DRAINAGE CONTROL

by

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1.0 Introduction

Drainage as its name implies, refers to removal of excess water from land under agriculture or urban growth. Surplus water could be from excessive precipitation, from seepage from storage reservoirs or from high ground water table, or flooding from rivers. Thus drainage control and flood control are two features that cannot be considered in isolation.

Drainage from agricultural land is called land drainage and could arise from over irrigation, or surface method of flood irrigation. Unlined irrigation canals also contribute to conveyance losses causing water logging and salinity problems. Main purpose of drainage is to provide a root environment that promotes optimum plant growth.

During construction stages of irrigation scheme such build up of water tables is not given due recognition as it is not of immediate concern. Result is drainage construction always lags for behind irrigation construction. This has been so from down the ages and this negligence in land use, water management and soil conservation practices can be traced to the downfall of irrigation based civilizations in the valleys of the Euphartes and Tigris in Mesopotamia, the Nile in Egypt and the Indus in India.

Drainage from built up areas is urban drainage. Criteria for drainage disposal for the two depend on the value of crop or property to be protected from water logging and/or inundation.

Thus agricultural land under paddy cultivation can afford inundation for a period of several days, land under horticulture would be ruined after a single inundation. In case of urban area no inundation is permissible.

Drainage is not a new subject. Herodotus the Greek historian in 400 BC spoke of drainage needs in the Nile Valley. In 200 BC the Roman statesman Cato, wrote of removing water from field and constructing sub surface drains in low lying areas. Romans used open ditches filled with permeable material to drain fields. In 12 century A.D. pipes were used by Arabs for drainage of gardens in Granada, Spain and are still in operation.

Early determination of need for drainage was based on observation of wet areas producing poor crops.

The first step is to establish a grid of the area where water table conditions are mapped out.

Shallow drains are best in humid areas where the soils are residual (ie., formed in place) and become less permeable with depth, High rainfall leaches out salts. Need for drainage is to dewater root zone (4 feet) of the soil profile to permit aeration.

2.0 Drainage Efficiency

In heavy soil drainage efficiency can be improved by

i. Land levelling
ii. Absorbing wells

iii. Mole drains (2.5 to 5m apart)
iv. Deep ploughing
v. Contour canals and bunds to take monsoon rains.
vi. Vacuum drainage at half the depth of conventional drains. (U.S.S.R.)

Provision of Drainage to land,

a. Improves land for mechanisation
b. Extends vegetation periods
c. Improves physical and genetic propertise of heavy soil
d. Increase aerations and warming up of soil
e. Improves bio-chemical and biological processes in soil.

Drainage is horizontal transportation of water and increases infilration because physical properties of the soil are improved. Addition of chemicals also improve the physical properties of the surface soil. There is possibility of having two layered drainage system.

Water logging is due to rainfall and low infilration capacity of heavy soil. Drainage is catching and eliminating water from places where its presence in excessive amount is not desirable. In the case of dam, drainage contributes to the stability of the structure by limiting the uplift pressure.

Deeper drains are expensive and does not provide any advantage Bi-level drainage - is placement of parallel drains at 2 depths alternatively.

River Flood

Drainage problems also arise due to river training works such as embankments along rivers. Such embankments cause local draienge problems in the areas protected from the river floods, as embankments are proposed then simultaneously steps should be taken to

a. Dry out swamps or pockets where natural drainage has been inhibited by the levee construction.
b. Lower ground water tables which have got elevated by the levee construction.
c. Provision of structures in the embankment with regulated openings.
d. If gravity flow in not possible, as is generally the case when river levels are high from precipitation in higher reaches of the catchment, mechanical removal becomes imperative.
e. In coastal reaches of rivers, tidal effects will influence river levels and gravity drainage could be utilized for times of low tide.

Flap gates could be used which could automatically operate with tidal variation.

Of Sri Lanka's 65,610 sq.km. teritory the area protected against floods by levees is confined to the lower reaches of Kelani, Gin, and Nilwala rivers.

Overall length of protection levees in the above 3 rivers are as follows :

River	Bank	Length km.	From	To
Kelani	left	4	Wellampitiya	Mahawatte
	right	7.1	Talwatte	Peliyagoda
Gin	left & right	22	Agaliya	Hegoda
Nilwala	left	3.07	Kadawedduwa	Naimmana
	right	4.9	Malimbada	Tudawa

In comparison a land locked country like Hungary with a total area of 93,000 sq.km. teritory, levees protect 1/4 of the entire area from floods. Total length of levees being 3850 km.

Drainage control of protected areas is effected by several canal systems each having a main collector. The area where from water is conveyed thro the canal system into one collector is called a drainage basin. The degree of development in a basin is measured by the specific discharge capacity of the basin and this is dependant on the canal network, canal parameters the structures and finally pump capacities.

The specific drainage capacity is the ratio between rate of flow capable to be conveyed in one second and the basin area. The unit being litre per sec per square kilometer. In the Hungarian example the specific drainage capacity varies from 10 to 70 litre/sec/sq.km (0.1 to 0.7 litres/sec/ha). For the Danube it is 25 and Tisza River is 15 ie, 0.25 to 0.15 litres/sec/ha. For design purpose the precipitation occurring 1 in 10 years normally suffice for agricultural land drainage.

Drainage is really surplus water management. The surplus water to be managed, means to be used later, should best be kept in storage. The best method is to keep it where it originates by reservoirs as surface, storage or replenishing ground water. This could be by agro technical means eg. deep ploughing, ridging, contour bunds etc., if the catchment is fully developed. If catchment is partly forested this is the best storage for keeping back temporarily waters at the source. Such temporary detention will lower flood peaks and augment ground water storage.

Drainage should be controlled drainage. If a land is drained fast, the conveyance canals have to be massive dimensions. Rapid drainage will cause ground water tables to drop which could be harmful to vegetation and even cause settlement of any buildings in the vicinity. By controlled drainage, canal dimensions could be reduced, pump capacities could be reduced and structure openings scaled down.

For a developing country we must make use of the high water river beds for detention storage. Such detention areas are generally swamps or low lying lands which should not be interfered with. In Sri Lanka's context one may say it is unwise to keep land fallow. Such land could be utilized as playing fields or for grazing alternatively it could be used for cultivating green leaf vegetables but at a certain risk for they are bound to be fecal contaminated.

3.0 Conclusions

Flood control and drainage control program needs integration of several data banks. These data banks cover hydrologic studies, engineering designs, economic analyses, ecological and social aspects. The last two are new facets in feasibility studies on water resource projects Hydrology studies can delineate areas subject to inundation, Engineering studies can propose structural measures and flood proofing measures to reduce flood damage.

Economic facets of such studies will determine the cost effectiveness and availability of funds. Social aspects will weigh the public support for program alternatives and the effects on environment. This myriad of possibilities makes flood control and drainage control programs a nightmare of sorts if not for the facility offered by mathematical modelling which could reduce the repetitive calculations drastically.

For a developing country there must be a judicious trade off between benefits and costs. If costs are compounded with interests payable on loans plus mounting maintenance costs, flood control and drainage projects should be embarked only after non structural measures as flood zoning, flood proofing and subsidized insurance schemes have been adopted to the limit of their feasibility.

Bibliography

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PUMPED DRAINAGE SCHEMES

Country	Name of Project	Drainage Area hectares	Pump Capacity cu.m³/sec	Drainage Modulus litrs/sec/ha
Hungary	Danube river			0.25
	Tisza river			0.15
Sri Lanka	Nilwala Kadawedduwa	8827	58.8	6.66
	Kadduwa	2370	8.4	3.54
	Kiralakele	4973	33.6	7
	Gin ganga Hegoda	24410	27.60	11.3
Japan	Shinkawa	28000	240	8.5