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FLOODING IN THE RED RIVER DELTA

January 1966

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## FLOODING IN THE RED RIVER DELTA

This study describes conditions of flooding in the Red River Delta of North Vietnam. Selected past instances of flooding along the river are included. The Ha Dong area west and south of Hanoi (see Figure 1), which has been particularly vulnerable to flooding in the past, is studied in some detail.

### I. Characteristics of the Red River Delta

The delta is a flat plain, crisscrossed by natural distributaries and manmade drainage and irrigation canals that are interwoven in a vast mosaic of ricefields. Viet Tri, at the head of the delta 100 miles inland, is only 15 feet above sea level; and the average, almost imperceptible, slope of the delta is less than 6 inches per mile.

In this flat environment it was essential that levees be built to protect the land from flooding by the rivers that cross it. By constricting the greatly expanded volumes of floodwaters, however, the levees accentuate the threat created when the river level is above the level of the surrounding land. The Red River has flowed as much as 26 feet above the land in the Hanoi area, a situation that suggests the magnitude of the flooding that occurs when the levees are breached.

The delta is compartmented by the natural and manmade levees of the different distributaries. (The French use the descriptive term "caisier," that is, "pigeonhole," to refer to the compartments resulting from this process.) Streams originate on the sides of the highest levees and flow toward the lowest elevation in the compartment. It is extremely difficult to drain these compartments, particularly when the bordering rivers are in flood and may be flowing above the elevation of the land in the compartment.

### II. The Red River

The Red River, some 750 miles in length, rises in southern China. At the China - North Vietnam border, 320 miles from the sea, it is only 293 feet above sea level. Thus, its average fall is less than a foot a mile, a factor which strongly influences its flood characteristics.

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During the low-water period, October through May, the Red River at Hanoi may be only 200 to 400 yards wide, though it flows through a sandy riverbed 1 to 2 miles wide. Figures for the level of the river at Hanoi near the beginning of the low-water period, 1 November for the years 1958 through 1962, indicate an average of 16 feet above sea level. Its average level at Hanoi in the later stages of the low-water period, however, is about 8 feet above sea level.

The river starts to rise at the beginning of June and subsequently fills its wide bed until at high water the river level at Hanoi is usually at least 26 feet above sea level. Figure 2 shows the variation in river level from May through November over a 28-year period, indicating that the average is well over 26 feet in July, August, and September. Figure 3 shows the mean discharge at Son Tay, about 25 miles upriver from Hanoi. In the 1915 flood, the discharge at Son Tay was measured at about 1 million cubic feet per second.

The high-water period, however, is not made up of a single flood with equally gradual upsurge and downfall, but rather it includes several floods each of which may cause the river to rise far above the average summer water level (see Figure 4). As a result of the very gradual gradient of the river, these floods are relatively slow. Figure 5 shows that the river took 3 days to rise from 25 to 39 feet in the 1926 flood.

The highest floods are generally in July and August, although flooding in June and September is fairly common -- statistics indicate that between 1884 and 1923 there were 20 floods above 25 feet before 20 June and 59 floods above 25 feet after 1 September.

### III. Past Breaks in the Red River Levees

Breaks in the levees have occurred frequently. Since 1900 the levees have been breached in 1902, 1903, 1905, 1909, 1911, 1913, 1915, 1917, 1918, 1923, 1924, and 1926. (Information on breaks since 1926 is unavailable.)

One of the most disastrous floods occurred in 1915, when levees were breached in 48 places. The Ha Dong area was almost completely inundated -- 257,000 acres of the total area of 268,000 acres were flooded. In the southern part of the Ha Dong area, water reached a level of 6 meters, or about 19 feet. Figures 6 and 7, roughly indicating the topography of the compartment, give some idea of the devastation caused by this depth over the ricefields. After the flood had receded, one section of the Ha Dong area was described as having ". . . the striking appearance of deserted dunes where, outside of half-ruined villages, nothing showed man's centuries-long work. Paths, streams, lowlands were all levelled, and all over this huge desolate expanse was not a blade of grass, not one tree, not a tombstone, no sign of life."

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On 30 July 1966, three breaches occurred in the levees not far from Hanoi. Two were closed on the 8th and the 12th of August, but one remained open. Consequently, over 250,000 acres of land on the left bank of the Red River were flooded.

IV. The Ha Dong Area

The Ha Dong area, which lies south and west of the Red River in the vicinity of Hanoi, is compartmented by the levees of the Red River on the north and east and by the levees of the Song (River) Day on the west (see Figure 6). The area is essentially a corridor with a slight north-south slope. The terrain also slopes inward from the Red River levees on the east and from the Song Day levees on the west. In the north the land varies in elevation from 12 to almost 35 feet, but much of the area south of the town of Ha Dong is less than 7 feet above sea level. This low-lying land is often inundated by heavy precipitation, per se; as of 22 June 1965, some of it was already under water to the extent that rice seedlings for the autumn crop were endangered.

Major levees along the Red River and the Song Day are generally from 22 to more than 40 feet in elevation. From the Hanoi area upriver those on the Red River are above 40 feet, mostly between about 42 and 49 feet. The area compartmented by these major levees is crisscrossed by secondary levees that vary from 4 to 22 feet in elevation.

Some conception of the number of people affected during time of flood may be gained from the 1956-57 population estimates published in Hanoi which list about 1,163,000 people in the Ha Dong area, including Hanoi.

The area is traversed by Route No. 1A, the main road from Hanoi southward along the coast; the Hanoi - Thanh Hoa rail line; and Route No. 6, which leads to the Dien Bien Phu area. These transportation routes are on embankments 3 to 14 feet high, but even so they are occasionally flooded to a depth of 4 to 8 inches. Normally, however, traffic is not interrupted.

In the low-lying parts of the area only 5th-month rice (harvested in June) is grown, as excessive inundation of the land during the summer prevents planting of the 10th-month rice (harvested in October-November). Tenth-month rice is planted in the highest parts of the area; and both 5th-month and 10th-month rice are planted in the transitional area between the highest and lowest parts (see Figure 9 and Plate I). If rice is submerged for as much as 4 days, it generally is killed. If the Ha Dong area were flooded most of the rice crop would probably be destroyed.

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Extent of flood damage in the Ha Dong area is influenced by two major considerations:

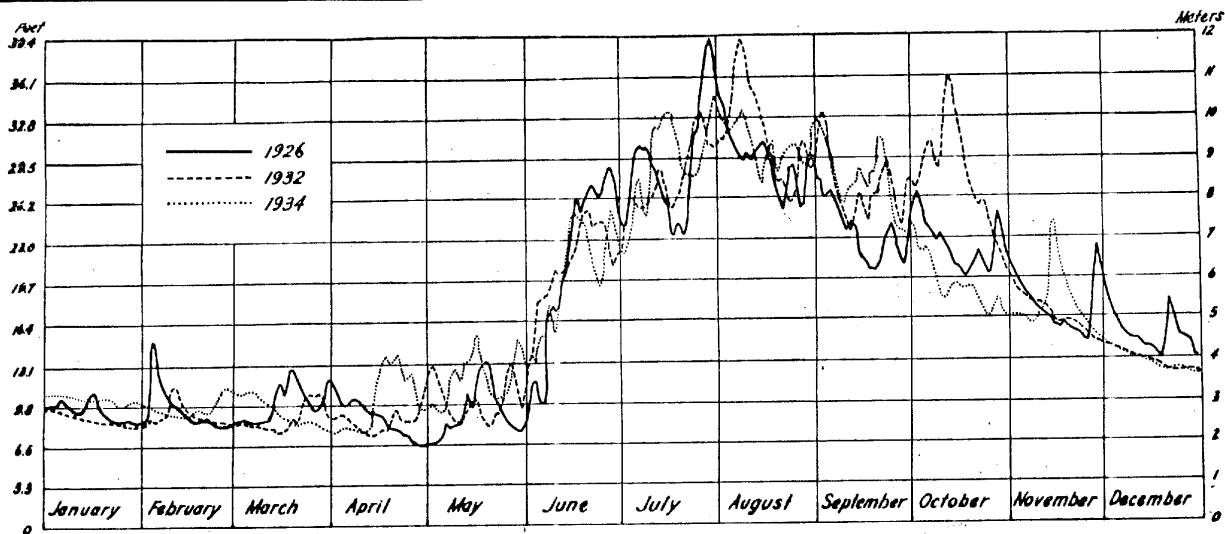
1. The network of protective secondary levees estimated to be as high as 22 feet tends to localize and minimize flood damage. It is possible, however, that these secondary levees could not withstand a flood discharge flow such as that measured in the 1913 flood (see Section II, The Red River) and consequently might deteriorate.
2. Flooding is most likely to occur when the level of the Red River is close to the top of the main levees upriver from Hanoi. As can be seen from Figure 2, the river level is often above 53 feet during July, August, and September. Maximum river levels would be most likely to occur after a typhoon -- when the river level rises above even the normal summer high water. As of 12 August 1965, the Red River had not covered the islands near Hanoi, which have peak elevations of about 53 feet.

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LEVELS OF RED RIVER AT HANOI IN 1926, 1932, 1934

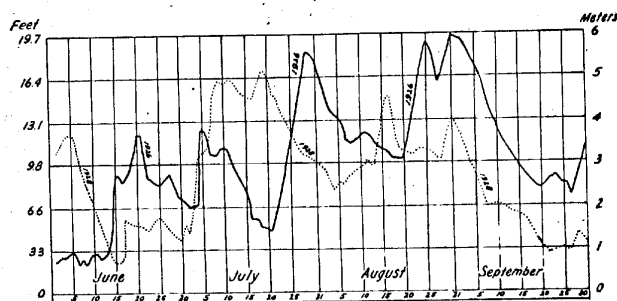
FIGURE II - 61. Tonkin Plain. Levels of the Red River at Hanoi in 1926, 1932, and 1934.

The river rises suddenly at the beginning of June. River discharge consists of a succession of flash floods lasting 10 to 15 days, during which the river levels rise quickly 6 to 15 feet and recede again.

TABLE II - 1  
RIVER LEVELS AT HANOI  
MEANING OF SYMBOLS

YEAR	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.
1907				0		00	
1908		00	0	00	00		00
1909			00	000	000	0	
1910				000	00		
1911		00	000	000	0		
1912			0	000	0		
1913		0	000	000	0		0
1914			000	00	00		
1915	00		000	00	0		
1916		0	0	0	0	00	
1917			000	000	0		
1918	00	00	000	000	00	0	
1919		0	000	000	00		
1920	0		0	0	000		
1921		0	000	000	000	0	
1922		0	00	000	00		
1923		00	00	000	00		
1924		0	000	00	0		
1925			00	00			
1926		0	000	000	0	0	
1927		0	00	000	0	00	
1928		0	000	000	0		
1929		0	00	000	000	0	
1930		00	0	00	00		
1931	No data						
1932			000	000	000	000	
1933	No data						
1934			000	000	00		

To guard against these floods, the Tonkin farmers have laboriously constructed artificial levees along most major streams. These have raised the high-water level of the rivers but have not been able to prevent floods caused by levee breaks. Between 1900 and 1925 levees broke in 13 different years. The floods of 1913 and 1915 were particularly disastrous (FIGURES II - 63 and II - 64). Areas which have suffered repeatedly from floods of the Red River are those at the head of the delta to either side of the river (Son Tay, Hung Hoa) and



LEVELS OF SONG THUONG AT PHU LANG THUONG  
1926 AND 1928

FIGURE II - 62. Tonkin Plain.

The succession of flash floods is more pronounced than the slight general increase in stream discharge.

the compartments of Ha Dong and Nam Dinh Nord between the Red River, the Song Day, and the Nam Dinh Giang. In the watershed of the Song Thai Binh, flooding by the Song Cau is particularly common and affects especially the area of Bac Ninh between the Song Cau and the Canal des Rapides. To prevent the recurrence of such floods and levee breaks, an ambitious program of widening and increasing the height of the artificial levees of the main streams and distributaries was started in 1924. It was planned to safeguard the plain against all floods up to a high-water level of 43.6 feet at Hanoi, that is, 4.5 feet above the highest river level measured there. This system of artificial levees was completed in 1937. The levees of the lower Song Cau also have been raised. Flooding of the Tonkin Delta through overflow of the main streams should thus be practically eliminated.

3. FLOODING BY TIDAL STREAMS. The tides of the Gulf of Tonkin penetrate the different distributaries for a distance of 30 to 50 miles. The range of the tides decreases rapidly inland,

a depuis longtemps (la pente moyenne de Lao Kay à Viet Tri est seulement de 27 cm. par km.).

4. *Les facteurs du régime.* — Ce régime s'explique par le relief du bassin du Fleuve Rouge ; très montagneux, il rassemble très vite les eaux four-

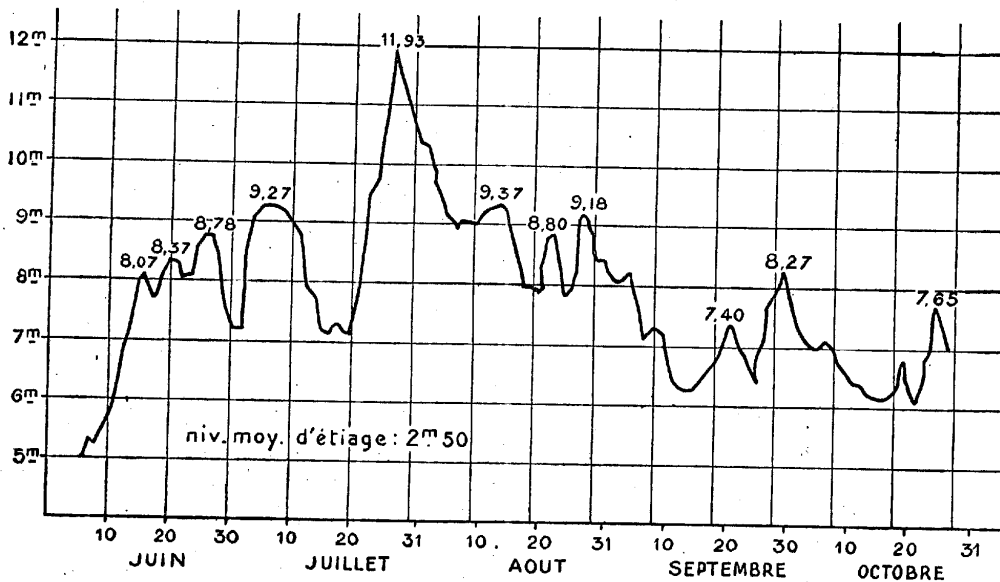


Fig. 9. — HANOI, 1926. Crue Fleuve Rouge.

nie par les pluies. Cependant la faiblesse de la pente sur les trois cents derniers km. du cours avant Viet Tri atténue la rapidité des crues : un cours encore plus long, en retenant plus longtemps le flot de crue, amènerait la fusion de toutes les crues en une seule (c'est ce qui se passe pour le Mékong). Il faut remarquer que la confluence des deux principaux affluents du Fleuve Rouge, Rivière Noire et Rivière Claire, juste à l'entrée du Delta, n'est pas un facteur favorable à l'atténuation des crues, d'autant que les crues de la Rivière Noire sont plus rapides que celles du Fleuve Rouge : la pente de la Rivière Noire est plus forte que celle du Fleuve Rouge jusqu'à une faible distance du Delta (à 100 km. du confluent, dans les rapides en amont de

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*Plate I*

