out at three sites i.e., Khaniyara (S1), Bhadwal (S2) and



PuranaKangra(S3) on River Manuni, a tributary in River Beas watershed. The study area is located between latitude 30°5'–32°15' North and longitude 76°15'–76°25' East (Fig.1).The present study was carried out during March 2009 to February 2011. The anthropogenic activities namely, slate mining, river bed mining, water withdrawal, micro-hydroelectric projects and miscellaneous activities were observed and recorded in the field. To ascertain the water quality, selected physiochemical parameters were analyzed following standard methods outlined in Welch (1952), ICMR (1963), Schwoerbel (1970), Golterman *et al.* (1978), Trivedy and Goel (1984) and APHA (2005). Identification of benthic macroinvertebrates was carried to lowest recognizable level with the help of keys by Burks (1953), Usinger (1956), Needham and Needham (1962), Hynes (1977), Macan (1979), Edington and Hildrew (1981), Elliott *et al.* (1988), Wallace *et al.* (1990), Dudgeon (1999) and Jessup *et al.* (2003).

## Results and Discussion

In River Manuni during the present study following anthropogenic activities were observed:

### Slate mining at S1 (Khaniyara)

Slate is a fine grained metamorphic rock characterized by a perfect cleavage, usually black, blue black, gray or light green in color. Generally used as roofing, flooring and wall paneling material. In addition, slate flour is also used in paints, rubber products for decorative uses. This non-metallic material is extracted by surface mining since time immemorial. In Himachal Pradesh quality slate is found in Chamba, Kangra, Kullu, Mandi and Shimla districts. At Khaniyara slate extraction is done manually by using crow bars, chisels and digging tools, often using blasting materials from the southern slopes of Dhauladhar range within an altitudinal range of 1500 to 2200m asl (approx.) (Fig. 2 a).The name Khaniyara has been derived from word *Khan* meaning mine or quarry, hence denoting a place of quarries. It is presumed that *Dhaugri*, *Hali* and *Scippy* communities were the early settlers in this village from Chanauta area of Chamba district and lower areas of Kangra district. Of these, *Dhaugri* community used to quarry and sell slates. In 1867, Mr. Robert Warkley Shaw took the quarrying right from *Zimindars* (local landlords) of Khaniyara for

Kangra Valley Slate Company. However, after independence the quarrying rights were transferred to village *Panchayats* in 1954. In 1975, Khaniyara and Dari villages constituted KhaniyaraGablidhar Slate Quarries Board, through which they leased out slate mines in village *shamlat*(common land) to the contractors. The amount of royalty collected was divided between Dari and Khaniyarapanchayats (Singh, 1993).Since the extraction site remains operational for long period of time, the debris generated in mining activities keep on accumulating down the slope. Also, the mining wastes dumped along the slopes, results in serious damage to houses, field crops besides choking of water courses especially during monsoon. The situation has particularly caused immense damage in the Thatharna forest zone.

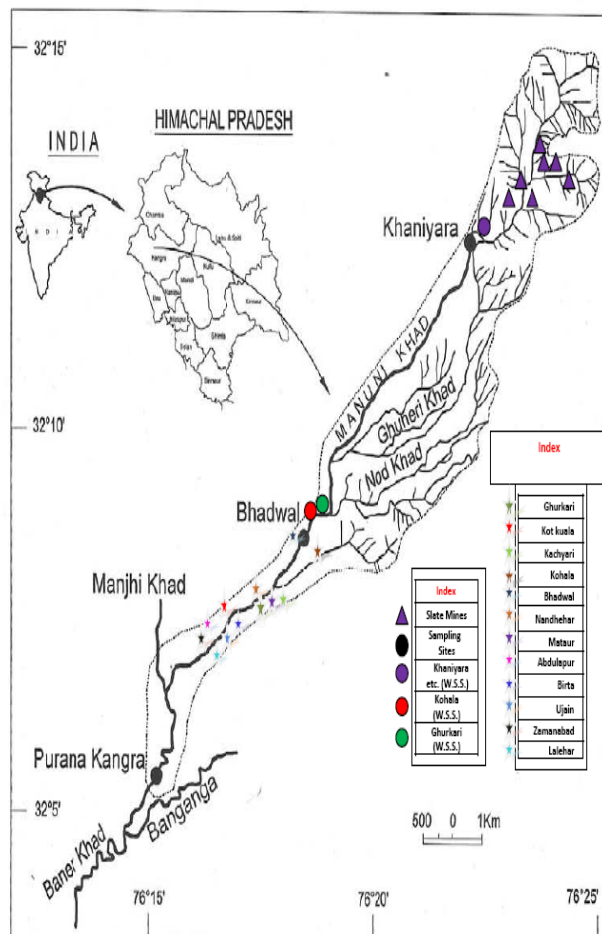


Fig. 1 Location map of River Manuni, Himachal Pradesh



Fig 2a Photograph showing slate mine and godown at Khaniyara

In 1995, a public interest litigation (PIL) was filed by Mrs. Trisha Sharma against the unscientific mining in Khaniyara. The Hon'ble High Court vide its judgment dated 11.12.96 in above PIL allowed the mining activities subject to certain stipulations viz. in conformity with the provisions of various legislations relating to mining activities, prevention and control of Pollution and Forest Conservation Act. As a result the Govt. of Himachal Pradesh vide notification No. Ind-VI (F) 12-40/ 78-1 dated 3-5-97, Shimla-2 has withdrawn the leasing rights from Panchayats and transferred these to Department of Industry (Mines). Based on the study conducted by Central Mining Research Institute (CMRI) with respect to the possibility of scientific mining of slates two areas, one in the catchment of ManuniKhad (16 Hectare) and another in the catchment of ManjhiKhad (9 Hectare) were identified. Till date 9 mining leases have been granted out of which 7 are in the catchment of ManuniKhad in the vicinity of Khaniyara village (Table 1). The production of slate in these quarries was 816 (MT) in 2009-2010 and 616 (MT) in 2010-2011, whereas the royalty collected were Rs. 204000 (2009-2010) and Rs. 153500 (2010-2011) respectively (Source: District Mining Office, District Kangra at Dharmshala, 2011). The debris from the mines invariably finds way to the river thus disturbing the substratum and water quality.

### River bed mining

River bed and riparian area mining are in practice since times immemorial, causing a great loss to aquatic biotic resources (Joshi and Shah, 2011). According to Himachal Pradesh state river/stream

bed mining policy “river natural resources must be utilized for the benefit of the present and future generation.” However, no River/Stream bed mining shall be allowed without the recommendation of the sub-divisional level committee which is supposed to look into all environmental and other related issues (Source: River/Stream Bed Mining Policy Guidelines, Govt. of Himachal Pradesh, 2004). In the study stream, river bed mining was observed at all the three sites (Fig.2 b). The sand and boulders were transported by mules and tractors. It was also noted down that people engaged with river bed mining were working under MGNREGA (Mahatama Gandhi National Rural Employment Guarantee Act) scheme, launched to provide employment to local people and engaging them in the development activities at grass root level. Generally 15 to 20 people were seen working at a time. Also, 4 to 8 mule and 3 to 4 tractor were engaged in mining activities with each making 7-10 trips in a day. Although, no stone crusher was observed to be in operation in River Manuni, nevertheless manual stone cutting with chisel and hammer was observed.

### Water withdrawal for drinking and agriculture purpose

Almost all rivers of the Indian subcontinent are regulated to serve as a source of irrigation water (Chitale, 1992). According to state water policy clause (11.1), “adequate, safe and sustainable drinking water facilities will be provided to the entire population both in urban and in rural areas throughout the year. Drinking water needs of human beings and domestic animals shall be first

charge on any available source of water.” In pursuance of this, three water supply schemes (W.S.S.) are in operation in River Manuni. Khaniyara-Dari-Sidhbari W.S.S. is drawing water from the right bank of ManuniKhad in Khaniyara, supplying drinking water to Khaniyara, Dari and Sidhbari villages. Similarly, Kohala and Ghurkari W.S.S. are also withdrawing water from Manuni and supplying to Kohala and Ghurkari villages. According to clause (7.0) of the state water policy irrigation requirement comes at number two in priority list. Also in the study stream water channels known as *Kuhl* have been constructed for irrigating the agricultural fields. The *Kuhls* operating between S1 (Khaniyara) and S3 (PuranaKangra) in the study stream are depicted in Table 2. These water channels further distribute water in the surrounding fields giving rise to

dendritic pattern. In order to have uniform distribution of water especially during lean period in summer season a system locally called as *Dolis* followed in the area customarily, since 1918. In this system lower regions of Manuni watershed have fixed dates for carrying water through *Kuhl* to the rice fields. These include Ujain, Birta, Lalehar, Kachyari, Ghurkari, Zamanabad, Abdulapur, Nandhehar, Mataur and Bhadwal villages. Further, each village has appointed its own *Kohli* (a caretaker of *Khul*) for the maintenance and systematic distribution of water resource amongst the farmers, who in turn, is given a small fraction of crop yield by every family. The water withdrawal (Fig. 2c), impose stress on the water bodies thereby affecting the fauna also.

**Table1: Detail of mining leases granted for slate mining in the catchment of ManuniKhad in the vicinity of village KhaniyaraDistt. KangraHimchal Pradesh**

S N	Name & Address of Lessee	Khasra No.	Ownership of Land	Area (Ha.)	Mohal	Mouza	Date of Grant Order	Lease Period
1	M/s Chobu Slate Mines Prop. Sh. HarbansRana V.P.O. Khaniyara	285/2/1	Govt.	0-30-00	Chakban	Khaniyara	26-09-08	25-07-09 to 24-07-19
2	Sh. O.P. s/o Sh. N. Ram V.P.O. Sidhbari	285/1	-do-	2-04-00	-do-	-do-	1-07-09	12-07-10 to 11-07-20
3	M/S ManooniEnterprises c/o B. Mehta Vill. Rakkar	167/1	-do-	1-21-10	-do-	-do-	1-1-09	06-9-11 to 05-09-21
4	M/S Kougri Valley Enterprises c/oSh. A. Singh V.P.O. Khaniyara	285/2/2/1	-do-	1-05-10	-do-	-do-	24-9-08	27-08-11 to 26-08-21
5	M/S Bhagsu Enterprises c/oSh.Kamlesh Kr. VPO. Khaniyara.	167/2	-do-	3-01-91	-do-	-do-	29-5-09	13-07-10 to 12-07-20
6	M/S Shalotu Valley Enterprises c/oSh. R. Lal	160/1	-do-	2-15-82	-do-	-do-	3-8-09	20-08-10 to 19-08-20
7	M/S Dhauladhar Enterprises c/oSh. Rajesh Gupta Vill. Khaniyara	167/3	-do-	1-26-94	-do-	-do-	26-8-09	05-10-10 to 04-10-20

Total Slate Production (Sr. No.1-7) = 816 MT (Year 2009-2010) & 616 MT (Year 2010-2011)  
 Total Royalty (Sr. No.1-7) = Rs. 204000 (Year 2009-2010) & Rs. 153500 (Year 2010-2011)

**Initiation of Mini Hydroelectric Projects**

Three mini hydro electric power projects upstream to S1 have been sanctioned by the Govt. of

Himachal Pradesh. These are Manuni hydroelectric project of 2.5 MW (Winsome Textile Industries Ltd.), Mini project of 2.0 MW and Manuni-II 4.8



MW(Ind-BarathEnergiesLtd. (Source: HIMURJA, 2011). The work is under progress in the first project (Fig. 2d). Land clearing and dumping

of debris in river generated by power projects add sediment to the river channel thereby affecting the water quality and the fauna.



Fig 2b Photograph showing river bed mining



Fig. 2c Photograph showing water withdrawal by IPH & Kuhl (Local water channel)

**Table 2 Name and number of ‘Kuhl’ local water channels drawing water from River Manuni, Himachal Pradesh.**

Between Sites	Name of Khuls
Khaniyara (S1) & Bhadwal (S2)	DodanKuhl, FakiriniKuhl, SaiherKuhl, TapdulKuhl, LachyadKuhl, DivdiKuhl, ManuniKhad Ki Kuhl-1, GhurluKuhl, NadahdhiKuhl, Nale de Kuhl, Lahta re Kuhl, ChamaradiKuhl, KtaserKuhl, ManuiKhad Ki Kuhl-2, ChauKuhl, LoharuKuhl (Total No.=16)
Bhadwal (S2) & PuranaKangra (S3)	Pul Bali Kuhl, GangalKuhl, NayeeKuhl, GailaKuhl, MaltiKuhl, DebadKuhl, ThaduKuhl, BatrulKuhl, RajoolKuhl, ChudhalKuhl and UjainbaliKuhl(Total No.=11)

(Source: Revenue Department, District Kangra Himachal Pradesh, 2011)

### Miscellaneous Activities

In many rivers the domestic waste, sewage and industrial effluents are discharged directly into water courses (Ranjit, 1995). It was observed that people have been using River Manuni as waste dumping site mainly of domestic origin. River Manuni is also being used as site for bathing, washing utensils and clothes in addition to

defecating by some people. Also, fishing is common in lower stretches of the river during summer.

Since, the riparian zone of River Manuni downstream to Khaniyara is surrounded by extensive agriculture fields, the agriculture related activities are prevalent throughout the year.



Fig 2d Photograph showing upcoming microhydroelectric project at Khaniyara



Fig 2e Photograph showing miscellaneous anthropogenic activities

Generally rice and wheat are grown in rotation in these fields. Grazing of goat and sheep by *Gaddi* (nomadic people) during their six months stay of the year in Kangra valley has also been recorded in riparian zone of River Manuni. Lastly, all adjoining villages use River Manuni as cremation sites for the last rituals of their near and dear ones (Fig. 2d). All these anthropogenic activities have been comprehensively affecting the ecology of River Manuni. The water discharge was visibly reduced in summer as compared to the winter season at all the sampling sites i.e., at S1:  $0.67 \pm 0.26$  &  $0.70 \pm 0.35 \text{ m}^3 \text{ s}^{-1}$  (SU-I, SU-II) and  $0.89 \pm 0.33$  &  $1.28 \pm 0.65 \text{ m}^3 \text{ s}^{-1}$  (WI-I & WI-II); at S2:  $0.88 \pm 0.53$  &  $0.47 \pm 0.10 \text{ m}^3 \text{ s}^{-1}$  (SU-I & SU-II) and  $1.59 \pm 0.92$  &  $2.46 \pm 1.05 \text{ m}^3 \text{ s}^{-1}$  (WI-I & WI-II) and at S3:  $1.66 \pm 0.99$  &  $0.99 \pm 0.42 \text{ m}^3 \text{ s}^{-1}$  (SU-I & SU-II) and  $3.04 \pm 1.54$  &  $5.36 \pm 1.34 \text{ m}^3 \text{ s}^{-1}$  (WI-I & WI-II) respectively. Also, increase in nutrient level was recorded in River Manuni in the downstream.

During the study period the mean annual nitrate was recorded  $0.023 \pm 0.009$  (2009-10) and  $0.105 \pm 0.105 \text{ mg l}^{-1}$  (2010-11) at S1 and  $0.050 \pm 0.01$  (2009-10) and  $0.214 \pm 0.168 \text{ mg l}^{-1}$  (2010-11) at S3. Whereas, the phosphate was recorded  $0.012 \pm 0.004 \text{ mg l}^{-1}$  (2009-10) and  $0.055 \pm 0.055 \text{ mg l}^{-1}$  (2010-11) at S1;  $0.025 \pm 0.01$  (2009-10) and  $0.112 \pm 0.100 \text{ mg l}^{-1}$  (2010-11) at S3 during study duration. A similar increase in nutrient concentrations downstream due to increased anthropogenic activities was also reported by Aura *et al.* (2011). Also, during the present study, 67 taxa of benthic macroinvertebrates were recorded from River Manuni. The benthic macroinvertebrate taxa recorded showed a decreasing trend from S1 (Khaniyara) to S3 (PuranaKangra). An increased number of taxa in the upper zone of study area may be due to the presence of thick riparian vegetation, as the intact riparian forest buffer support higher levels of biodiversity (Moore and Palmer, 2005).

As such, monitoring of benthic macroinvertebrate communities is necessary to understand the changes over a period of time. Further, these results can be used for conservation and management of the ecosystems (Kazanci and Dugel, 2008). Therefore, conservation program at drainage level need to protect the headwater region from degradation, as the headwater streams may act as source habitats for some species occurring also in large rivers (Angermeier and Winston, 1999; Heino *et al.*, 2005). Further, long term studies are required to keep an eye on the anthropogenic activities in the watershed so as to provide the base data for ecological planning.

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