551.515.3 (541.4)

TORNADO OVER CHAPRA AND NEIGHBOURHOOD IN BIHAR ON 19 OCTOBER 1987

In the afternoon of 19 October 1987 some places of western part of Bihar plains were badly hit by a tornado. According to State Government, 20 human lives were lost, 517 persons were injured, 2773 houses were damaged and population of about 17000 was affected.

This is for the first time when occurrence of a tornado was reported in the State of Bihar and that too in the post monsoon season. All the six tornadoes reported in India, *i.e.*, one in Assam on 19 April 1963 (Nandi & Mukherjee 1966), one in Punjab on 10 March 1975 (Mandal & Basandra 1978), two in Orissa on 12 May 1976 and 16 April 1978 (Ghosh 1982) and one in Delhi on 17 March 1978 (Gupta & Ghosh 1980) occurred in pre-monsoon season. The other peculiarity of this tornado was that the funnel cloud associated with the tornado lifted intermittently from the ground and created havoc wherever the funnel cloud touched the ground. The distance between two places, where the tornado touched the ground varied from a few kilometres to few tens of kilometres. The parent cloud travelled a long distance of about 200 km.

2. *General description* — The author has made a survey of some of the places affected by the tornado. Persons at all the places surveyed had confirmed to have seen the funnel cloud. A small boy of the Roopganj Mohalla of Chapra town reported that he had seen two cloud masses (funnel cloud). One was moving towards him (east) and other to northeast. The boy escaped the tornado by a few metres. According to eye-witness, it was a grey dark mass of cloud with reddish glow, reaching the ground. Its lower portion was in resemblance to thick smoke spiralling upwards, and was full of debris. The peculiarity and loudness of the sound attracted the attention of all the persons who were in the open. It had a roaring sound resembling to an aircraft or railway engine. A man was confused and reported to the A.S.I. Piprakothi police station that an aircraft crashed over Chandsaraiya damaging whole village. In east Champaran district, the glow was brilliant and white, however, the actual cloud was not seen as it was dark there. All have confirmed that they had not experienced such storm during their life time nor they had heard about such storm. The debris depicted the churning motion. There were number of cases of lifting. A girl at Amsari was lifted and dropped in a well. She was rescued. A tractor and a tonga were lifted at Kharaunichanda. There were number of lifting of persons, vehicles and other objects at Chapra town. A boat was lifted about 5 metres from bed of a stream and dropped on road in Chapra. A rolled tent and furniture were lifted at Khorangpur. A boy was lifted and dropped in a pond at a distance of more than 200 metres across road at Chandsaraiya village. The boy died and the dead body was recovered next morning. In the same village a jeep was lifted 3 metres above the ground. There was unbelievable story of lifting of a double storeyed building before collapse at Roopganj Mohalla of Chapra town. The debris were thrown in the direction to which the tornado has moved (NE to N).

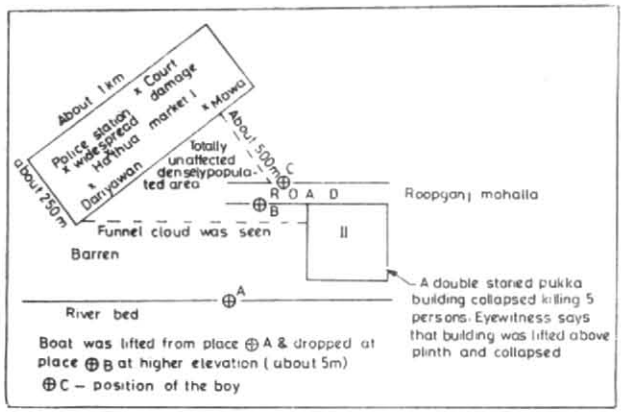

Fig. 1. A schematic diagram showing two distinctly separate areas suffered damages at Chapra

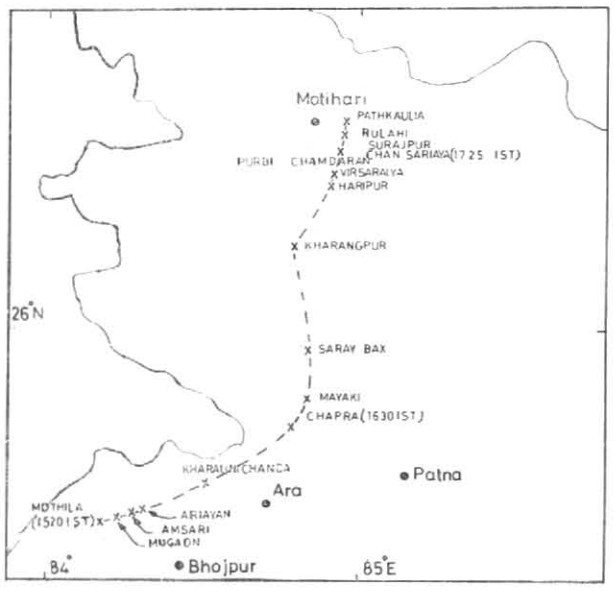

Fig. 2. Track of tornado of 19 October 1987

At Virsaraiya one hand pump was unscrewed from the pipe and thrown off. This indicated sense of rotation of the tornado as anticlockwise.

There was only one report of sucking of water from the stream at Kharaunichanda. There was a shower at Chapra ahead of the tornado but it could not be confirmed if it was a shower of sucked water or shower from cloud.

Report of twin funnel clouds by a boy is a very interesting feature. The damages at Chapra support the observation of the boy. A schematic diagram of damages is given in Fig. 1. The damages were located in two distinct unconnected areas. The area marked I belonged to main part of city and thus there was widespread damage. In area II the collapsed building was on the southern part of the city and was almost a lonely building surrounded by barren land on west, south and east, thus it was a single building affected. North of the road there was some sign of strong wind just on the side of the road in the form of blown off tiles. Both the areas were affected simultaneously. Obviously such type of damages could not have occurred with a single funnel cloud. It confirms the presence of twin tornadoes in Chapra. Though there is no previous report of occurrence of twin tornadoes in India but twin tornadoes have occurred in the past (Brown *et al.* 1973).

3. *Track of tornado* — The track of tornado and the villages affected are shown in Fig. 2. According to visual evidence tornado was observed at 1520 IST at Mathila, it moved towards NE and was observed at 1630 IST at Chapra and at 1725 IST at Chandsaraiya. Times of observations of tornado given by the eye witnesses for the places in between were rough estimates but fitted well in the above sequence of time. Thus the parent cloud moved a distance of about 200 km in about 2 hr.

The path width of the tornado varied from place to place. It was 50 m at Mathila, 250 m at Chapra and 150 m at Chandsaraiya. As mentioned earlier, the tornado lifted from the ground intermittently. Most of the areas affected by the tornado were either of paddy fields or remote. Thus it was not possible to estimate accurately the length of the path of the tornado at all the places. However, at Chapra the path length was definitely about 1 km and on the basis of statements of eye-witnesses regarding funnel cloud it appeared that wherever the tornado touched the ground the path length was no longer than 1 km.

4. *Damage* – The position of the places known to have been affected are shown in Fig. 1 and also are given below :

Bhojpur district : Dumroan block (1) Mathila, (2) Mugaon, (3) Amsari, (4) Ariyaon and (5) Kharaunichanda (Shahpur block).

Saran district : (1) Chapra, (2) Mayaki and (3) Saraybax.

Gopalganj district : (1) Khorangpur (Baikunthpur block)

East Champaran district : (1) Haripur, Virsaraiya (Chakia block) and (2) Surajpur, Rulahi, Pathkaulia (Motihari block)

In general, damage took place along the path. The most serious damage took place at Chapra where 6 people died and more than hundred were injured. Hundreds of houses were damaged. One double storey building collapsed. Number of electric and telephone poles were bent and twisted. Further loss of lives took place at Kharaunichanda, Mayaki and Saraybax, where 2 people in each of the villages killed. Three persons killed at Chandsaraiya and one at Haripur.

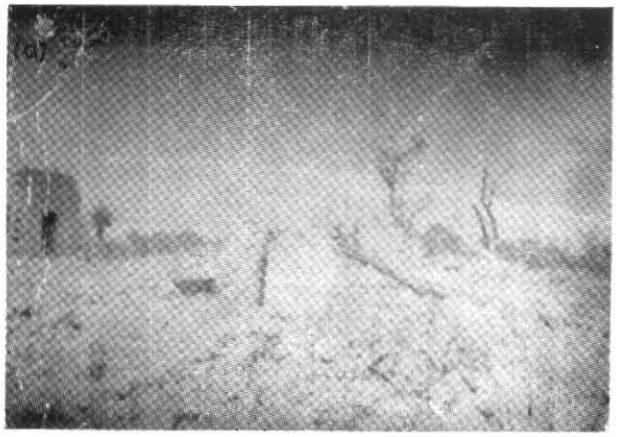

Fig. 3(a). A pucca house completely damaged at Chandsaraiya, killing two persons

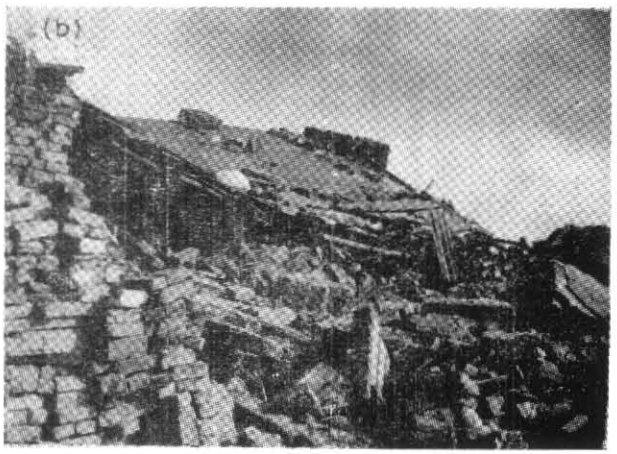

Fig. 3(b). A double storeyed building collapsed at Chapra, killing five persons

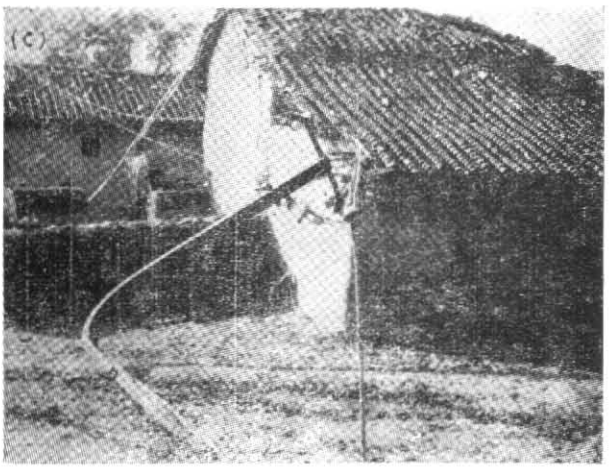

Fig. 3(c). An electric pole bent, tiles of adjacent house broken in Ariyaon village

Loss of property and complete destruction of houses occurred at Khorangpur, Chandsaraiya, Surajpur, Rulahi and Pathkaulia. Figs. 3 (a-c) show some photographs of damages at some places.

At any place the tornado lasted for 20 to 30 seconds. Considering the damages in Chapra and Chandsaraiya the FPP classification of the tornado was F_2 P_0 P_3 (Fujita 1973).

5. *General weather* — At the time of occurrence of the tornado the sky was overcast at all the places under the influence of a depression. The surface wind was light (about 5 kt) and there was light rain at some places. As stated earlier, Chapra had a shower a few minutes before the occurrence of the tornado. No thunder was reported in association with the tornado, but had been heard earlier at some places, reddish to white glow was reported every where indicating the lightning flashes.

6. *Synoptic situation at 1730 IST on 19 October* — The tornado, which was spotted at Mathila (about 110 km westsouthwest of Patna) at about 1520 IST, lay centred within a depression field. The nearest timing synoptic chart of 1730 IST indicated that the depression was centred at about 100 km west of Patna. The estimated central pressure of the depression was less than 1000 hPa with Patna reporting a pressure departure of 6.0 hPa at 1730 IST. The associated upper air cyclonic circulation extended up to mid-tropospheric level and the system tilted NE-wards with height. The light surface wind in the depression field increased rapidly and veered with height becoming southwesterly/ 55 kt at 700 hPa level over Patna. It gave a wind shear of 50 kt between surface and 700 hPa level.

7. *Discussion* — An examination of the track of the tornado and the time sequence of its occurrences at different places (Fig. 2) confirms that there was only one parent cloud which occasionally lowered and touched the ground in course of its movement. Between any two points on the track where the tornado is known to have hit, there were vast areas of paddy fields and barren lands. Therefore existence of some more places hit by the tornado in between is not ruled out.

The parent cloud had moved nearly 200 km in two hours giving it an average speed of 100 km/hr. The speed was not uniform all along its course of movement. It was slower earlier and faster in later part of its journey.

Tornado is a mesoscale instability weather phenomenon but it generally occurs in associaton with synoptic scale systems. The different studies have mentioned the following synoptic conditions favourable for development of tornado as stated by Mandal and Basandra (1978) :

(*i*) The tornadoes are related to the large scale synoptic system although an individual tornado may appear as a local or short lived phenomenon.

(*ii*) Presence of conditional and convectional instability.

(*iii*) Presence of a layer of moist air near the earth's surface with deep layer of dry air aloft.

(*iv*) Presence of some mechanism for releasing the instability, like frontal lifting, diurnal heating general convergence or orographic lifting.

In present case there was marked instability, with the presence of a depression field, there was very strong trigger mechanism to release instability. Wind veered with height and there was strong wind with strong vertical wind shear of the order of 20 kt/km at lower levels. In the field of (tropical) depression, that too near its centre, neither moist wedge can be expected nor it was present.

Thus there was very favourable condition for development of a tornado.

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