Soil Conservation-a Measure of Flood Control.

By

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Introduction

The Indus river system is made up of the main rivers namely Indus, Jhelum, Chena, Ravi, Sutlej and Beas. These rivers are further made up of quite a number of tributaries which are of two categories. In the first category fall those tributaries which form and join the main river in the mountainous region. In the second category fall those tributaries which take their start either in the mountainous region, or in the sub-mountainous tract or lower down in the plains. The major part of the tributaries in the second category drain the sub-mountainous region. This short note will deal with the study of the tributaries of this category with particular reference to "Soil Erosion" an agent responsible for forming these tributaries and flood, an outcome of this process.

These tributaries are mostly flashy streams which at times bring down huge discharges especially in monsoon season. Flood in an individual tributary, however big it may be, may not matter much in the river ordinarily but when such a flood synchronises with the flood in the main river, it causes havoc.

Flood of 1957

The river Chenab recorded highest flood of 8,30,000 cusecs in the history of Marala Headworks on 26th August 1957. In addition, the Left Upper Marginal Bund was over topped and breached at many places causing a flow of about 4,00,000 cusecs. The huge flood was very flashy and the rate of rise was very quick as is indicated by the Hydrograph enclosed. It would be interesting to know that the major contribution in this high flood was by the 'Tawi' a tributary of the river Chenab which joins it shortly above the Marala H/works. It is roughly estimated that the Tawi brought down about 8,00,000 cusecs out of the total combined discharge of 12,30,000 cusecs. The synchronisation of the high floods in the main river Chenab and its tributary 'Tawi' boosted up the peak discharge to a level that overtopped the marginal Bund and caused severe breaches therein. The overtopping of the Marginal Bund and its breaches worked as a safety valve at that critical moment and saved the costly Weir from a disaster. The Weir at Marala had passed a peak discharge of 8,30,000 cusecs against its designed capacity of 7,36,000 cusecs.

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Yet another synchronisation of floods created chaotic conditions in the districts of Sialkot, Gujranwala aud Sheikhupura. As would appear from the rainfall statement given below, the rainfall was heavy and intensive on 25/8 and 26/8/1957 .—

	Marala	Kham-bran-wala.	Bomban wala.	Sango-wali.	Warpal	Sialkot	Wazir-abad.	Naro-wal
25/8/57	4.50	1.80	4·70	4·20	2·00	1·23	6·72	0·30
26/8/57	11.00	12.00	11.54	7.20	7.10	9.22	Not received.	8.35

As the catchments of " Aik " and " Palkhu " are adjoining to that of " Tawi ", these two torrents, tributaries of Chenab too, swelled simultaneously. The breach water from Upper Marginal Bund of Marala Headworks joined hands with the flood waters of Palkhu and Aik and this combined water swept past the tract dislocating the population and breaching the canal systems serving the area. The heavy local precipitation in the drainage basins of " Aik " and " Palkhu " below Upper Chenab Canal and the spill from Chenab combined caused severe break down of communication between Wazirabad and Gujrat.

Another synchronisation occured lower down. The discharge of " Bhimber " another tributary of Chenab that flows past the town of Gujrat and takes its root in the sub mountainous region ol Azad its Kashmir added its flow to the already swelled Chenab and boosted up its discharge to 10,80,000 cusecs at Khanki, as is indicated by the hydrograph enclosed. Fortunately, it did not cause much damage to any work.

The river 'Ravi' has a sizeable tributary named " DEG " that causes a great flood menace when it is in spate simultaneously with the main river. The catchment area of " Deg " is close to that of "Tawi". The heavy precipitation on 25th and 26th August 1957 in the catchment of " Deg " as well brought down heavy flood therein but fortunately it did not synchronise with the flood of 'Ravi' which followed and thus very acute condition was averted.

From the experience of the floods of 1957 and that of previous years, it is now more than evident that, barring few occasions, whenever the main river brings down heavy discharge, the flood conditions become more acute when heavy and synchronised contribution is made by the tributary torrents that join in the main rivers enroute.

The Main Rivers

As is well known to every body the main rivers in the mountainous region higher up are situated in the territory, at present in

the possession of a foreign country. To study conditions of flood in that territory is impossible. All that can be guessed is that a large scale deforestation has been done and is in progress because of the heavy demand of timber and fire wood. This coupled with high intensity of rainfall causes higher floods in the main rivers than those experienced in the past.

The Tributaries.

The tributaries as aforesaid originate mostly from the sub-mountainous regions. These drain the tracts that were once the flood plains of big rivers. Their formation and the present configuration of land are due to age long "soil erosion" which has brought about geological changes from ages in the past.

Soil erosion and its causes.

Soil erosion is defined as the process of soil removal by natural agencies namely wind and water either by the action of one or both combined. The menace of soil erosion has been active not only in this country but it has had its effect on the destiny of every agricultural people recorded in history. This process continued through centuries in the past with the result that conditions got out of control and the havoc by floods went on increasing year after year causing destruction to life, land and property. The result has been ruinous. It is beyond any doubt that a cultivator has a good deal to do with the flood control because land use must do its bit in any large scale scheme for the prevention or control of flood waters. It is an established fact that the uses to which we have put our uplands have been the cause for flow of much water and silt that form the floods. In the United States of America, the disasterous effects of soil erosion were taken notice of in good time. The efforts made by the people and the measures adopted to conserve water and soil have been most successful and the results achieved have been splendid. The soil conservation practices adopted there, have now become the standard ones and are being freely used and applied by countries the World over. It would do a lot of good to study the methods and practices adopted in that country and devise ways and means to apply those to our lands with modification where necessary. India has similarly gone ahead to develop Damodar valley on the same lines through a combined plan of flood storage in reservoirs on main river and head water control in the uplands by conservation measures.

What has happened in the uplands of West Pakistan indicates the degree of unbalance between the eroding forces and the resisting power of soil in that locality. The intensity of rainfall, its duration, frequency and time of occurrence together with the steepness of slope constitute the main eroding factors. The resistence offered by land is determined by soaking capacity of soil and the magnitude of dislodgement when unprotected by plant or vegetation cover.

Improper use of upland in West Pakistan and effect on floods.

As aforesaid the use to which land is put has a good deal of effect on the intensity and duration of floods. Pakistan is an agricultural country. Among the rural population, agriculture is the main occupation. The influx of refugees and the increase in population since the dawn of independence have called for more and more food production. The " Grow More Food " compaign launched already has caused every inch of available land to come under plough. This indiscriminate tillage of land and removal of soil cover especially in the uplands has accelerated the soil erosion and the intensity of floods in the tributaries under study.

Soil conservation.

Soil erosion cannot be checked in absolute sense. The normal rates of erosion and run off are those resulting from natural conditions of soil cover. The solution of the problem of control lies in gaining factual knowledge as to how and where the natural plant covcr can be destroyed by breaking the land without disasterous losses. To achieve this end restrictions should be placed on open cultivation on slopes and conditions must be laid down to hold erosion within predetermined limits. There would thus be certain slopes befitting the cultivated crops, steeper slopes best suited for permanent pastures and still steeper slopes that are only to be used for forests. The division between these principle uses can be very wide and flexible and its application to a particular unit of sub-catchment would depend on determination of local conditions and requirements.

Soil conservation measures.

The measures of soil conservation include interalia :—

(*a*) Contour farming
(*b*) Strip cropping
(*c*) Contour ridging
(*d*) Terracing
(*e*) Gully plugging
(*f*) Construction of bunds
(*g*) Afforestation.

The detailed study of these conservation practices is outside the scope of this paper. Suffice it to say that run off as a result of precipitation in such catchments would considerably slow down and the lag so caused would avert flood conditions. Soil erosion would thus not only be checked but considerable areas which had already gone waste would be recovered and reclaimed.

Planning soil conservation measures in head waters of Tributaries.

Soil erosion has taken into its grip huge areas in the Ex-Punjab territory. An estimate made in this direction is as under :—

Area destroyed by erosion	5 lac acres
Area seriously affected	10 ,,
Area partially affected	15 ,,
Area under threat of erosion	10 ,,
Total	40 lac acres.

The task of conservation in the vast tract spread over all the districts of Ex-Punjab is an uphill one and requires careful and thorough planning. Technical planning should be based on hydrographic units. Each drainage basin and its sub-catchments have specific features of their own and for successful development each small catchment should be adopted as a unit for treatment and operation.

Detailed contour survey of the drainage basin of a tributary selected for development should be done. As all the land proposed to be treated is proprietary the existing revenue shajras shall have to be correlated with the survey plan. Remembering that the individual holdings are very small, the correlation of the two maps becomes all the more necessary. This task becomes easier to manage if the consolidation of holdings is carried out in that area. Land capability and land use maps could also be based on this survey.

Hydrological studies for the main rivers, tributaries and their sub-tributaries are very essential to determine the quantity and intensity of rainfall and run off drained by the basins. This requires a comprehensive study of the tract for siting raingauge stations and discharge sites. Intensive propaganda is needed to make the tillers of land realise their obligations to themselves, to their neighbours and to the community at large.

CONCLUSION

If the catachment areas of the tributaries of the rivers Ravi, Chenab, Jhelum and Indus are treated on the basis of soil conservation measures suited to the locality and small dams constructed on the main tributaries to conserve water that ultimately comes down, the contribution made by these to the acute flood conditions experienced in the past few years is reduced to almost Nil. The lag, thus, caused for the flood waters of these tributaries to reach the main river becomes effective. Synchronisation with the flood in the main river does not occur with the result that the situation remains under control.

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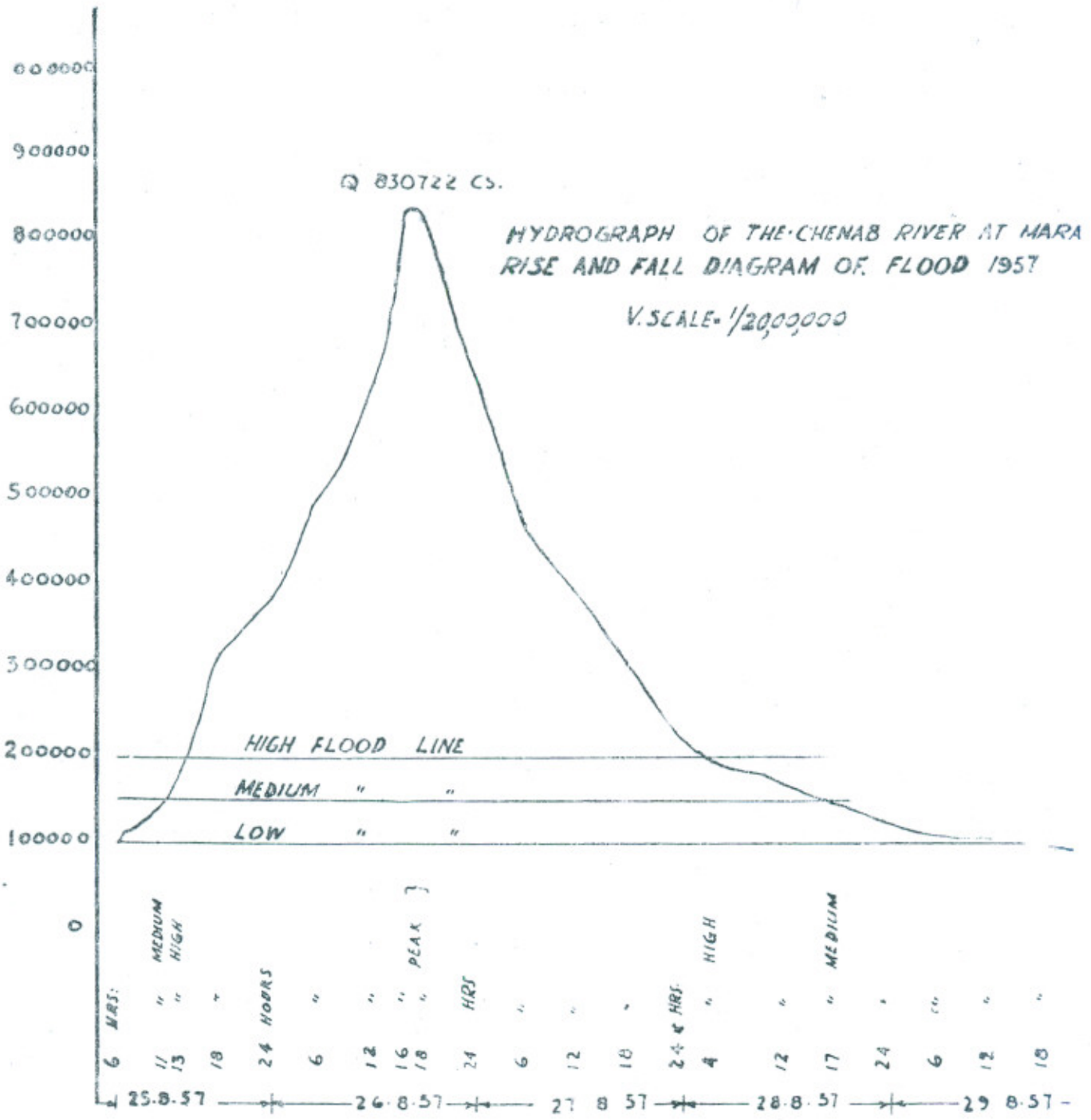
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HYDROGRAPH OF THE CHENAB RIVER AT MARA
RISE AND FALL DIAGRAM OF FLOOD 1957
V. SCALE = 1/200,000
900000
800000
700000
600000
500000
400000
300000
200000
100000
0
HIGH FLOOD LINE
MEDIUM " "
LOW " "
6 HRS: " MEDIUM
11 " " HIGH
13
18
24 HOURS
6
12
16 PEAK
18
24 HRS
6
12
18
24 HRS
4 HIGH
12
17 MEDIUM
24
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18
25.8.57
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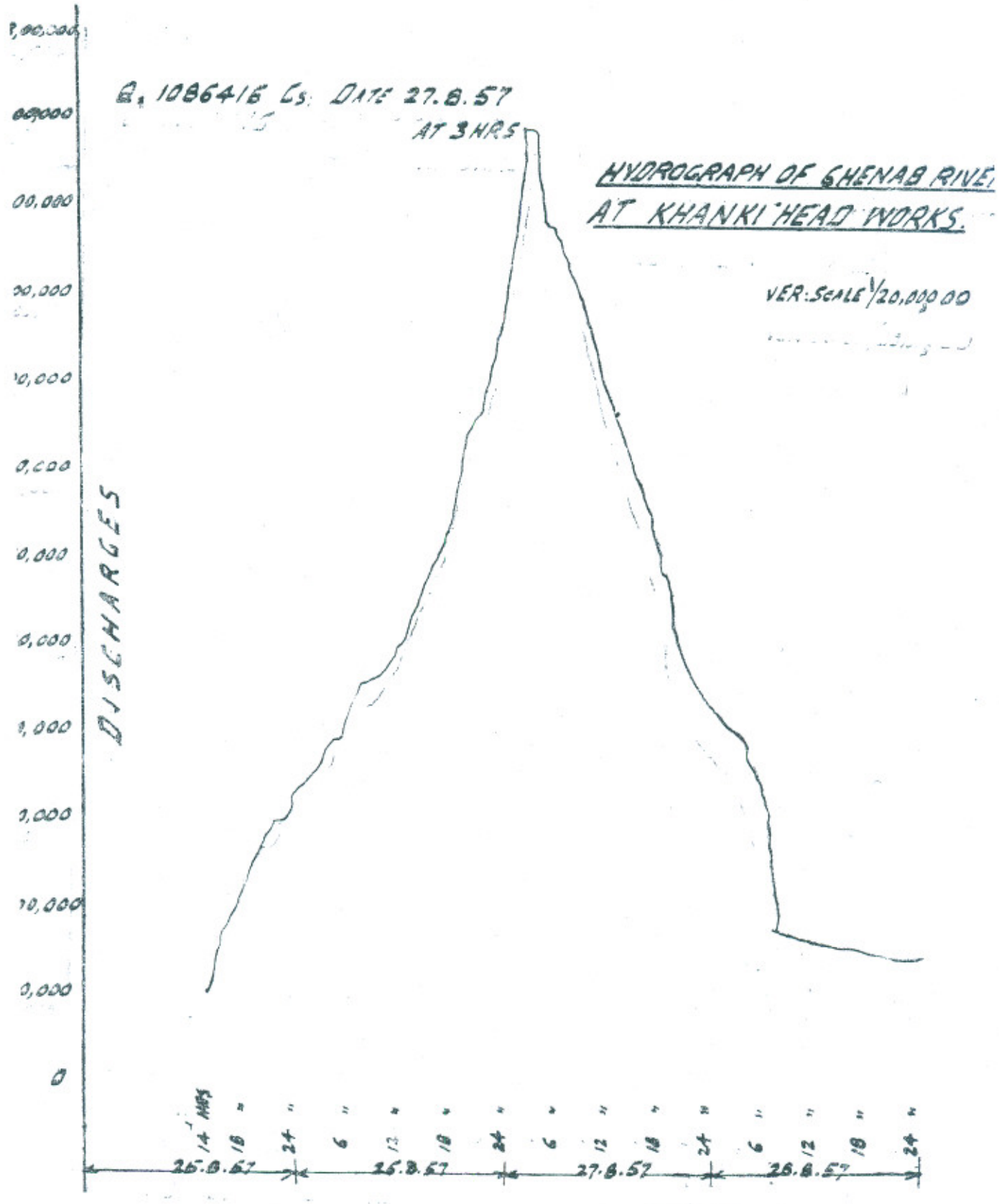
29 8.57


Q. 1086416 Cs. DATE 27.8.57
AT 3 HRS
HYDROGRAPH OF CHENAB RIVER
AT KHANKI HEAD WORKS.
VER: SCALE 1/20,000 00
DISCHARGES
0
14 HRS
18 "
24 "
6 "
12 "
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