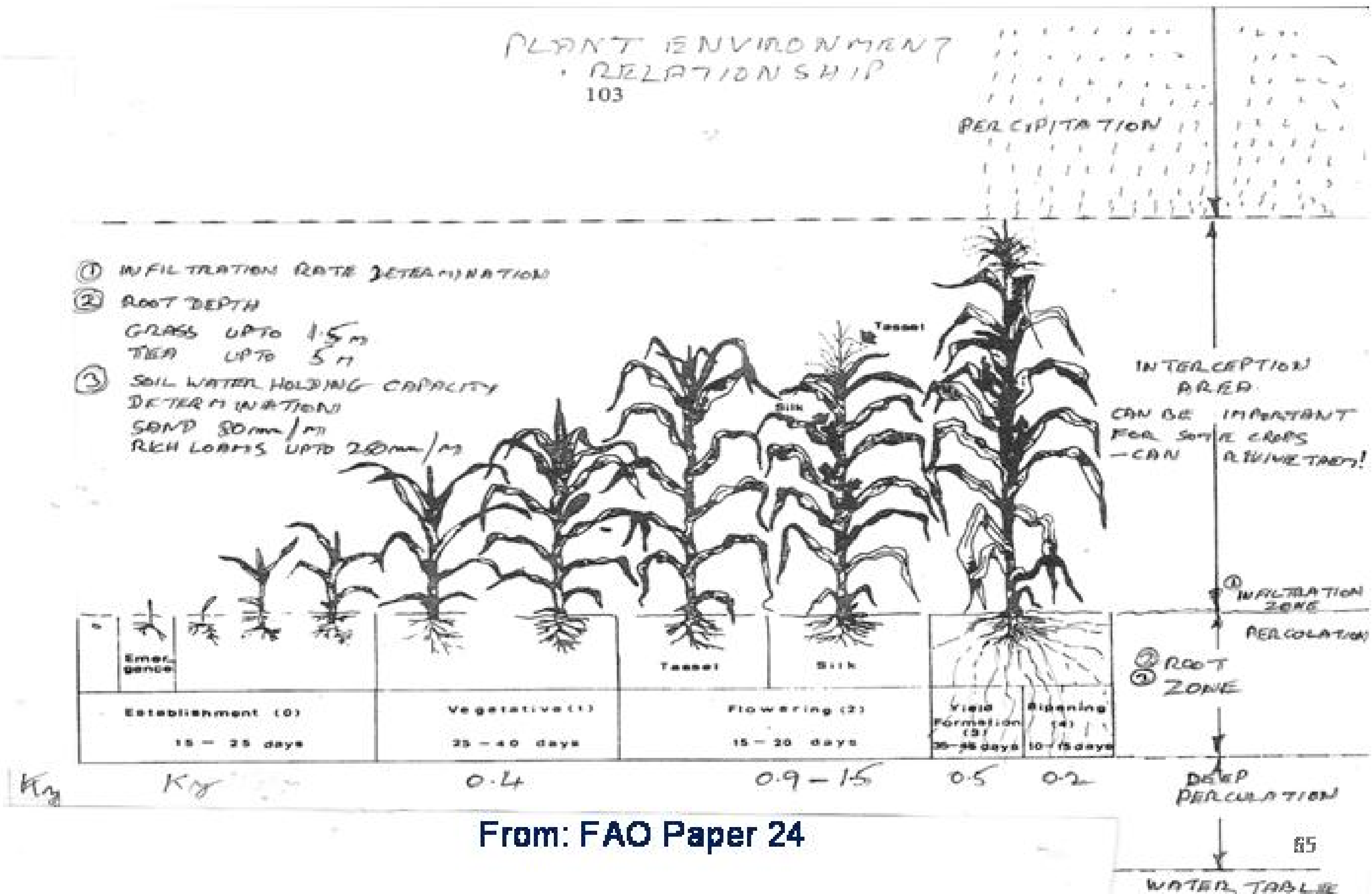
CROP DEVELOPMENT DIAGRAM



From: FAO Paper 24

CROP WATER REQUIREMENT PAPER 24 PAGE 39

EXAMPLE:

Given:

Cairo; corn planted mid-May; for total growing season winds are light to moderate (0-5 m/sec), and mid-summer RHmin is 30-35%; ETo initial stage is 8.4 mm/day; irrigation frequency initial period assumed to be 7 days.

I	Planting date		Late spring, early summer
II	Length of growth stages	local information (or Table 22)	
	initial		20 days
	crop development		35 days
	mid-season		40 days
	late season		30 days 125 days
III	Plot periods as indicated	Fig. 7	
IV	kc initial stage (1) ETo = 8.4 mm/day irrig. frequency = 7 days	Fig. 6	kc initial = 0.35
	kc mid-season stage (3) wind = light/moderate humidity = low	Table 21	kc mid-season = 1.14
	kc late season stage (end) (4) wind = light/moderate humidity = low	Table 21	kc end of season = 0.6
V	Plot kc value and connect values with straight lines	Fig. 7	kc development stage = 0.35-1.14 kc late season stage = 1.14-0.6
VI	Read kc value from prepared graph for each selected period at mid point of 10 to 30 day period		

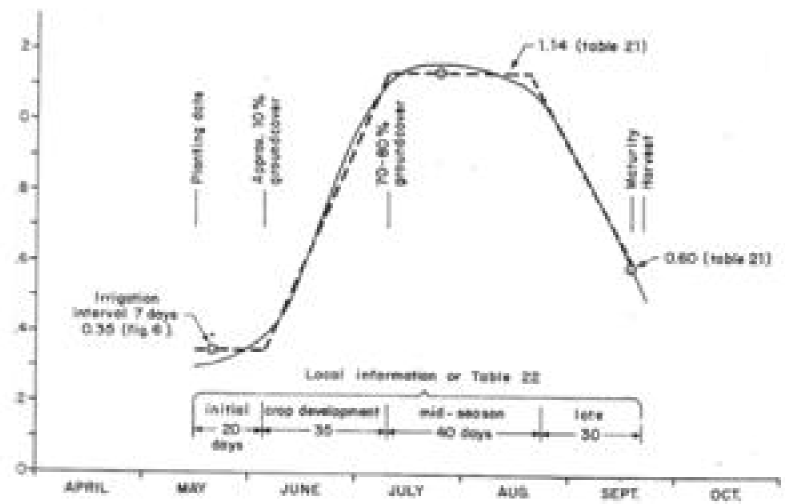


Fig. 7 Example of crop coefficient curve

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An example of: a Crop Coefficient Curve

Now the design of the pipe work and sprinklers to be used can be undertaken.

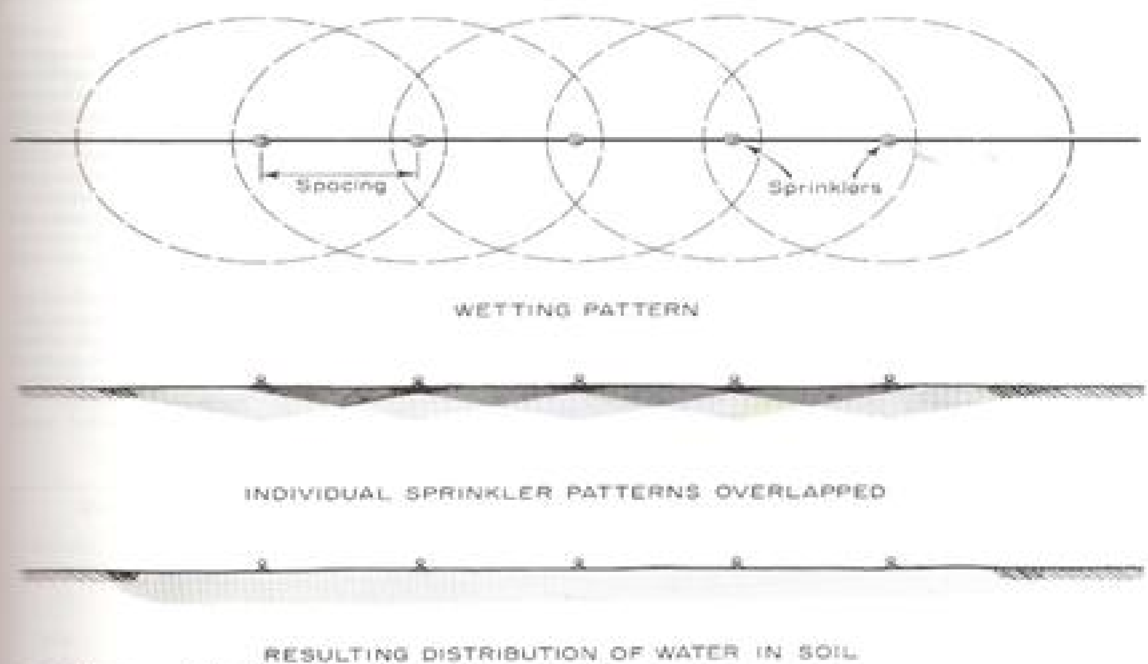
This design work is not to be determined in this document.

Sprinkler Irrigation Patterns

2.6 Water distribution
It is difficult to design a rotary sprinkler which produces an even irrigation over the whole of the wetted circle. Normally the application is heaviest close to the sprinkler and reduces towards the edge. The pattern of distribution is shaped like a triangle (figure 2.6). To make the distribution more even or uniform, several sprinklers are operated close together so that their distribution patterns overlap (figure 2.9). This determines the spacing needed between sprinklers. For good uniformity overlap should be 65% of the wetted diameter. Uniformity can be improved by putting them much closer together but this may lead to problems of high water application rates. The number of sprinklers used also increases, raising the cost of the system.

The uniformity of distribution from a stationary sprinkler system can be tested in the field. To do this several small cans are placed in a square grid between the sprinklers (figure 2.10). The system is then operated for a typical irrigation set time and water is collected in the cans. By measuring the depth of water in each of the cans it is possible to see just how uniform is the irrigation.

Uniformity of distribution for a mobile system can be tested by setting a line of cans across the travel path of the machine.



2.9 Wetting and distribution patterns from several sprinklers operating close together

Source of this document not known/is lost

Young Tea under Irrigation, Kusuku Division, MTIDP

Irrigation in Progress Mambilla T. E. Kusuku Division on young tea Area is subject to high afternoon winds in excess of 10 metres per second

Drainage and Salt Problems Indus Basin Irrigation Project

- Résumé / Abstract

- Water logging and salinization are major impediments to the sustainability of irrigated lands and livelihoods of the farmers, especially the smallholders, in the affected areas of the Indus Basin. These problems are the result of a multitude of factors, including seepage from unlined earthen canal systems, inadequate provision of surface and subsurface drainage, poor water management practices, insufficient water supplies and use of poor quality groundwater for irrigation. About 6.3 million ha are affected by different levels and types of salinity, out of which nearly half are under irrigated agriculture. Since the early 1960s, several efforts have been made to improve the management of salt-affected and water-logged soils. These include lowering groundwater levels through deep tube wells, leaching of salts by excess irrigation, application of chemical amendments (e.g. gypsum, acids, organic matter), and the use of biological and physical methods. However, in spite of huge investments, the results have in general been disappointing and the problems of water logging and salinity persist. This paper reviews sources, causes and extent of salinity and water logging problems in the Indus Basin. Measures taken to overcome these problems over the last four decades are also discussed. The results reveal that the installed drainage systems were initially successful in lowering groundwater table and reducing salinity in affected areas. However, poor operation and maintenance of these systems and provision of inadequate facilities for the disposal of saline drainage effluent resulted in limited overall success. The paper suggests that to ensure the sustainability of irrigated agriculture in the Indus Basin, technical and financial support is needed and enhanced institutional arrangements including coordination among different federal and provincial government agencies to resolve inter-provincial water allocation and water related issues is required.

http://cat.inist.fr/?aModele=afficheN&cpsidt=19978035

Two Typical Drain Bedding Methods

- Bedding Types
- Two typical bedding methods, one for each type of pipe, are illustrated opposite. There are numerous 'classes' of bedding for drainage, designed to suit all sorts of ground conditions, pipe types and anticipated loadings. Each class is identified by a different letter. For further detail, consult Approved Document H of Building Regs.
- Bedding detail for flexible pipes [Plastic] and,
- Bedding detail for rigid pipes [Clayware] Class B bedding
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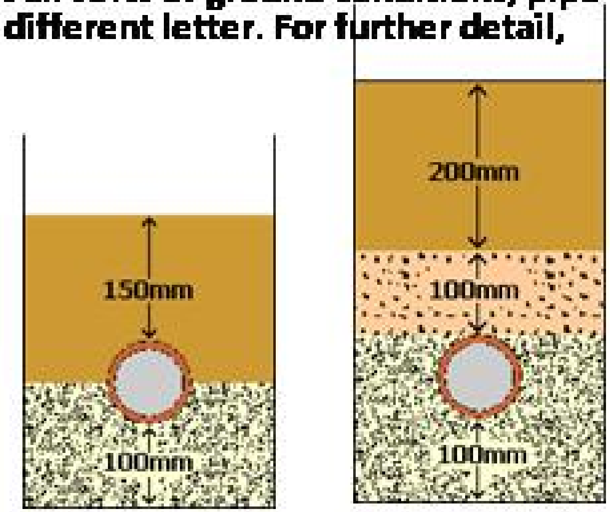


- KEY
- Selected Fill - no stones over 40mm, no lumps of clay over 100mm, no organic or frozen material
- Selected Fill or Granular material
- Granular material - 10mm single size or 14-5mm graded

http://www.pavingexpert.com/drain02.htm

Pipe-laying basics

Typical laying methods for the 3 most common types of pipes are considered below. Handling, cutting and jointing will vary for each type of pipe and its associated range of fittings, but the general principles remain the same. Pipes should be laid in straight lines to a steady gradient. A taut string line, sight rails or, more commonly nowadays, a laser line is used to ensure accuracy in alignment and level. The bedding is prepared in advance, with a recess scooped out to accommodate sockets, if necessary. Pipes should be laid on a full bed of granular material and NOT propped up on bricks, bits of stone, broken flagstones etc. The pipe should be consolidated into the bedding or have the bedding packed beneath it until it is at the correct alignment and level as indicated by the guide line (string or laser).

http://www.pavingexpert.com/drain02.htm

Other Small Structures at Mambilla Tea Estate

Weir under construction, Mambilla T. E. Kakara Division MTIDP

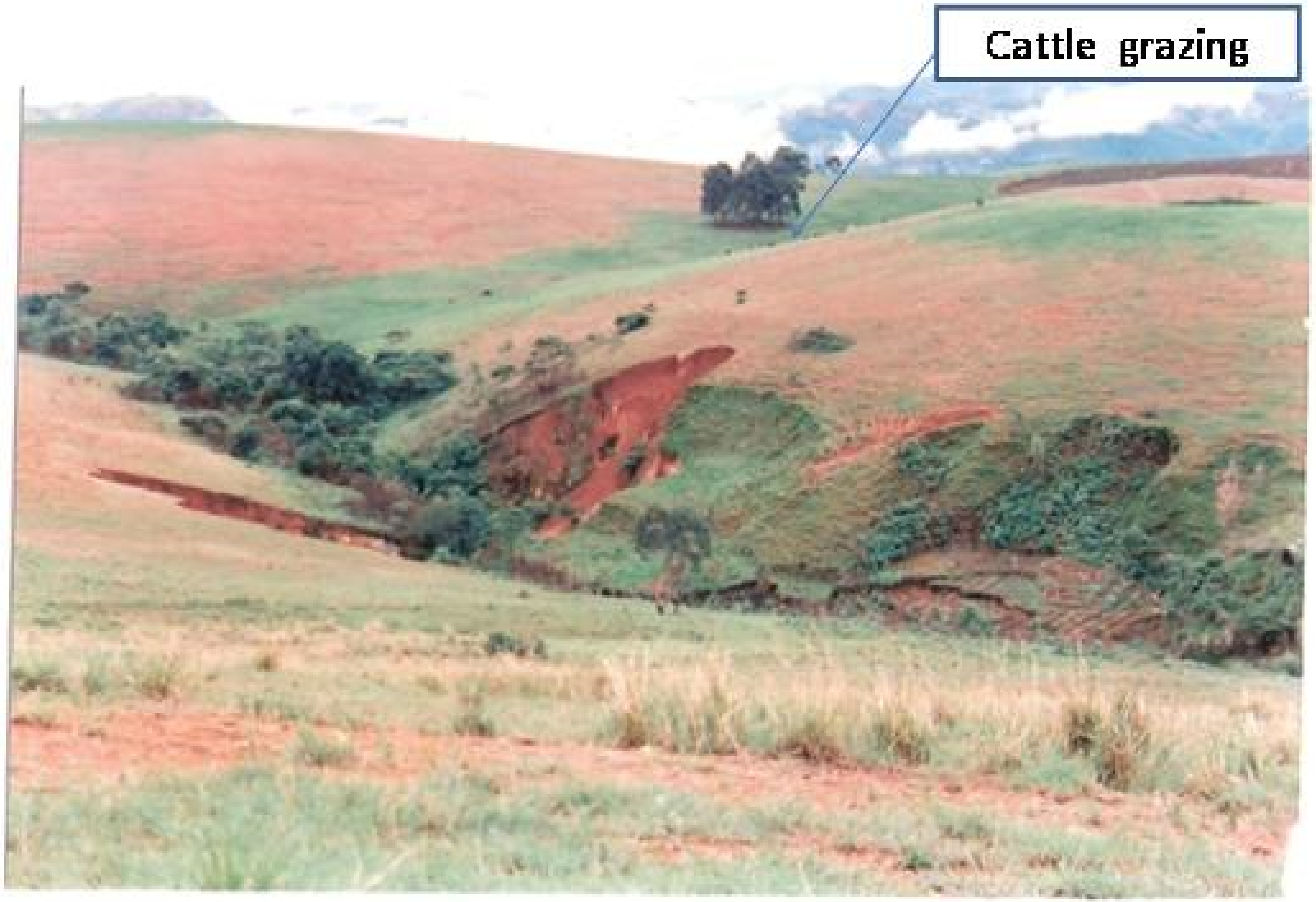
Completed Weir and revetted river bank, Mambilla T.E. Kakara Division MTIDP, for water supply off-take

Bridge under construction over small river, Mambilla T.E. Kusuku Division

(The stream bed is dry during the dry period but floods up to and over the bridge deck level in the rains)

Completed Bridge over small river, Mambilla T.E. with temporary bridging (still in place to left handside)

River bank erosion Mambilla Plateau (note cattle grazing in background!)



Rural Road, Contour drain eroded by heavy rainfall, Out-grower scheme Mambilla Plateau (MTIDP)

Filtration Plant for Drip Irrigation, Guadalquivir River Basin in Spain

Ex libris RMH

Drip Irrigation, Guadalquivir River Basin in Spain

Ex libris RMH

Farm Channel and Control Sluice, Guadalquivir River Basin in Spain

The Design

- There should be enough information in this document, on crop water requirement, infiltration rates, soil water holding capacities and rainfall, in theory, to design the amount of water required by the crop. Pipe and sprinkler design can now be under taken! The guiding principle will be to use a maximum water velocity of 1.5 m/sec. in the pipe layouts. I will write no more. I hope you enjoyed my little effort!

Bibliography:

1) Crop Water Requirements, FAO Irrigation & Drainage Paper 24
2) Yield Response to Water, FAO Irrigation & Drainage Paper 33
3) Agro-meteorological Field Stations FAO Irrigation & Drainage Paper 27
4) Sprinkler Irrigation Equipment and Practice by Melvyn Kay 1983 B T Batesford
5) Surface Irrigation Systems and Practice by Melvyn Kay 1986 Cranfield Press`
6) Irrigation Principles and Practice by Vaughn E. Hansen, Orsen W. Israelsen & Glen E. Stringham
7) Course notes taken by author from Department of Agricultural Water Management Silsoe College, Cranfield in 1990
8) Details from various web sites as listed on the various slides.
9) Authors (RMH) photos maybe copied but request this web site be mentioned.
10) Acknowledgement of NBPC Ltd the client, Bohea Ltd., technical staff provider and HVA International, management of the MTIDP Project.

END