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551.515.1 (267.64)

Cyclones and depressions over north Indian Ocean during 2000*

1. Introduction

During the year 2000, 6 cyclonic disturbances (5 cyclonic storms and 1 depressions) formed over north Indian ocean. One depression (1-2 September 2000) formed over the land. The other 6 cyclonic disturbances formed over the Bay of Bengal. No cyclonic disturbance formed in the Arabian Sea. Two cyclonic storms (26-30 November and 23-28 December 2000) reached the intensity of very severe cyclonic storm. No cyclonic disturbance formed in the winter season.

This year, the first cyclonic storm formed during 27-30 March over the Bay of Bengal. This storm dissipated in the sea area over east-central Bay of Bengal without crossing coast. The second storm (cyclonic storm) which formed over the Bay of Bengal during 15-19 October also dissipated in the sea area over west-central Bay of Bengal without crossing coast. The third storm (cyclonic storm) formed over the Bay of Bengal during 25-28 October and crossed West Bengal-Bangladesh coast east of Sagar Island along Long. 89.0° E. The fourth storm (very severe cyclonic storm), formed over the Bay of Bengal during 26-30 November. It moved in a westerly direction and crossed north Tamil Nadu coast near Cuddalore. It caused loss of 12 human lives and moderate damage. The fifth storm (very severe cyclonic storm) formed in the Bay of Bengal in the last week of December (23-28). It moved in the westerly direction and crossed Sri Lanka coast and emerged into a Gulf of Mannar. It made second landfall near Tuticorin (south Tamil Nadu) and weakened into a depression over Tamil Nadu. It caused heavy rainfall over Tamil Nadu.

Tracks of these systems are given in Fig. 1. The brief history and monthly distribution are given in Table 1 and 2 respectively. In Table 3, crucial observations of ships are given. Seasonwise description of these system is given below.

2. Winter season (January and February)

No cyclonic disturbance formed during the season.

3. Pre-monsoon season (March-May)

During the season, one cyclonic storm formed over the Bay of Bengal. Details are presented below :

3.1. *Cyclonic storm over the Bay of Bengal (27-30 March 2000)*

This is the only disturbance which formed during pre-monsoon season.

3.1.1. *Life cycle*

A low pressure area formed over Andaman Sea and adjoining southeast Bay on 27 March and concentrated into a depression at 1200 UTC of 27, near Lat. 7.5° N/ Long. 90.0° E. Moving in a northwesterly direction upto 28 and then in northerly direction, it intensified into a deep depression in the morning of 29 and was near Lat. 13.0° N/Long. 88.0° E at 0300 UTC of 29. Moving in a northnortheasterly direction, it further intensified into a cyclonic storm at 1200 UTC of 29 near Lat. 14.0° N/Long. 88.5° E. Moving in a northeasterly direction, it weakened into a deep depression at 0900 UTC of 30 when it was centred near Lat. 15.0° N/Long. 90.0° E. It further weakened into a depression at 1200 UTC of 30 when it was centred near Lat. 16.0° N/Long. 90.5° E. It then weakened into a low pressure area by 0300 UTC of 30 and became less marked on 1 April 2000 over east-central Bay of Bengal.

3.1.2. *Satellite cloud features and other observations*

Maximum intensity reported by INSAT Cloud Imagery (ICI) was T 3.0 (45 knots) on Dvorak's scale from 2100 UTC of 29 to 0300 UTC of 30. The lowest estimated central pressure was 998 hPa and estimated pressure drop at the centre was 10 hPa at 2100 UTC of 29, 0000 UTC and 0300 UTC of 30.

3.1.3. *Weather and damages*

No damage to life and property was reported. However, fairly widespread rainfall occurred over Andaman & Nicobar Islands.

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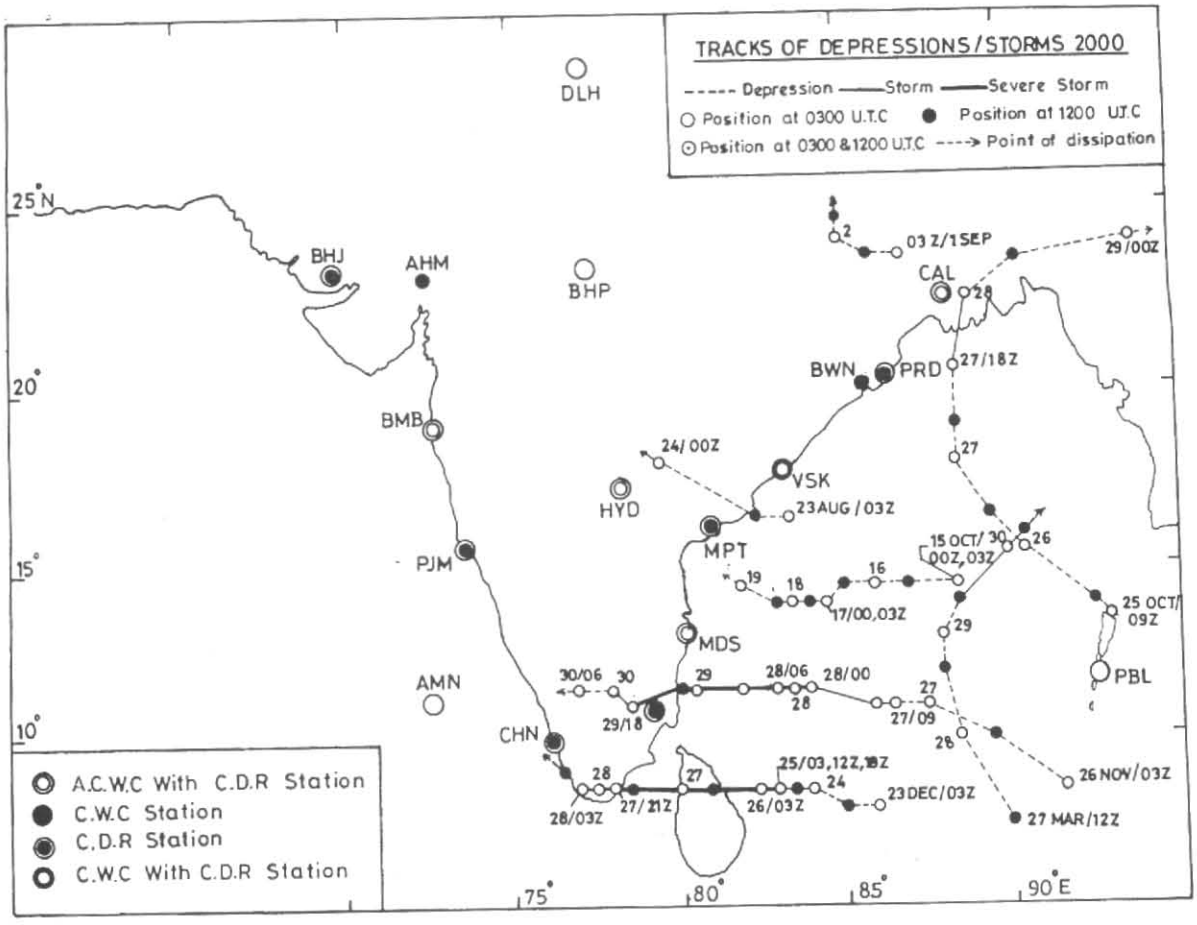

Fig. 1. Tracks of depressions/storms during 2000

4. Monsoon season (June-September)

During the season, one depression formed over the Bay of Bengal and another depression formed over land. Details are given below :

4.1. *Depression over Bay of Bengal (23-24 August)*

4.1.1. *Life cycle*

A low pressure area formed over north Bay of Bengal and neighbourhood on 17 August. It became well marked on 18 and persisted on 19 and 20. It was seen over west central Bay off Orissa-north Andhra coast on 21 and 22. Subsequently, it then concentrated into a depression in the morning of 23 August and lay centred at 0300 UTC of 23 near Lat.16.5° N / Long. 83.5° E about 150 km south of Visakhapatnam. By the midnight of 23, it crossed north Andhra Pradesh coast near Kakinada and weakened into a well marked low pressure area over Telangana and neighbourhood on 24. It moved in a northwesterly direction across south Vidarbha and dissipated over south Gujarat coast and neighbourhood on 28 August.

4.1.2. *Satellite cloud features and other observations*

Maximum intensity of T 1.5 on Dvorak's scale was reported by INSAT cloud imageries from 0300 UTC of 23 to 0000 UTC of 24.

TABLE 1

Brief history of cyclonic storms and depressions over the Indian seas and neighbourhood during 2000

S. No.	Type of system	Life period	Point of crossing the coast	Estimated central pressure (hPa)	Recorded max. wind	Highest "T" No. (estimated)
1.	CS	27-30 March	Dissipated over sea	998	-	3.0
2.	D	23-24 August	Andhra Pradesh coast, north of Machilipatnam	994	-	1.5
3.	D	1-2 September	-	-	-	-
4.	CS	15-19 October	-	996	-	2.5
5.	CS	25-28 October	Bangladesh coast	998	-	2.5
6.	VSCS	26-30 November	North Tamil Nadu coast near Cuddalore	958	-	5.5
7.	VSCS	23-28 December	Tamil Nadu coast south of Tuticorin	970	-	5.0

D- Depression, DD-Deep depression, CS – Cyclonic storm, SCS - Severe cyclonic storm, VSCS – Very severe cyclonic storm, Super CS – Super cyclonic storm.

TABLE 2

Storms/depressions statistics 2000

Name of	Winter	Pre-monsoon			Monsoon				Post-monsoon			Total
the system	Jan-Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Over Bay of Bengal												
Depressions/Deep depressions							1					1
Cyclonic storms		1							2			3
Severe cyclonic storms										1	1	2
Very severe cyclonic storms												
Super cyclonic storm												
Total												6
Land depression												
Deep depression								1				1
Over Arabian Sea												
Depressions/Deep depressions												
Cyclonic storms												
Severe cyclonic storms												
Very severe cyclonic storms												
Super cyclonic storm												
Grand Total		1					1	1	2	1	1	7

TABLE 3

Crucial observations during the storm periods

Call Sign (1)	Date/Time (UTC) (2)	Lat. (°N) (3)	Long. (°E) (4)	Direction (°) (5)	Speed (kts) (6)	PPPP (hPa) (7)
		Cyclonic storm over Bay of Bengal (27-31 March 2000)				
VVKG	280300	7.3	82.6	310	13	1010.3
SHIP	290300	11.1	82.5	020	25	1008.5
SHIP	300300	15.1	83.0	020	20	1008.7
		Cyclonic storm over Bay of Bengal (15-19 October 2000)				
ATJW	160600	13.2	84.8	230	35	1000.2
VTZJ	160600	11.4	91.7	240	08	-
VTJR	170000	10.2	90.2	230	08	1007.1
VWKG	170600	13.5	84.3	210	30	997.2
DHBN	170600	5.9	86.9	230	11	-
VTJR	171200	11.6	90.0	160	06	1006.3
VTJR	180000	-	-	230	12	1007.0
VTJR	180300	-	-	250	08	1008.3
VWWK	181200	20.9	88.1	220	18	-
VVFH	210600	14.7	72.4	260	24	1010.3
		Cyclonic storm over Bay of Bengal (26-28 October 2000)				
VTJR	260000	15.8	81.6	050	04	1008.9
VTJR	270000	14.8	80.4	050	08	1008.1
		Very severe cyclonic storm over Bay of Bengal (27-30 November 2000)				
VWPN	270000	12.6	83.1	310	10	-
VTZJ	231200	12.1	87.0	090	41	1010.7

4.1.3. *Weather and damages*

In association with the depression, heavy rains were reported from districts in the central parts of Andhra Pradesh. Hyderabad city received exceptionally heavy rain of 24 cm on 24 August. In the above districts 131 deaths were reported due to wall collapse, drowning etc. As per the preliminary estimates, about 8651 houses were fully damaged, 27026 houses partly damaged in 2886 villages/towns. 98079 people were evacuated and kept in 189 relief camps. About 5368 cattle were reported as lost and 2389 roads of Panchayati Raj, R & B and National High Ways were damaged over a distance of 7435 km disrupting traffic. 1578 minor irrigation and Panchayati Raj tanks breached. An estimated 1,77987 hectares paddy and other crops were damaged in the affected districts. Due to heavy rains 902 power transformers were damaged. 28 sub-stations, 787 distribution transformers were damaged 33 KV lines numbering 225 and 11 KV lines numbering 6000 were damaged. Preliminary estimate of a loss of Rs. 776.75 crores was reported by the Government of Andhra Pradesh.

4.2. *Land depression over Gangetic West Bengal (1-2 September)*

4.2.1. *Life cycle*

A low pressure area formed over west-central Bay of Bengal off north Andhra Pradesh south Orissa coast on 26 August and persisted on 27. It lay over northwest Bay of Bengal off Orissa coast on 28 and off Orissa – West Bengal coast on 29. It became a well marked low pressure area over northwest Bay of Bengal off West Bengal coast on 30 and persisted on 31 August. It moved inland and concentrated into a depression, centred at 0300 UTC of 1 September near Lat. 23.0° N/Long. 87.0° E close to Bankura. Moving in a northwesterly direction it lay centred at 0300 UTC of 2 September near Lat. 24.0° N/Long. 85.0° E about 70 km south of Gaya. It weakened into a well marked low pressure area over central Bihar near Gaya on 3 September morning. It lay as a low pressure area over east Uttar Pradesh on 4 and persisted on 5, 6 and 7 merged with the monsoon trough on 8 September.

4.2.2. *Satellite cloud features and other observations*

The system was not tracked by INSAT.

4.2.3. *Weather and damages*

System caused heavy rain in Bihar plains and east Uttar Pradesh on 30 August and 1 September. No significant damage to life or property was reported.

5. Post-monsoon season (October-December)

During this season, two cyclonic storms and two very severe cyclonic storm formed over the Bay of Bengal. Details are presented below :

5.1. *Cyclonic storm over the Bay of Bengal (15-19 October 2000)*

5.1.1. *Life cycle*

Under the influence of a well-marked low pressure area over east-central and adjoining parts of southeast Bay of Bengal, a depression formed over eastern parts of west central Bay at 0000 UTC of 15, near Lat. 14.5° N/Long. 88.5° E, about 650 km southeast of Visakhapatnam. It intensified into a deep depression at 1800 UTC of 15, near Lat. 14.5° N/Long. 86.5° E. The deep depression further intensified into a cyclonic storm at 0000 UTC of 17, near Lat. 14.0° N/Long. 84.5° E. Moving in a westerly direction, it weakened into a deep depression at 0300 UTC of 18, near Lat. 14.0° N/ Long. 83.5° E and into a depression at 1800 UTC of 18, near Lat. 14.5° N/Long. 82.5° E. The depression further weakened into a well-marked low pressure area at 0900 UTC of 19 over sea, off south Andhra Pradesh-north Tamil Nadu coast.

5.1.2. *Satellite cloud features and radar observations*

The maximum intensity of the system reported by ICI on Dvorak's scale was T 2.5 from 0000 of 17 to 0000 UTC of 18.

Estimated lowest Central Pressure was 996 hPa from 0600 UTC to 1200 UTC of 17.

5.1.3. *Weather and damages*

Under the influence of this system widespread rainfall with isolated heavy rain occurred over coastal

areas of Andhra Pradesh and Orissa. As the system weakened over the sea itself, no damage to life and property was reported.

Exceptionally heavy rainfall reported (cm) are given below :

17 October : Sompeta 13, Mandasa 11, Palasa 8, Pathapatnam 6.

18 October : Kaikalur 8, Amlapuram 7.

Orissa : Mahendragarh 7.

19 October : Yellamanchili 12, Visakhapatnam AP & Annapalli 6 each.

5.2. *Cyclonic storm over the Bay of Bengal (25-28 October 2000)*

5.2.1. *Life cycle*

A low pressure area formed over Andaman Sea in the morning of 24 October 2000. It concentrated into a depression over east-central Bay of Bengal at 0900 UTC of 25, near Lat. 13.5° N/ Long. 93.0° E. Moving in a northwesterly direction, it intensified into a deep depression at 0300 UTC of 27, near Lat. 18.0° N/ Long. 88.5° E. Moving in a northerly direction, it further rapidly intensified into a cyclonic storm at 1800 UTC of 27, near Lat. 20.5° N/ Long. 88.5° E. It crossed Bangladesh coast east of Sagar Island between 0100 and 0300 UTC of 28 and weakened into a deep depression near Lat. 22.5° N/Long. 89.0° E at 0300 UTC of 28. It further weakened into a depression at 1200 UTC of 28, near Lat. 23.5° N/ Long. 90.5° E. The depression weakened into a well-marked low pressure area in the morning of 29 over Bangladesh and adjoining Assam & Meghalaya.

5.2.2. *Satellite cloud features, radar and other observations*

The maximum intensity of the system reported by ICI on Dvorak's scale was T 2.5 from 1800 of 27 to 0000 UTC of 28.

5.2.3. *Weather and damages*

In association with this system, widespread rainfall occurred in Andaman & Nicobar Islands. Squally winds of 50-60 kmph were experienced in north and south 24 Paraganas districts of Gangetic West Bengal as per press reports. Widespread rainfall with isolated heavy falls occurred over Nagaland, Manipur, Mizoram & Tripura, Gangetic West Bengal, Assam & Meghalaya on 27, 28 and 29. Principal amounts of rainfall (cm) are:

28 October : Bashirhat 12, Canning Town 11, Deganga 9, Baraipur 8, Calcutta AP and Digha 7 each, Kohima 6.

29 October : Shillong 11.

The system severely affected six of the seven districts of the state of Meghalaya. It caused extensive damage to infra-structure, standing crops and plantation. Hundreds of housed were damaged rendering thousands of people homeless. It also caused loss of a large number of livestock. The preliminary estimate of total damage was of the order of Rs. 60 crores.

As per press reports, in Gangetic West Bengal on 28 October, two irrigation dams and an embankment was damaged in Pathor Pratima and Gobordhan in south 24 Paraganas districts and Sandeshkali in north 24 Paraganas district. Many mud huts collapsed in south and north 24 paraganas districts and one child was injured in north 24 paraganas districts.

5.3. *Very severe cyclonic storm over the Bay of Bengal (26-30 November 2000)*

5.3.1. *Life cycle*

Under the influence of a cyclonic circulation, a well-marked low pressure area formed over south Andaman Sea and adjoining southeast Bay of Bengal in the morning of 26 November 2000. It concentrated into a depression at 0300 UTC of 26 near Lat. 8.5° N/Long. 91.5° E. It further intensified into a deep depression at 1500 UTC of 26, near Lat. 10.0°N/Long. 90.0° E. Moving in a westerly direction, it rapidly intensified into a cyclonic storm at 0900 UTC of 27, near Lat. 11.0° N/Long. 86.5° E. The cyclonic storm further intensified into a severe cyclonic storm at 0000 UTC of 28, near Lat. 11.5° N/Long. 84.0° E. It moved further westwards and intensified into a very severe cyclonic storm and lay centred near Lat. 11.5° N/Long. 83.0° E at 0600 UTC of 28. It crossed north Tamil Nadu coast near Cuddalore at 1130 UTC of 29 as a very severe cyclonic storm and weakened into a severe cyclonic storm close to Cuddalore around 1200 UTC of 29 near Lat. 11.5° N/Long. 80.0° E. It rapidly weakened into a cyclonic storm at 1800 UTC of 29 near Lat. 11.0° N/ Long. 78.5° E and into a deep depression at 0300 UTC of

30 near Lat. 11.5° N/ Long. 78.0° E, very close to Salem. It further weakened into a depression at 0600 UTC of 30 near Lat. 11.5° N/Long. 77.0° E. The depression further weakened into a well-marked low pressure area over Tamil Nadu in the same evening.

5.3.2. *Satellite cloud features, radar and other observations*

Maximum intensity of T 5.5 was reported by INSAT Cloud Imageries from 1800 UTC to 2100 UTC of 28. The lowest estimated central pressure was 978 hPa at the time of landfall. The winds experienced over the central areas were reported to be of the order of 110-120 kmph. ICI reported 'eye' from 0500 UTC to 1800 UTC of 28.

Radar centres given by CDRs Karaikal and Chennai agreed very well with ICI centre and also with coastal observations at the time of landfall. CDRs Chennai and Karaikal observed the system and reported the centre of the system on the basis of 'eye' from 1350 UTC of 28 to 0450 UTC of 29 and 0800 UTC of 29 to 0300 UTC of 30 respectively.

From the information gathered from the affected people in the coastal areas, it was learnt that lull period lasted for a maximum of 45 minutes on 29 indicating prevalence of 'eye' which was, however, not seen in the satellite and radar images at that time.

5.3.3. *Weather and damages*

The system produced comparatively very less rainfall activity. However, a few stations in the south-west and western sector of the storm received very heavy rainfall during the 24 hour periods of the order of 20 cm and above, the highest being 45 cm on 29 at Thozhudhur and 44 cm at Kilarheruvai in Cuddalore district.

Tamil Nadu and Pondicherry were mainly affected. The loss is due to crop damage, uprooting of big trees and partial damages to more than one thousand Kuchha houses and fourteen brick houses due to strong wind. 10 persons in Tamil Nadu and 2 in Pondicherry lost their lives due to wall/building collapse/electrocution. Sugarcane in 100 acres, 30,000 plantain trees, 50,000 plantain saplings also got destroyed in Tamil Nadu. As per press reports, estimated loss in Cuddalore district is about Rs. 20 crores. The system did not cause any damage in coastal Andhra Pradesh. Only Nellore district received significant rainfall and Nellore reported 9 cm of rainfall on 30 November. Damage to crops, plantains and Kutcha houses were also reported from the state of Pondicherry. Total loss is estimated to be about Rs. 50 crores in Pondicherry as per press report.

5.4. *Very severe cyclonic storm over the Bay of Bengal (23-28 December 2000)*

5.4.1. *Life cycle*

Under the influence of the trough in the lower levels, a low pressure area formed over central parts of south Bay of Bengal in the morning of 23. It rapidly concentrated into a depression at 0300 UTC of 23, near Lat. 8.0° N/ Long. 86.0° E. Moving in a westerly direction, it intensified into a deep depression at 0000 UTC of 24, near Lat. 8.0° N/ Long. 84.0° E. At 0300 UTC of 25, it further intensified into a cyclonic storm near Lat. 8.5° N/ Long. 83.0° E. The cyclonic storm intensified into a severe cyclonic storm at 1800 UTC of 25, near Lat. 8.5° N/ Long. 83.0° E. It rapidly intensified into very severe cyclonic storm at 0300 UTC of 26 near Lat. 8.5° N/ Long. 82.5° E. At 1200 UTC of 26, it crossed north Sri Lanka coast and emerged into the Gulf of Mannar. The very severe cyclonic storm weakened into a severe cyclonic storm at 1200 UTC of 27, near Lat. 8.5° N/ Long. 78.5° E and into a cyclonic storm at 2100 UTC of 27 near Lat. 8.5° N/ Long. 78.0° E. It crossed coast south of Tuticorin on early morning hours of 28 December. It further weakened into a deep depression at 0600 UTC of 28 near Lat. 8.5° N/ Long. 77.0° E. The deep depression weakened into a depression at 1200 UTC of 28 near Alapuzha at Lat. 9.0° N/Long. 76.5° E and further weakened into a low pressure area over east-central Arabian Sea at 0000 UTC of 29.

5.4.2. *Satellite cloud features and other observations*

Maximum intensity of T 5.0 was reported by ICI on Dvorak's Scale from 1200 UTC to 1500 UTC of 26.

CDR Karaikal reported radar fixes and gave the storm centre from 0600 to 2100 UTC of 26. It reported circular open 'eye' on 0800, 0900 and 1400 UTC of 26. Storm centres given by CDR Karaikal agreed well with that of ICI.

Only the north and northwest sectors were within the radar visibility. Closed 'eye' and the spiral bands in the farther sector could not be seen due to range and height limitations.

5.4.3. *Weather and damages*

In association with the system widespread rainfall occurred in south Tamil Nadu, Rayalaseema, Pondicherry and Kerala. Exceptionally heavy rainfall was reported on 28 December by following stations in Tamil Nadu : Senkottah 33 cm, Ramanathapuram 17 cm, Tiruchendur 15 cm, Vilathikulam 14 cm, Tuticorin 14 cm, Ambasamudram 14 cm and Palayamkottai 14 cm.

Three districts of Tamil Nadu state were affected by the storm. In the Ramanathapuram district, 350 houses were reported damaged. The reported damages from the remaining two districts are as below :

Tirunelveli : Cattle head lost – 2, houses damaged – 162 (fully 16, partially 146)

Tuticorin : Cattle heads lost – 3, houses damaged – 318 (fully 65, partially 253). Fishing boats lost – 95, loss to corps – Paddy crops – 281 hectares, Betel – 80 hectares and plantain – 650 hectares.