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DEVIATION OF THE SUNGEI MULIA

By

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Introduction

This paper focuses on a single episode, namely the deviation of the Sungei Mulia from its original course, shortening its journey to the Sungei Blongkong, a tributary of the Sungai Gombak. An attempt will be made to reconstruct the environment and suggest possible causes of this event. There is no doubt that the diversion reflects the unstable conditions within the padi area itself, but it is difficult to evaluate the hydrological significance of changes in land use on the discharge and sediment load characteristics of the river prior to and during the deviation. Hence, the paper is confined to an examination of the unstable conditions within the area which fostered the deviation of the Sungei Mulia. In the year of observation (1968) canals at two other locations within the same padi area showed similar unstable conditions resulting in scour and erosion which involved much expenses, time and labour in maintenance works.

The Field Area

The field area covering less than an acre of land lies off the 4th. Mile Bentong Road (Fig. 1B), on the periphery of the Gombak 7th. Mile Irrigation Scheme. Downcutting and regrading of the stream bed and regradation of stream level had not at the time of the survey extended beyond this small area.

Prior to the deviation, the Sungei Blongkong and the Mulia flowed as indicated on Fig. 1B. Within the field area the two rivers flowed roughly parallel to each other and in the same direction as indicated in Fig. 1A. Though the Mulia has been canalised, the Blongkong is still in its natural state. A drain discharges almost directly opposite the point where the Mulia's bund was breached. The slope towards the Blongkong has been emphasized by the canalisation of the Mulia, whose bed is as high as 5.4 feet above that of the Blongkong only 181 feet away (Fig. 1C). According to local inhabitants a natural overflow channel operative only during the padi season, existed formerly along the line of the modern diversion of the Mulia. An escarpment stabilised with vegetation shows the headward regradation which had been initiated by this overflow channel.

The soil types are all recent floodplain deposits. Soil sampling and a visual tracing of layers were carried out along the length of the newly-eroded channel. The profile of the general sequence of layers together with the characteristics of each layer appear in (Table 1). This general sequence was broken along the banks of the Mulia by irregular deposits of radically different material at certain localities. Fig. 1A shows the occurrence of Samples 2 and 3 which are described in Table 1. The silty sand and cohesive silty clay, existing on the opposite banks of the Mulia, extended down the entire visible profile. It is difficult to determine exactly where the boundary between the two profiles had been.

Padi and dusun (tree) crops cover a large part of the area. The land along the new channel had been cultivated with shallow rooted bananas and tapioca. The discussion of the deviation shows how the relief, drainage, soils and vegetation of the area created a potentially unstable situation which only required a trigger to bring about the deviation.

The Deviation

The deviation occurred on the night of June

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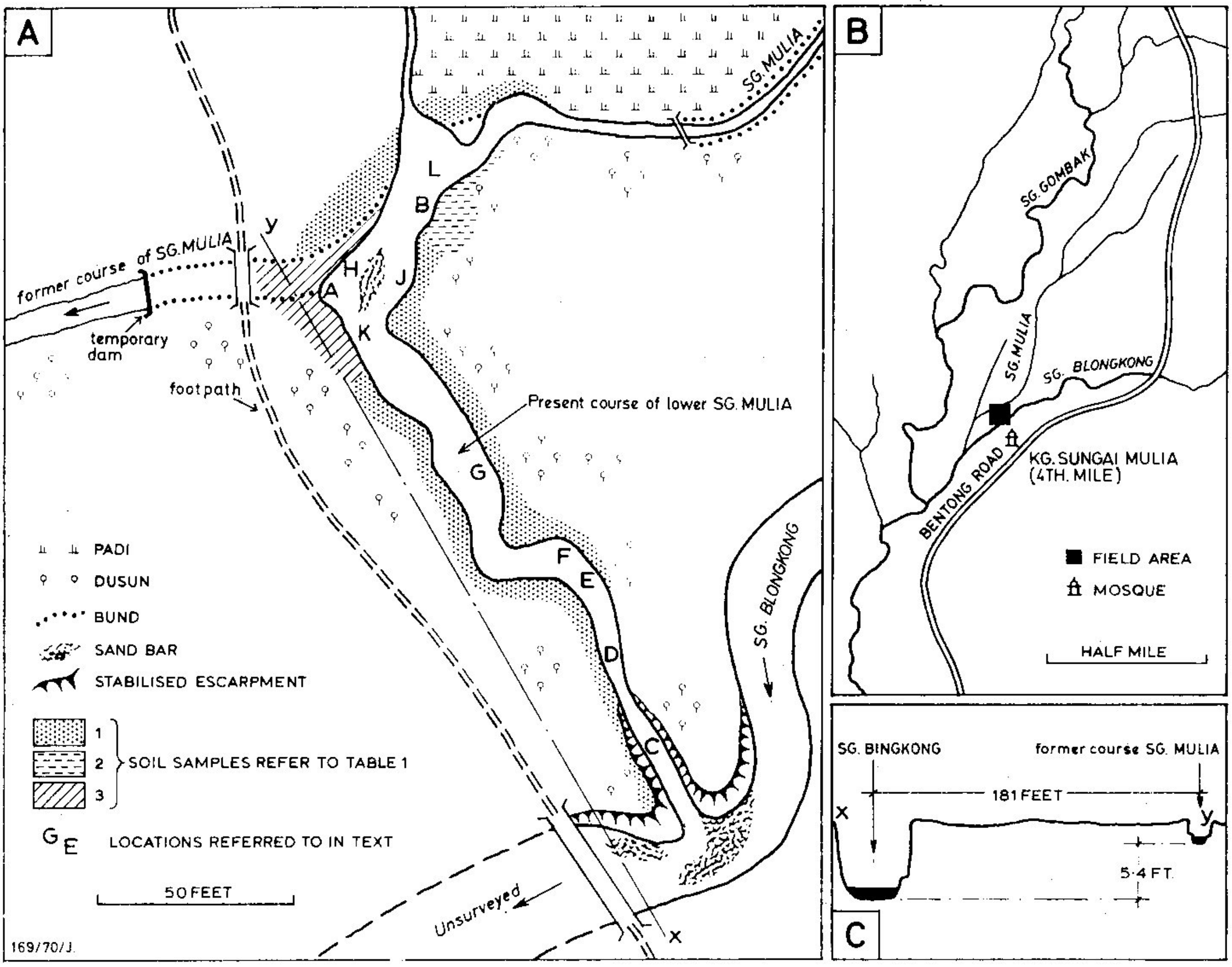

Fig. 1A: *Diversion of the Sungei Mulia.*

Fig. 1C: *Section Along X - Y.*

Fig. 1B: *Position of field area.*

TABLE 1 : SOIL CHARACTERISTICS

Sample	Thickness (inches)	Name	Clay	Composition (percentage by weight)					Remarks
				Silt	Sand	Gravel	Organic content	Sampled at (see Fig. 1A)	
1 H_1	6	Sandy silt	17	38	45		1.6	whole of sample 1 studied at E left hand bank.	loose and friable
1 H_2	10	clay silt	22.5	47.5	30				
1 H_3	12	silty clay	39	44	17				
1 H_4	16	Sandy clay	35	33	32				very cohesive and resistant; contains nodules of iron concretions
1 H_5	14	sand	0	4	96				loose uncemented quartz particles 65% of sand is coarse
1 H_6	11	gravelly sand	0	0	75	25			
1 H_7	—	silty clay	38	42	20				Slimy and liquid
1 H_8	—	sandy organic soil	7	15	78		9.28	at F LH bank	high content of organic matter of volume
2	—	silty sand	12.05	16.0	71.5			at L LH bank	very loose when dry
3	—	silty clay	47.5 33	38.0 56	14 11			at H RH bank at K RH bank	very cohesive and resistant
4	—	Organic silty sand	15	12	73		3.1	at Mulia Bund J RH bank	dark

TABLE 2 : RAINFALL AMOUNTS MEASURED IN THE VICINITY OF KG. SG. MULIA

	Station 4062	Station 4064	Station 4065
Location	**Batu Caves Estate GR. VK 494 913**	**Aborigine Settlement Ulu Gombak VK 540 984**	**Wardieban Estate VK 529 883**
Period of Records	1909 — 1965	1921 — 1965	1919 — 1965
Maximum 24 hr. Rainfall	7.66	5.36	6.28
Maximum 48 hr. Rainfall	8.30	6.36	6.98
10. 6. 68	1.65	0.08	0.64
11. 6. 68	0.23	—	0.65
12. 6. 68	0.12	—	0.48
13. 6. 68	0.09	—	1.90
14. 6. 68	—	—	1.78

14th 1968. Though there had been heavy, prolonged rainfall since the morning of the previous day various individuals agreed that this was not extraordinary. No rainfall data was available for the particular site, but Table 2 gives the rainfall amounts of surrounding stations. Although rainfall does vary in intensity over short distances, the available data seems to verify inhabitants' observation.

The deviation involved the breaching of the bund somewhere between A and B in Fig. 1A. On June 25th when the writer first saw the area, there was still vertical erosion and slumping giving rise to bare vertical banks from point C headwards (Fig. 1A). Within eleven days, from the new cut alone, 1810 cubic feet of dusun soil had been removed. Aided by surface and subsurface seepage from the padi fields, padi land had also collapsed (Plate 1).

Though water depth did not decrease greatly (1.2 feet compared to a previous 1.4 feet) the width of the channel had on average more than doubled. At point H (Fig. 1A) widths of 11 and 12 feet, measured on June 27th and 2nd July respectively, showed a progressive widening which had not ceased even on July 21st. At the breach in the bund the width at the time of survey measured 30 feet compared to a previous 5.5 feet.

Again though water depth had not changed much, the stream had incised itself such that at the time of survey the average bankfull depth was 5.6 feet compared to a previous 2.7 feet. Bankfull depth increased downstream to a maximum of 8.3 feet at point C (Fig. 1A). This downgrading and collapse of bunds on either side extended till point 'J'; the knickpoint had travelled 380 feet in 23 days.

This incision produced a marked steepening of the Mulia's profile. The former gradient calculated to be 1: 148 using exposed bed and bund heights, had increased to 1:49 in the new channel. The regradation has left the old channel and parit mentioned earlier as hanging valleys, producing marked knick-points in their respective profiles, and a reversal of flow in the former Mulia making it a tributary of the new channel. This was checked with a temporary dam (Fig. 1A and Plate 2), delaying the process of undercutting and slumping.

Discussion and Conclusion

Two streams flowing within a short distance of each other with the bed and water surface of one much higher than the other create a potentially unstable situation. Had the hydrologic conditions in the area been uncontrolled and the Mulia not been bunded or canalised, the deviation would have occurred much earlier.

The most likely route for a deviation would have been along an existing overflow channel, especially since the parit discharged almost at right angles and directly opposite the overflow channel. However under the given conditions it is difficult to explain why the deviation occurred on that day especially since the previous day's rainfall had not been unusually heavy.

On July 6th the parit contributed 18% of the total flow of the Mulia (Table 3). If its discharge had been increased for some reason, it could have produced a significant deflection of the main stream of water, causing it to erode the left bank of the Mulia. Fig. 1A shows the bunds and channels to have been slightly sinuous at this stretch. Thus a certain amount of friction against the left bank would have been present, and even a slight deflection of the main stream might have been sufficient to cause the current to erode the sand at B instead of the clay. This would have caused not only soil erosion but also a greater quantity of water to flow down the overflow channel, creating two possibilities.

The bed-bank difference was greatest at C and D (Fig. 1A) where the slopes were already graded and stabilised. The increased flow down the overflow channel could have caused the knickpoint to retreat rapidly upstream and thus divert

Plate I: *Erosion of Padi Land*

Note the differential erosion of soil samples I and 3 (S I and S 3 respectively), which correspond to those shown on Table 2 and Map 3; the remaining portion of the bund (c) and the padi dying in the sawah. The Mulia and the kampong taliayer are annotated 'a' and 'b' respectively.

Plate 2: *The Old Lower Mulia*

A downcutting of the bed is discernible and the knick-point marking the head of the regradation corresponds to K 3 on Map 3. Note the temporary dam across the Mulia (a); and the holes in the clay profile (b), through which there is a sub-surface seepage of water.

TABLE 3 : FLOW CHARACTERISTICS — 6TH JULY

	Area (sq. feet)	Velocity (ft/sec)	Discharge (cusecs)	Percentage of Discharge
Taliayer	1.00	1.52	1.52	18.09
Sg. Mulia (upstream of breach)	5.55	1.2308	6.831	81.01
Sg. Mulia (at breach)	6.70	1.25	8.4	100.00

the Mulia's headwaters to the Blongkong. This process would have met with little resistance from the shallow rooted crops and loose silty surface layers along the new cut. The fourth horizon (Table 3) could have delayed the incision but once breached, the erosion would have been rapid as the soil below was loose, coarse sand underlain by slimy clay. Bed scour and reversal of flow in the old lower Mulia would have accelerated the process of regradation. Thus the knick-point which was formerly at the point marked by the break of slope of the escarpment (Fig. 1A) had travelled up to 'J' by 7th July.

Borings at various localities within the same irrigation scheme showed the occurrence of similar layers of coarse sand which at every instance was found to be saturated with water. Augering was difficult with the collapse of sand from the sides, and excavated sand flowed when tapped. Thus the deflection of part of the Mulia's discharge down the overflow channel and the subsequent increase in subsurface flow in the same direction could have caused the sand to flow thereby causing or aiding the collapse of sections of the land along the new cut.

Though the deviation was caused by the chance combination of minor factors acting on the inherently unstable relationship between two streams, no obvious trigger mechanism has been found. Scour and erosion have occurred at two other localities within the irrigation area in the same year. The only common factor to all three cases operating on the left bank of the Gombak which would have affected the hydrology was the clearing of agricultural land to the east of the Bentong Road for large scale housing development. Further research should be directed on the effects of the changes in land use on the discharge sediment yield and storm run-off characteristics of canalised river channels.

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