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THE 1967 FLOOD IN KELANTAN, WEST MALAYSIA

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SINOPSIS

Kertas ini ialah satu penganalisaan tentang hujan/banjir yang berlaku di Kelantan di antara 2hb. ke 6hb. Januari, 1967. Perhatian khas diberikan kepada aspek-aspek cuaca, haidrol, dan ekonomi. Kajian ini menunjukkan, di antara lain, bahawa fenomena-fenomena cuaca di kawasan teropika adalah pada sebahagian besarnya dipengaruhi oleh keadaan udara di tempat jauh dari tempat berlakunya fenomena-fenomena tersebut dan dalam kes ini ianya dipengaruhi oleh keadaan terkanan udara di China/Siberia. Dalam kejadian banjir tahun 1967 ini, lebih kurang 84.0 peratus daripada penduduk Kelantan telah terlibat dan 20.0 peratus atau pun 125,000 orang sekurang-kurangnya terpaksa dipindahkan ke tempat-tempat yang selamat. Kerosakan telah dianggarkan sebanyak lebih kurang $(M)30,000,000. Memandangkan kepada kerapnya hujan lebat/banjir berlaku di pantai timur Malaysia Barat amnya dan Kelantan khususnya, maka disyorkan supaya pihak-pihak yang berkenaan memikirkan kemungkinan menukar/mengubahsuaikan guna-tanah di lembah-lembah yang terlibat dengan memperkenalkan cara yang boleh mengurangkan kerosakan banjir. Ini boleh diselenggarakan samada dengan memindahkan seluruh bandar atau kampong dari kawasan lembah ke kawasan yang tinggi ataupun mengubahsuai satu-satu kawasan indastri supaya tempat-tempat medan kereta, misalnya, berada dizun banjir sementara bangunan-bangunan yang tidak tahan dilanda banjir diletakkan di kawasan-kawasan tinggi supaya terselamat dari banjir.

SYNOPSIS

This paper is a case study of the heavy rainfall/flood which occured in Kelantan during 2nd. through to 6th., January, 1967. It analyzes the meteorological, hydrological, and some economic aspects of the situation. Among other things, the analysis shows that local weather phenomena in the tropics are largely influenced by atmospheric conditions far beyond the immediate locality where the phenomena are observed, and in this case they are influenced by the pressure condition in China/Siberia. In the 1967 flood analyzed here, about 84.0 percent of the population in Kelantan were affected and at least 20.0 percent or 125,000 people had to be moved to safer grounds. Damage was estimated to be in the region of $(M)30,000,000. As flood and heavy rainspells are recurring phenomena in the east coast of West Malaysia

in general and in Kelantan in particular, it is suggested that the feasibility of changing/modifying the use of flood plain land so as to introduce a practice that is less susceptible to flood loss be considered. This may range from transfer of an entire town or village from a riverine to an upland site, to a modification of an industrial site so that parking lots are in the flood zone and vulnerable buildings are on higher land.

In the east coast of West Malaysia and Singapore, the northeast monsoon season (Mid–October–March) normally brings spells of heavy rainfall resulting in localized inundation and occasionally widespread floods.[1] This season is mainly influenced by the cold winter anticyclone over the China/Siberian region.[2] Gan[3] described the heavy rains as in some way connected with low level strengthening of the northeast trades following the development of large intensifying cold anticyclone over China. The widespread equatorward acceleration and increase of wind speed was originally termed 'Surge of the trades' by Deppermann who considered it as responsible for initiating the 'most spectacular weather of the cold season.'[4] Watts attributed the heavy rains as due to strong convergence which takes place on air-stream boundaries[5].

This paper is a case study of one such rain spell/flood during the northeast monsoon in the State of Kelantan from about 2–6 January, 1967. It analyzes the meteorological, hyrdrological and some economic aspects of the situation. Fig. 1 shows the location of the study area and place names mentioned in the text.

Meteorological Aspects

As there were very few observations available, surface as well as upper air, from China and Japan, and as the satellite tracking station had not yet been established at the time of the flood, only a very brief account

1 see Tan Suan-Foon, *Torrential Rain in Singapore, 9–10 December, 1969*, Meteorological Service Singapore, Memoir No. 9, p. 1.

2 Tan Suan-Foon, *Torrential Rain in Singapore, 9–10 December, 1969;* Chia Lin Sien and Chang Kin Koon, 'The record floods of 10th. December, 1969 in Singapore.' *Journal of Tropical Geography*, v. 33, 1971, 9–19; Chia Lin Sien, 'A case study of a disturbance during northeast monsoon over Southern West Malaysia and Singapore on 9th. and 10th. December, 1969.' paper presented at the Seminar on Synoptic Analysis and Forecasting in the Tropics of Asia and Southwest Pacific, December, 1970, Singapore; L.K. Liow, 'A study of the 9th/10th. December, 1969 heavy rainfall in Singapore.' Singapore Meteorological Service, 1970 (unpublished).

3 T.L. Gan, *A Study of Some Heavy Rain-Spells on the East Coast of Malaya During the Northeast Monsoon Season*, Memoir of the Malayan Meteorological Service, No. 6, 1962.

4 C.E. Deppermann, *Outlines of Philippine Frontology*, Manila: Bureau of Printing, 1936.

5 I.E.M. Watts, *The Equatorial Weather*, U.o. London Press, 1955, 244pp.

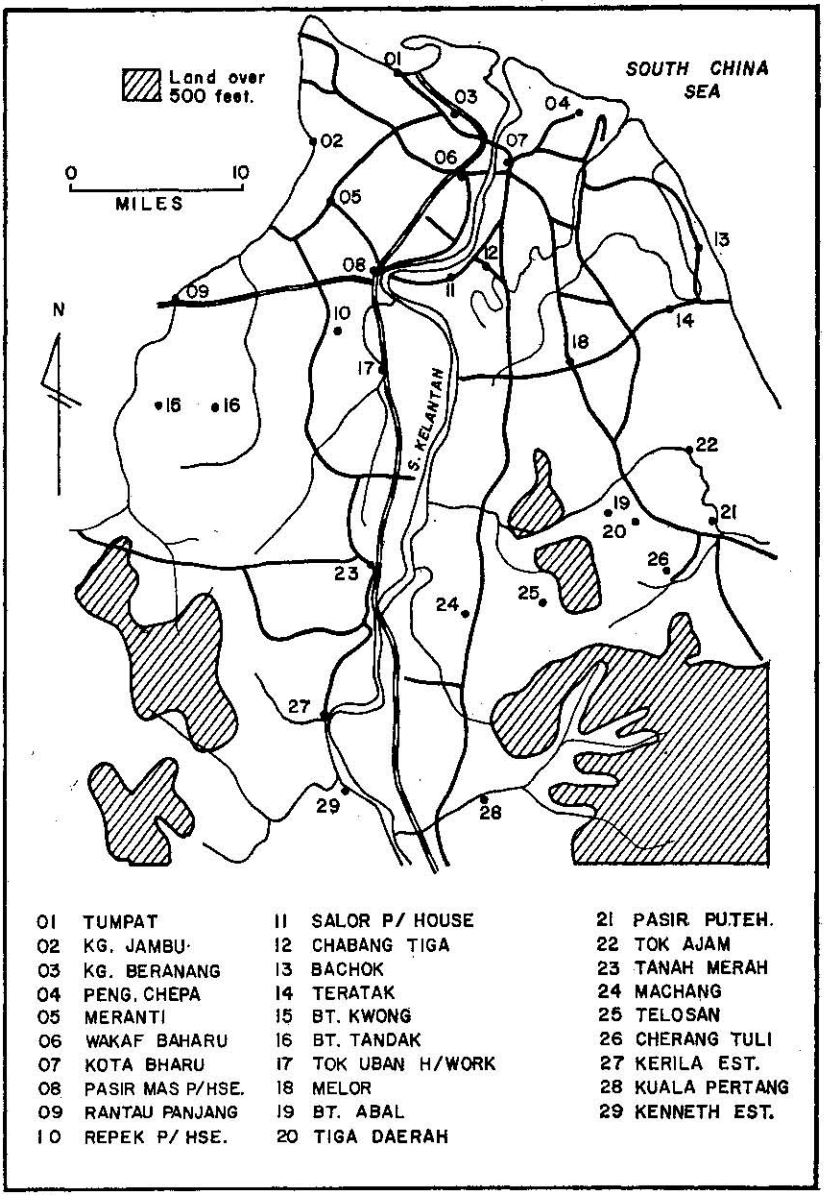

FIG. 1 LOCATION OF RAINFALL STATIONS AND RELIEF, KELANTAN.

of the synoptic situation during the heavy rainspells/flood of January, 1967 is attempted here[6].

Comparisons of isobars between 1st. through to 3rd. January, 1967 reveal a sharp intensification of the anticyclone over China. The surface pressure at Hong Kong increased by 8.0 mb. from 1018.7 mb. on 1st. January to 1026.7 mb. on 3rd. January indicating a possible outbreak of bad weather over the east coast of West Malaysia[7].

Surface northeasterly winds along the South China Sea strengthened progressively equatorwards after 1st. January and constituted what is known as monsoonal 'surge' which subsequently affected the east coast of West Malaysia. On the 4th., stronger northeasterly surge was observed over South China Sea with wind in the region of 30 knots reported as far south as 2°N latitude. A small vortex at the surface over Pahang was located. Rain was widespread but with the heavy downpour mainly confined to the northeast and central part of the east coast of West Malaysia. The station at Kota Bharu reported a steady increase in rainfall reaching a maximum of 23.03 inches on 6th., January. Over West Malaysia the vortex at the surface was still over central Pahang on the 5th. but it was no longer evident on the 6th. On the 7th., the weather improved as the disturbance moved across West Malaysia and the surface anticyclone weakened over China. Simultaneously there was a decrease in wind speed over South Vietnam at the 850 mb. level and winds over West Malaysia backed to easterlies at the 200 mb. level. Surface weather charts for the 2nd. through to the 5th. January, 1967 are shown in Fig. 2 to illustrate the main meteorological events.

Rainfall and Extent of Floods

Flooding on a catastrophic scale hit the State of Kelantan in early January, 1967 when intense prolonged rainfall occurred throughout the northeast coast of the peninsula. Such intensities never happened at least since 1932 (Fig. 3). During the January, 1967 flood, nearly 48.0 percent of rainfall in the month of January fell on one day (6/1/67) and about 94.0 percent of it during the week between 2–8 January, 1967. Fig. 4a-f shows the rainfall distribution from 2nd. to 7th. January, 1967 for Kelantan and Fig. 5 shows the six-day total rainfall distribution, 2–7 January, 1967. The analysis indicates an intensification of rainfall from 2nd.

6 see however T.L. Gan, 'The circulation pattern over Singapore and the the East Coast of West Malaysia during January and February 1967 compared with that of January and February 1968.' in W.M.O. *Forecasting of Heavy Rains and Floods: Proceeding of a Joint Seminar held by the Regional Assn. II and V of the World Meteorological Organization at Kuala Lumpur, West Malaysia from 11th. to 23rd. November, 1968*, Geneva, 1970, 283–289.

7 Gan, *A Study of Some Heavy Rain-Spells on the East Coast of Malaya during the Northeast Monsoon Season.*

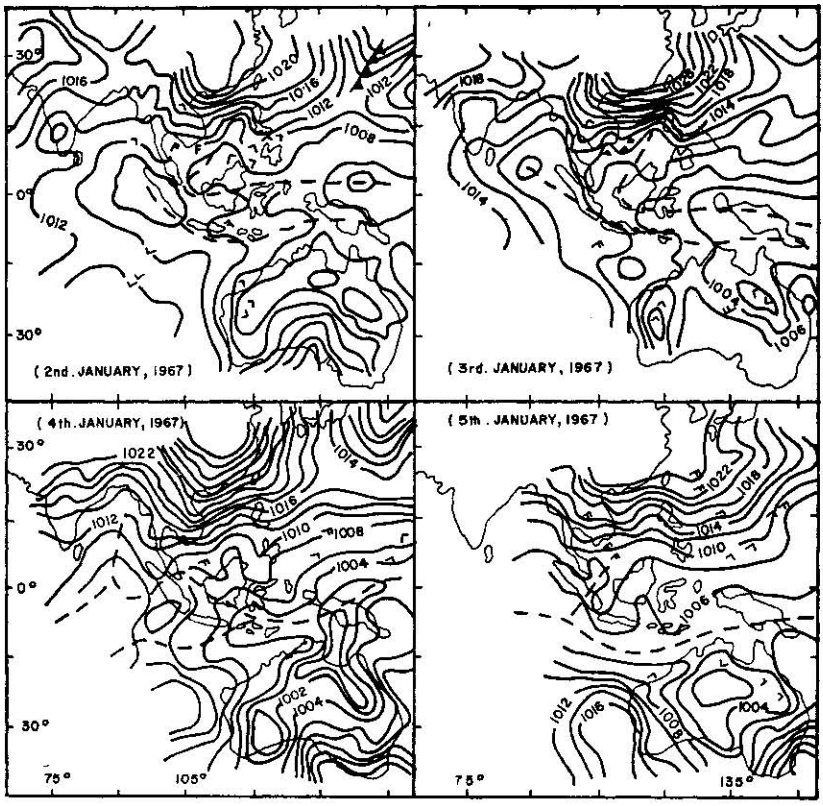

FIG. 2 SURFACE CHARTS FOR 0600 GMT 2nd. TO 5th JANUARY, 1967

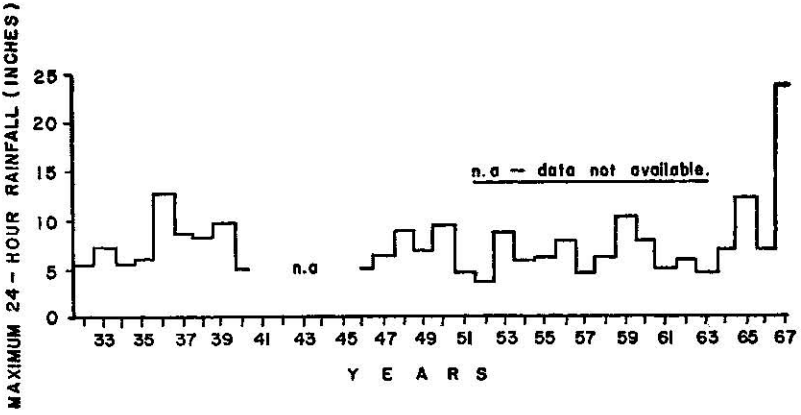

FIG. 3 24 - HOUR MAXIMUM RAINFALL (1932 - 1967), KOTA BHARU, KELANTAN.

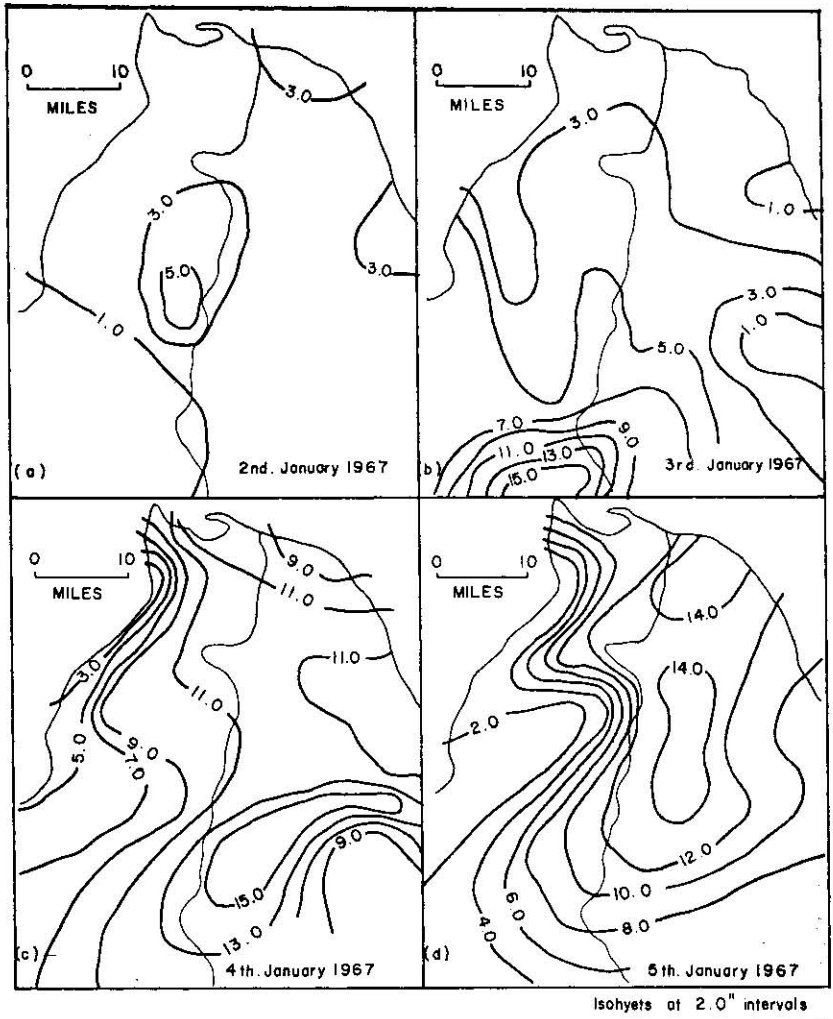

FIG. 4(a–d) DAILY RAINFALL DISTRIBUTION, 2nd TO 5th. JANUARY, 1967 INCLUSIVE, KELANTAN WEST MALAYSIA.

through to 6th. January, with the belt of maximum rainfall migrating progressively from inland areas towards the coast.

During the storm period, the swirling flood waters of Sg. Kelantan and its tributaries swept through all the riverine areas in the upper catchment. In its lower reaches the river overflowed both banks and on the night of 4th. January inundated nearly the entire coastal plain. At this time in Kota Bharu, the flood level was reported to exceed R.L. 18.00. On the 6th., the flood level reached its maximum of R.L. 20.40 and most of Kota

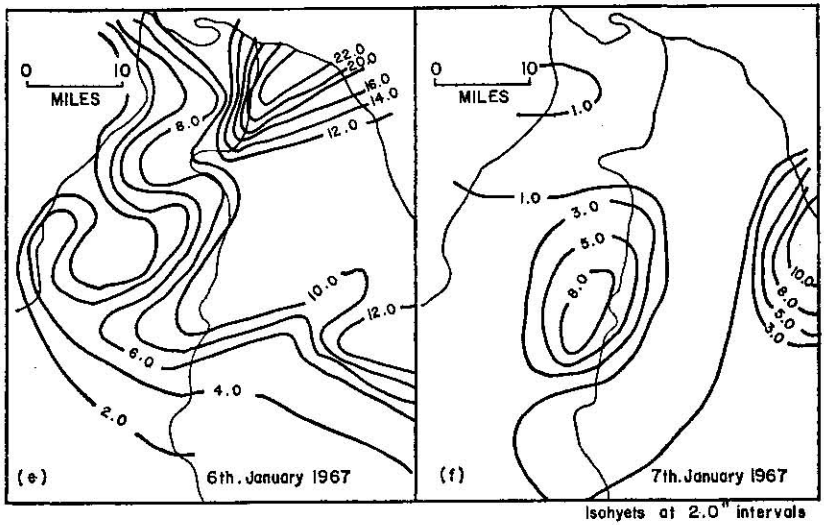

FIG. 4 (e–f) DAILY RAINFALL DISTRIBUTION, 6th. TO 7th. JANUARY, 1967 INCLUSIVE, KELANTAN WEST MALAYSIA.

Bharu town was under water. The progressive changes in flood levels on different parts of Sg. Kelantan are shown in Fig. 6. As a result of the spill from Sg. Kelantan, Sg. Golok rose to abnormally high levels, and with the exception of Golok town in Thailand, inundated its entire flood plain. The overspill from Sg. Kelantan also intensified flooding of the catchment of Sg. Kemasin, Sg. Pengkalan Datu and Sg. Semerak. The extent of the land submerged was estimated at more than 1,150 sq. miles, approximately 20.0 percent of the entire area of Kelantan. Fig. 7 shows the approximate areas affected in the 1967 flood in Kelantan. Based on all available records up to 1967 for Kota Bharu, Kelantan, an estimate of the return period of the extreme rainfall of 6th. January, 1967 is attempted[8] (Fig. 8). From the above relationship, the return period of the maximum 24-hour rainfall for 6th. January, 1967 is found to be approximately 40 years. However, due to the short length of the rainfall records on which the study was based, the return period of 40 years in this case would be best interpreted as merely giving an indication of the exceptionally high rainfall on 6th. January, 1967.

As a direct result of this severe flood damage, the Deputy Prime Minister appointed a Special Committee to examine the causes and extent of floods and flood damage in West Malaysia, and advise the Government

8 For detail regarding this method, see R.G. Barry. 'Long-term precipitation trends.' *Introduction to Physical Hydrology*, (ed. R.J. Chorley), 1969, 193–196; L.B. Leopold, M.G. Wolman & J.P. Miller, *Fluvial Processes in Geomorphology*, Freeman, 1964, 63–66.

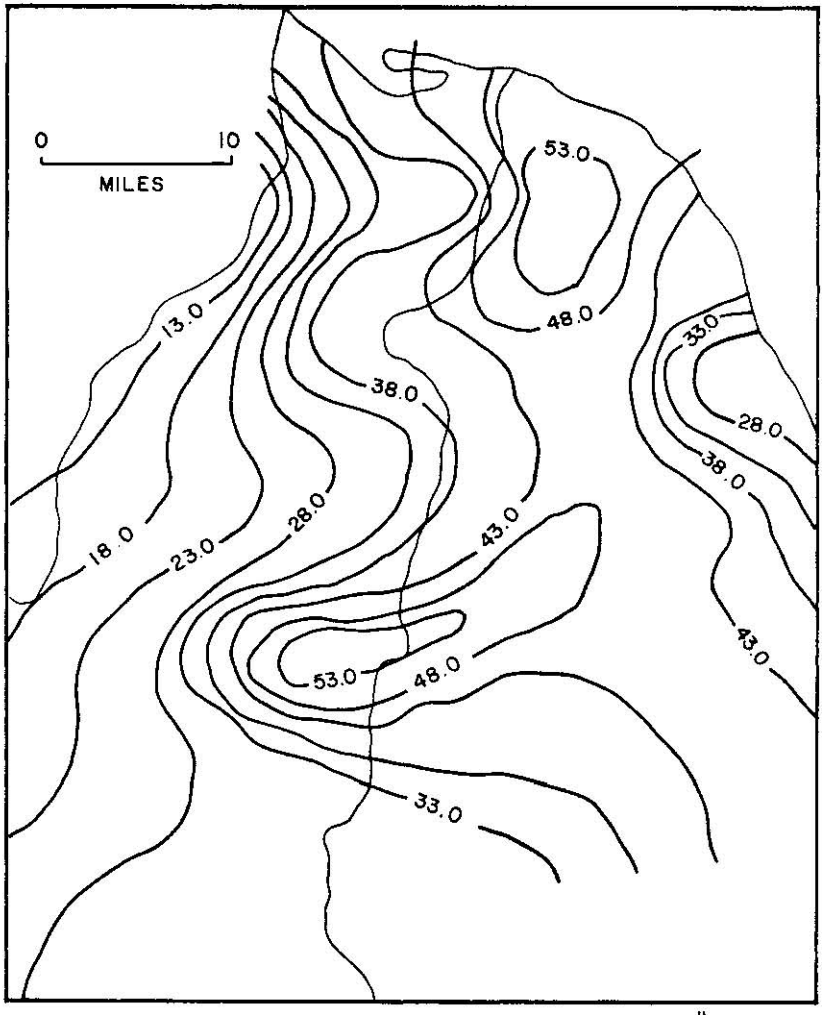

FIG. 5 SIX-DAY TOTAL RAINFALL DISTRIBUTION OVER KELANTAN 2nd. TO 7th. JANUARY 1967.

on the measures to be taken to reduce or prevent such floods in the future[9]. The possibility of seeking external assistance to achieve these objectives was also included in the terms of reference of the Committee. The major recommendation made by this Committee was for the establishment of a comprehensive flood forecasting and warning system com-

9 see Ministry of Agriculture and Cooperatives, Malaysia, *Triennial Report of the, Drainage and Irrigation Division for the Year 1967, 1968 and 1969*, Kuala Lumpur 1970, p. 2.

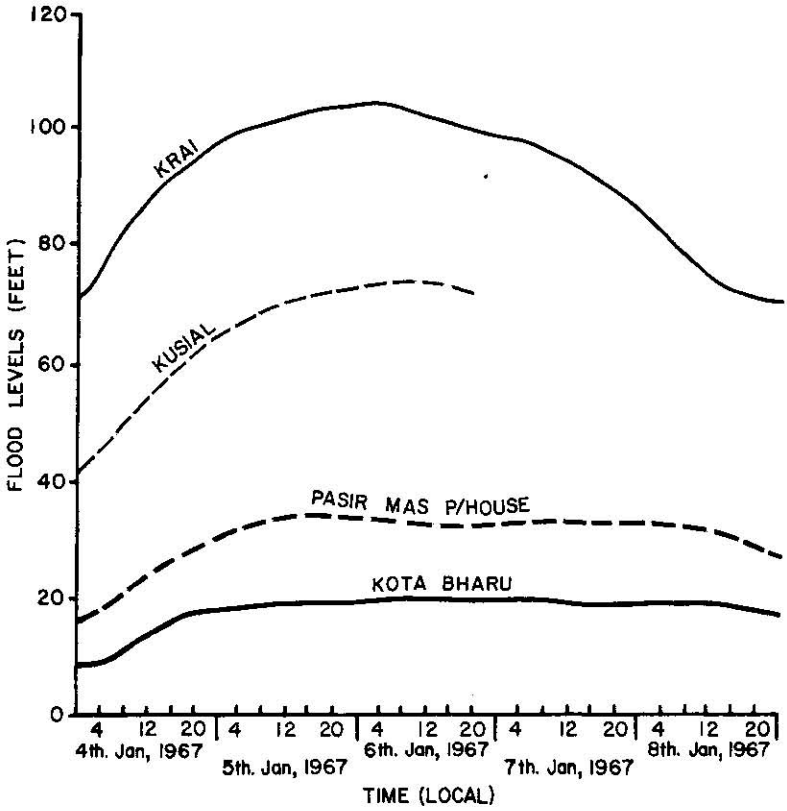

FIG. 6 SIMULTANEOUS FLOOD LEVELS OF SELECTED WATER LEVEL STATIONS ON SUNGAI KELANTAN 4th. Jan — 8th. Jan, 1967.

prising: (a) Automatic Pictures Transmission equipment for the reception of weather satellite data to be installed for the Meteorological Department; (b) Three sets of Probability of Precipitation Intensity Radar along the East and West Coast of Malaysia for the Meteorological Department; and (c) Telemetering, rainfall and water level stations in the Sg. Perak, Sg. Kelantan and Sg. Besut and Sg. Trengganu Catchments for the Drainage and Irrigation Department.

Six factors have been listed as the main reasons which contributed to the 1967 flood and they are first, the unusually heavy rains as can be seen from Figs. 3 and 4; second, the closing up of the Kelantan estuary by sand bars; third, the very low ground level along main river banks, being less than +5.00 at a distance of 25 miles from the outlet in places; fourth, the poor conditions of the various drainage systems; fifth, the small tidal range along the Kelantan coast especially during the northeast monsoon

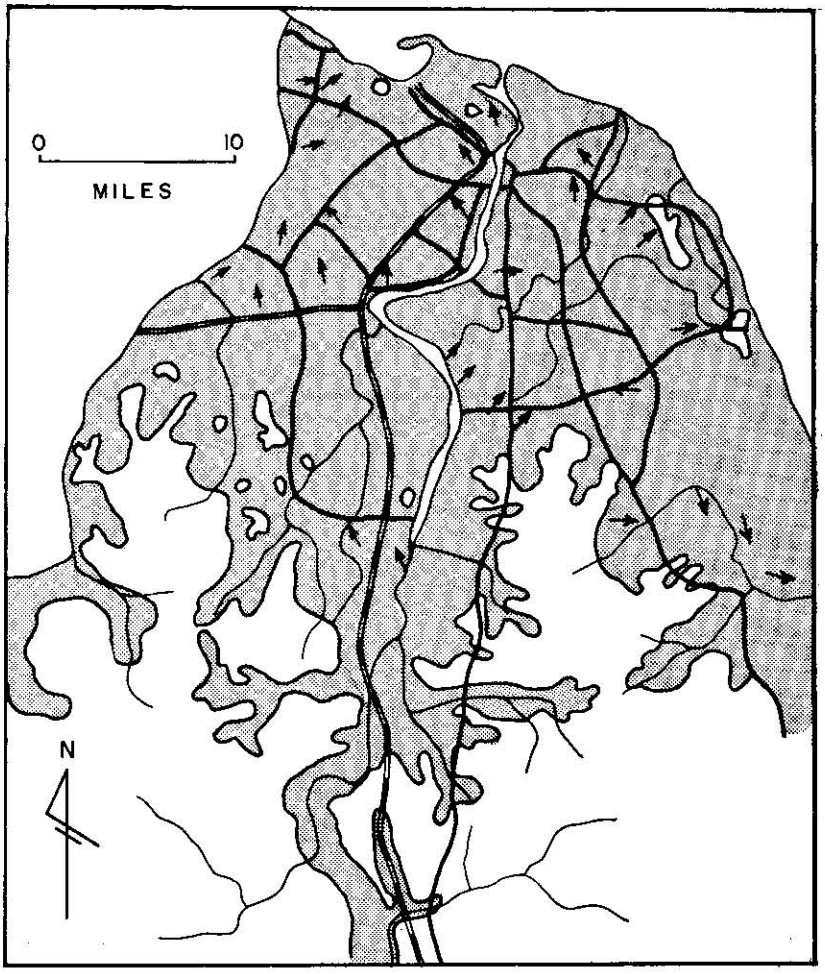

FIG. 7 FLOODED AREAS IN KELANTAN ON 6th. JANUARY 1967. ARROWS INDICATE THE DIRECTIONS OF MOVEMENT OF FLOOD WATERS.

season; and finally, the indiscriminate developments of the upper reaches of the river and throughout its catchment area resulting in rapid run-off from the hills and heavy silting in the rivers.

The Effect of Flood

Though it has been estimated that the scale of destruction has cost the nation some 30 million dollars[10] in the State of Kelantan, it would not

10 Currency is in Malaysian dollars throughout.

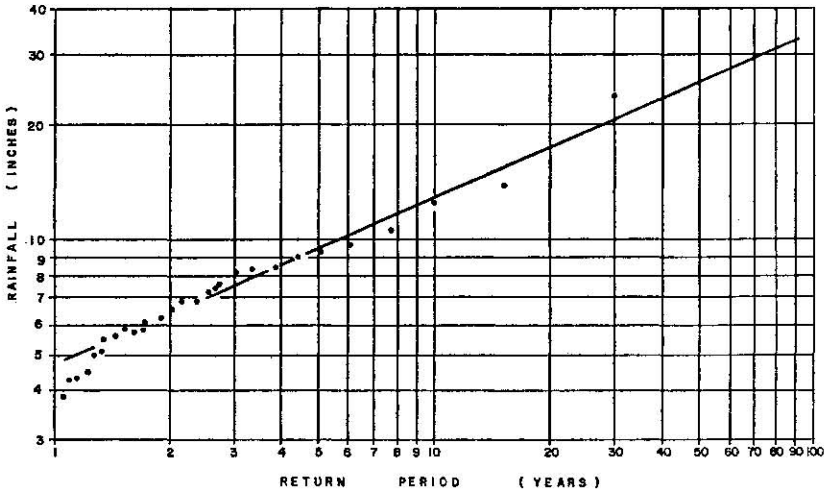

FIG. 8 RETURN PERIOD OF EXTREME RAINFALL, KOTA BHARU, KELANTAN.

be possible to asses the actual extent of damage as loss of lives and property and the destruction of homes and communities could not be reckoned purely in monetary terms. However, an estimated damage caused by the 1967 flood is given in Table I.

TABLE I

ESTIMATE DAMAGE CAUSED BY THE 1967 FLOOD
(EXC. LOSS DUE TO INTERRUPTED SERVICES
SUCH AS EDUCATION, TRANSPORT, COMMUNICATION ETC.)

Category	Kelantan ($)	Trengganu ($)	Perak ($)	Total ($)
Land and crops	15,567,000	3,251,000	2,500,000	21,318,000
Structures	4,879,000	2,241,000	3,737,000	10,857,000
Property	892,000	4,694,000	116,000	5,702,000
Mining activities	–	229,000	621,000	850,000
	21,338,000	10,415,000	6,974,000	38,727,000

(Ministry of Agriculture)

Kelantan was completely cut-off from the rest of West Malaysia on 5th. January, with the Pengkalan Chepa airport closed and all telecommunication lines down. A state of emergency was declared by the Chief Minister on the same day. Numerous cutting and bank slips together with washouts put off the local train services. The 12-foot high overhead railway bridge at the 43rd. mile Kota Bharu–Kuala Krai Road was sub-

merged. Several parts of Kota Bharu were without lights and no operation could be carried out in the General Hospital because of electricity failure. It was estimated that a total of 536,800 persons or over 84.0 percent out of the State's population of 636,700 were affected by the flood. At least 125,000 persons or about 20.0 percent were forced to flee from lowlying areas. Various places of evacuation were set up and landing zones selected for flying in relief. The death toll went up to 38 since 4th. January[11].

TABLE II

DAMAGE TO PADI AREAS IN THE 1967 FLOOD, KELANTAN

Districts	Total Padi Areas		Estimated loss of padi (gantang)	Estimated cost ($)
	Area planted (acres)	Area damaged (acres)		
Kota Bharu	32,400	13,500	3,447,000	2,240,550
Pasir Mas	42,200	15,800	3,002,000	1,951,300
Bachok	25,800	15,100	3,827,000	2,487,560
Pasir Puteh	30,800	15,400	5,190,000	3,373,500
Tumput	20,500	12,700	4,445,000	2,889,250
Machang	10,000	3,200	886,400	576,160
Tanah Merah	16,700	550	110,000	71,500
Ulu Kelantan	4,700	1,200	264,000	171,600
	183,100	77,450	21,171,400	13,761,410

(D.I.D., *Flood Report January, 1967*, Kel.)

With the crops and livestock, the loss was heavy due to the depth and duration of the flood, while many padi fields were rendered useless by heavy discharge of river sand over the fine alluvium. Table II gives the estimated loss of padi in all the eight districts while Table III gives the flood damage to irrigation areas. Damage to transportation and communication routes was one of the major consequences of the flood. Destruction to roads took varying forms and degrees of severity and was esti mated to be in the region of $782,000. The severity of the flood was further aggravated by disruption to the railways. To add to the chaos the main telephone exchange which was located on relatively low ground was inundated and all telephone services were disrupted. The telecommunication Department estimated the damage to be in the region of $86,550. Table IV is a comprehensive report from the National Electricity Board on the damage sustained during the flood. Among other things, it indicates that power stations and substations suffered the most damage.

11 Drainage & Irrigation Department, *Flood Report January, 1967*, (unpublished).

TABLE III

FLOOD DAMAGE TO IRRIGATION AREAS IN JANUARY, 1967 IN KELANTAN

Scheme	Total area (acres)	Area planted (acres)	Area damaged (acres)
Sg. Lemal Irrigation Scheme	23,000	19,700	5,150
Jubakar/Baroh Kelong Bunding	1,700	1,600	480
Salor Irrigation Scheme	4,100	4,100	475
Bt. Abal Irrigation Scheme	3,800	3,760	160
Ulu Sat Irrigation Scheme	1,251	1,010	90
Pasir Mas Irrigation Scheme	5,100	5,100	–
Repek Irrigation Scheme	1,120	768	154
Teratak Pulai Irrigation Scheme	1,560	1,480	350
Sg. Danan Irrigation Scheme	800	800	20
Padang Lindong	624	624	–
Pertok and Putat	145	140	50
Sg. Galang	200	180	20
Lubok Dongor	130	130	80
	43,532	39,392	7,029

(D.I.D. *Flood Report January, 1967*, Kel.)

TABLE IV

DAMAGE OF NATIONAL ELECTRICITY BOARD PROPERTIES DURING JANUARY, 1967 FLOOD

Items	Estimated damage $
Office building and breakdown rooms, Jalan Tok Hakim, Kota Bharu	5,188.60
Office building, Pasir Mas	370.00
Board Qrs.	12,065.00
Substations	22,861.00
Power stations	28,212.00
Rural stations	166.00
Board's vehicles	208.80
	69,071.80

(D.I.D. Flood Report January, 1967, Kel.)

Conclusions

Besides supporting the contention that local weather phenomena in the tropics are largely influenced by atmospheric conditions far beyond the immediate locality where the phenomena are observed, this study also indicates the importance of proper planning in the development of river catchments and the need for more efficient flood warning systems in order to reduce damage to a minimum. However, as flood and heavy rain-spells

are recurring phenomena in the east coast of West Malaysia during the monsoon season, perhaps it would not be too irrelevant at this stage to consider the feasibility of changing/modifying the use of flood land so as to introduce a practice that is less susceptible to flood loss[12]. This may range from transfer of an entire town or village from a riverine to an upland site, to a modification of an industrial site so that parking lots are in the flood zone and vulnerable buildings are on higher land.

Acknowledgements

I wish to thank the Director, Ministry of Agriculture and Fisheries, the Director of the Malaysian Meteorological Service and the staff of the Malaysian Drainage and Irrigation Department, Kuala Lumpur for data, and the Cartographic Section of the Department of Geography, National University of Malaysia for the diagrams in this paper.

12 I. Burton et. al., 'The Shores of Megalopolis: Coastal Occupance and Human Adjustment to Flood Hazard.' *Pub. in Climatology*, Vol. XVIII, No. 3, 1965, 603 pp.; *Types of Agriculture Occupance of Flood Plain in the U.S.*, Dept. of Geog. U.o. Chicago, Res. Paper No. 75, 1962; G.F. White, *Human Adjustment to Flood: A Geographical Approach to the Flood Problem in the U.S.* Dept. of Geography, U.o. Chicago, Res. Paper No. 29, 1962; F.C. Murphy, *Regulating Flood Plain Development*, Dept. of Geography, U.o. Chicago, Res. Paper No. 56, 1958; G.F. White et. al., *Papers on Flood Problems*, Dept. of Geography, U.o. Chicago Res. Paper No. 70, 1961