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Ref: Changing river courses in the western part of the Ganga–Brahmaputra delta by Kalyan Rudra (2014), Geomorphology, 227, 87–100

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ABSTRACT

Research on river dynamics of the GB delta is in the early stages, and it is a topic of multidisciplinary interest. A narrow sectoral approach of research may lead to much confusion. The 'discussion' has a declared vision of offering corrected information against inconsistencies, improper understanding, and misrepresentation of facts in my paper. But in reality, the critics' arguments are based on the wrong premise, and those may create much confusion. This reply is designed sequentially to address issues raised in the 'discussion'.

This is in reply to the discussion by Bandyopadhyay et al. (2015), hereinafter stated as critics, on my paper entitled 'Changing river courses in the western part of the Ganga–Brahmaputra delta' published in Geomorphology, 227, 87–100.

The changing river courses in the Ganga–Brahmaputra delta (GBD) is not the exclusive domain of geology and geomorphology but a topic of multi-disciplinary interest (Mukherjee, 1938; Eaton, 1996; Chakrabarti, 2001) and a narrow sectoral approach of research that may lead to much confusion. In 2003, a special issue of Sedimentary Geology (155) was dedicated to the Bengal Basin, and the editor noted that 'understanding of the Sedimentary Geology of the Bengal Basin appears to be in its early stage'. This is especially important in the case of the western part of the GB delta, which has gone through rapid changes since the partition of Bengal in 1947. Still, I am thankful to the critics for raising some issues of debate, and as desired by the editor I would like to put my reply on record in the following paragraphs.

1. The critics decline to accept the Bengal Basin as a 'geomorphic unit', rather they prefer to identify it as a structural unit. I applied the phrase 'geomorphic unit' in the broader sense encompassing structure, process, and stage. No geomorphic unit can be described in isolation from its underlying structure, and Bengal Basin is not an exception. No one denies that the Bengal Basin is the cradle of GBD but its boundary within the basin is disputed. While the Bengal Basin, which covers 200,000 km^2 with more than 20 km Tertiary–Holocene sediment layers, is identified by its surroundings like the Indian craton in the west, the Himalayan foredeep in the north, and the Indo-Burman fold belt in the east, the geographical extension of the GBD leaves ample scope for debate. This largest delta of the world has also been described as the Bengal delta or Ganges delta (Fergusson, 1863; Majumdar, 1941; Bagchi, 1944; Umitsu, 1993; Sarkar et al., 2013). There has been a great deal of controversy regarding the geographical delineation of the delta and the processes involved in its evolution (Chakraborty, 1970). In fact, experts have different opinions on this issue. One group opined that the delta can best be delineated by the Bhagirathi–Hugli in the west, the course of the Ganga/Padma in the north, combined flow of the Ganga/Padma and Brahmaputra in the east and the Bay of Bengal in the South (Oldham, 1870; Bagchi, 1944; Basu and Chakraborty, 1972; Bagchi and Mukherjee, 1979; Rudra, 2014). Such identification corroborates its geometrical identity. Notably, none of the three boundaries is fixed but change their position continuously. The changes in the position of the western, northern and eastern boundaries depend on the width of the meander belt and the limit of avulsion. The southern boundary has been constantly changing from accretion and erosion of coast line (Rudra, 2012). The critics proposed to extend the western boundary of the delta beyond the present course of the Bhagirathi–Hugli to include 'para–deltas' formed by the western tributaries. But a counterview states that the flat terrain lying to the west of the Bhagirathi–Hugli is not a part of the delta proper (Chatterjee, 1973). The critics have a complete misconception about the Rarh or Trans-Bhagirathi region. The undulating terrain along with the easterly sloping plains lying to the west of the Bhagirathi–Hugli River is popularly known as Rarh Bengal. It is a composite region comprised of (i) plateau

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fringe (120–36 m), (ii) Piedmont zone (36–18 m) and (iii) moribund zone (<18 m). The course of the Bhagirathi–Hugli marks the boundary between Rarh in the west and delta in the east (Bagchi and Mukherjee, 1979).

Other groups have used the term GBD in a wider sense and have identified the whole of the Bengal basin as the delta (Goodbred and Kuehl, 1998, 2000; Alam et al., 2003; Allison et al., 2003; Uddin and Lundberg, 2004; Sarkar et al., 2013). Bandyopadhyay (2007) proposed to divide the GBD diagonally into two halves by the present course of the Ganga/Padma and lower Meghna. He opined that the south western part is built by the Ganga system and north eastern part is by the Brahmaputra and Meghna system. This statement is not fully correct and reflects the author's lack of knowledge about recent changes of the river courses, which enters the Bengal Basin through the Rajmahal–Meghalaya gap (Bushra et al., 2014). In fact, the Teesta (which earlier discharged into the Ganga) migrated eastward in 1787 and joined the Jamuna or Brahmaputra (Hirst, 1915; Majumdar, 1941; Rudra, 2012). The Teesta fan, which covers an area of 18,000 km^2 and overlies the Barind tract in its northern fringe, is flanked by the Mahananda in the west and the Teesta in the east (Chakraborty et al., 2010). So such an idea that the area lying north east of the present course of the Ganga–Padma that was built only by the Brahmaputra–Meghna system is untenable (Fig. 1).

The Brahmaputra played an equally important role in the filling up of the Bengal Basin. Much of the Brahmaputra sediment had been sequestered in the Sylhet Basin until 1830 when the river avulsed to its present course at the expense of its old path through Mymensingh. This can be attributed to the greater southward extension of the delta along the Hugli estuary, which carries much less of a sediment load into the Bay of Bengal compared to the Meghna estuary. Notably, the Holocene shifting of the principal flow and sediment load of the Ganga from west to east happened successively (Allison et al., 2003) and the avulsion of the Brahmaputra occurred many times east and west of Madhupur tract between 18,000–3000 cal years BP (Goodbred and Kuehl, 2000). The most recent change of the course of the Brahaputra is widely referred by many scholars (Morgan and McIntire, 1959; Coleman, 1969). The Ganga and the Brahmaputra discharged independently into the Bay of Bengal until the late eighteenth century when James Rennell (1780) surveyed Bengal. The Brahmaputra flowed through Mymansingh and discharged into the Bay of Bengal through Meghna estuary (Hirst, 1915). The recent westward avulsion of the Brahmaputra took several decades and finally completed in 1830 when a

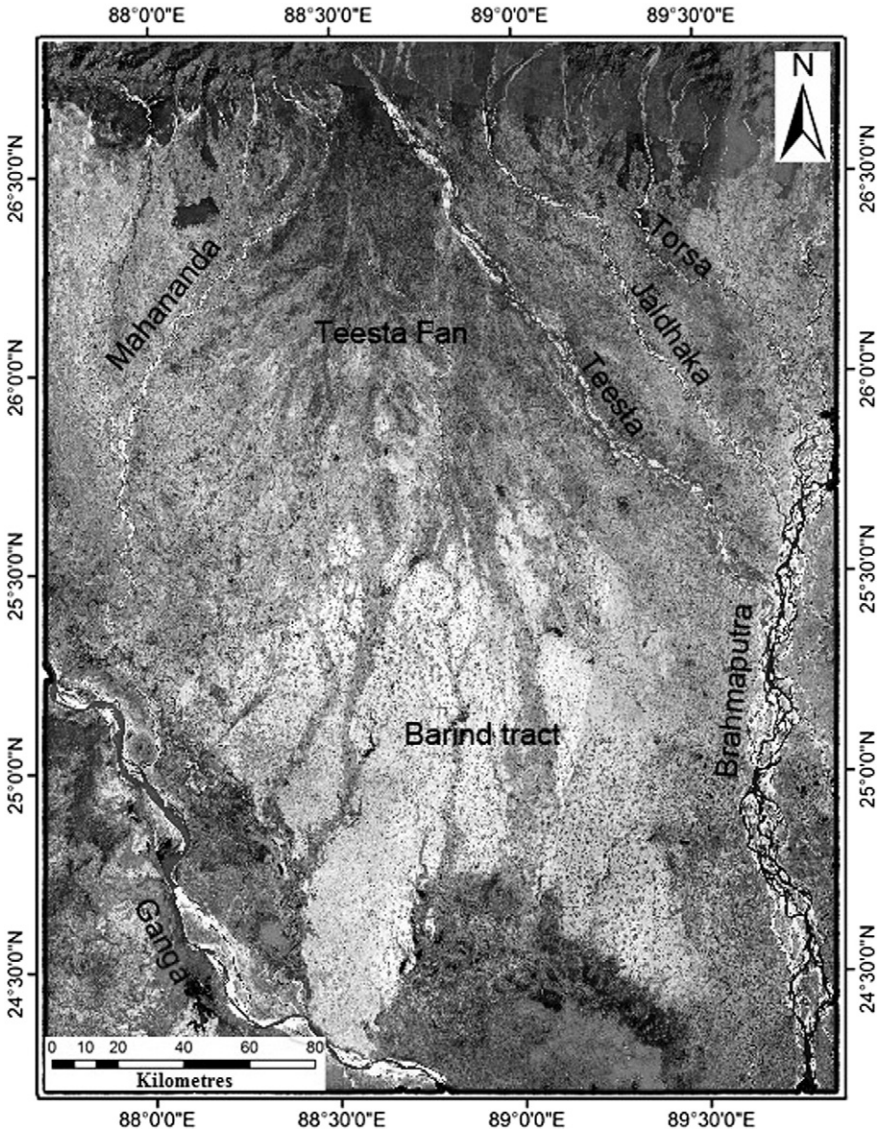

Fig. 1. The image showing Barind tract and the Teesta fan.