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Water Management for Field Crops

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Abstract: Water supply for agricultural use has kept no pace neither with population growth nor with economic growth. And such new additional sources of water are becoming scarce and more expensive to development. This call for proper water management practices to enable utilisation of water without waste. Water management involve phases which include erosion control, drainage, irrigation, flood control and water resources development and conservation. Water management then becomes a necessity for individual national to meet the daily need of water for field crops production. The practice of water management include irrigation, drainage, flood and run off control. And also adoption of some land cultural practices and also use of remote sensing techniques to conserve water.

Key words: Water Management · Irrigation · Crops · Agriculture · Farmers

INTRODUCTION

Water management implies utilisation without waste as to make possible a continuous high level of crop production while improving environmental quality [1]. Water management involves following phases: erosion control, drainage, irrigation, flood control and water resource development and conservation. Although soil erosion takes place even under virgin conditions, the problems of poor management are caused by human exploitation of natural resources and the removal of the protective cover of natural vegetation. Problems are even more serious because of high population density and increased run off caused by severe changes in land use.

The higher population of man on the earth, facing farming as a cheap occupation has then called for better advances to make water for field crop production.

It is increasingly apparent that a huge international water problem will be looming over development in the coming decades [2]. According to Yoder [3], no where more than Africa and the Middle East is water likely to become the most critical resources issue and the most limiting input to food security and economic and social development.

Water supply for agricultural use has kept no pace neither with population growth, which is the fastest in the world nor with economic growth which is booming in many countries region. As a result, by 2005, according to Yoder [3], the amount of water available in the middle east and north Africa is expected to drop by 80% in a single life time, from 3430m^3 to 667m^3. New additional sources of water are becoming scarce and more expensive to develop. These therefore calls for good advances in water management.

Advances in Water Management

Irrigation Water Management: Is only one part but very important part of water management for field crops. In the 1980s irrigation water management turned to improving management and recovering investment in systems constructed in previous decades being rivers and streams regulated only with one run-off. The dams create resources to store water for use at later time. For example from night to day thus avoiding night irrigation, or from season to the next allowing irrigation when it is other wise too dry [2]. Ground water, though often more expensive than surface water as per unit basis, is increasingly being tapped for irrigation by local groups when other reliable irrigation options are not available. In most cases, tube wells tap directly into a ground water reservour and deliver water when necessary [3].

River Basins: In Indonesia locally managed systems in a river basin having long established arrangements for sharing water among systems during period, lower systems depend on controlled leakage through a series of diversion. Farmers have modified the flush gate of a government-built weir in Bali, Indonesia, to allow proportional sharing of the river. They raised the gate to its fully opened position and built a still in the gate to the

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same elevation as the canal intake. Then inserted a side wall in the gate to adjust the opening to allow proportional discharge division between the canal and down stream users that could be easily choke.

Run off Farming: This involve collection of precipitation water from a specially treated portion of a non-cropped area and stored in the soil profile of a cropped area. This is used to grow Qutta pine (*Pinus eldarice*) and *Arizona cypress* (*Cupressus Orozonica*) in semi arid climate on a sandy soil treated with wax and a clay soil treated with sodium chloride salt. The treated run-off contributing area were varied in length to provide water supply estimated initially to be two, three and four times the normal 300mm annual precipitation. Twenty five trees were planted per species per site per water-level treatment for as total of 300 trees [4]. Run-off farming shows promise for growing Christmas bees and many other crops including wheat and barley giving 4.0 and 4.8 grain/ha respectively in arid and semi arid lands where water is scarce.

Waste Water Re-use: The re-use of water on agricultural lands is advantageous because it not only provides the required crop water but also contains some valuable plant nutrients [5]. The work of researchers such as Oswu [6], indicate increased yield of sorghum crop as a result of using sewage effluent for its irrigation. The environmental pollution and health hazards posed by effluent irrigation are taken into account by its treatment and probably appreciate crop selection for irrigation. Result showed that the salinity sodium hazard and bacterial concentration of the effluent irrigation system and that of the tap water were brought into acceptable level for application [7]. Th pH of the sewage effluent was 6.7, while that of tap was 6.3. The electrical conductivity of the solution extract of soil before and after the irrigation period on experimental plot were 3.9 and 4.3μs/m respective. At the eleven weeks after planting, the height of crop melon irrigated with effluent and tap water were an average of 242mm and 150mm respectively. It is concluded that waste water was suitable for irrigation.

Flooding Regimes: The NCRI Badeggi rice irrigation scheme in Nigeria observed that seasonal stream flow is not sufficient to meet irrigation and domestic water needs. Water was managed for rice production through flooding regimes at different intervals. The results showed that rather than from transplanting to harvest maintaining saturation of the flood, flooding water at 40 days after transplanting (DAP), 60 and 90DAT, flooding for 90DAT gave good yield comparable to flooding throughout the growing period of the crop [8]. Through flooding regimes. According to them double cropping of rice could be possible.

Basin to Basin Flooding: This is the basic water application method for rice; it is also used in irrigating non rice crops but with a difference, instead of the supply being continuous and simultaneous, it is intermittent and mostly rotational. The specific method of water application however, is closely to the type of seed bed that is prepared and the kind of crop that is grown. According to Miranda [9], there are at least four application practices commonly used (1) Flush basin:- Flooding with rudimentary field ditches for Soybean and Mung bean (2) Broad bed for chilli, garlic and cucumber (3) Raised beds for onions and (4) Furrows for corns, sugarcane and cassava. The raised beds for onions cultivation especially in fine textured soils and under high ground water table conditions. The water impounded in the deep ditches on the side of the beds is scooped and sprinkled or splashed in bed twice daily in Indonesia and less frequently in Srilanka and the Philipines. The furrow, the narrow ride and furrow or furrowed basin system is extensively used for row crops such as corn and cassava in Indonesia and chilli in Srilanka. In the Philipines studies, furrow irrigation is proving to be suitable for irrigation corn in coarse-textured soils in the Banga river irrigation system and the Allah river.

The Modern Irrigation Pumps: The modern irrigation pumps permits a wide range application of water with limited restriction to topography. In certain mountainous locations where snow melt provides the source of irrigation water, gravity sprinkled irrigation systems have been well adapted with pumping cost is zero [10]. In such systems, the potential energy available at the source of water is converted to pressure energy at sprinkler nozzles to apply the water to the crops. The modern irrigation pumps largely belong to the category of variable displacement pumps. Under this group is the centrifugal pump. This is sub-divided as volate difusser and turbine pumps. For high lift applications, deep well turbines, the sub-marsibles, or volate-multi-stage have been widely used for irrigation. Where high lift is not required. The gasoline engine driven versions of this pump are popular among small farmers. Through these modern devices the actual irrigated area in Nigeria increased for over 1000 percent from an estimate of under 20,000ha in the early 70s [11] to about 200.000ha in 90s.

Cultural Method for Water Management

Tillage Alternative: Ethiopia farmers working with researchers identified niches and opportunities for tillage alternatives and for tie-ridge and planting implement for semi-arid sorghum production areas. The objective is to determine how tillage could be used for water management. Ploughing was done at depth of 12-15cm, soil tillage was by loosening the ground. This promotes rain water infiltration and rapid crop establishment due to rapid growth. This results in efficient use of rain water and reduced lixiviation [6]. However, the effects of ploughing remain only for one growing season. Although annual tilth can result in destruction of the soil structure in the long run [12].

Ploughing also appears to be a basic water saving technique with yield increase ranging from 25% to over 100% when compared with none-ploughed condition. Ploughing is indispensable even for maize cropping in areas receiving more than 800mm of annual rainfall. Ploughing needs to be associated with application of organic matter to stop the dry spells occurring during the flowering and grain filling stages of the crop. Even in dry season mulched soil helps in conserving the water applied through irrigation. This is good for furrow irrigation.

Ridge Tillage: This consists of the construction of raised earth in rectilizen shapes before sowing. Sowing is done on top ridge constructed across slopes, it is a good water and soil conservation technique. This system jeopardised crop establishment in areas with irregular rainfall as the ridges dries more quickly. Hilling is done during the growing period from the first weeding onward by pulling earth from between the sowing rows around the stems of the plants. This permit control weeds.

Tie Ridge or Tied Hill: This involves making small dikes at regular intervals (every 1-2m) in the furrows. Run-off is almost eliminated and all water is captured.

Remote Sensing Technique: The development and use of measuring components of energy at the earth's surface shows great promise for managing farm water resources [13]. Using reflected and emitted radiation measurements coupled with routine agrometeorological information, it is possible to assess crop stress and evapotranspiration from vegetative surface. Methods have been developed using foliage temperature measurements to determine when plants are under stress and to quantify that stress for irrigation scheduling purposes. From reflected radiation and surface temperature data, evapotranspiration can be calculated and if a water budget procedure is used, the proper quantity of water needed for irrigation can be applied.

Water Harvesting Systems: This have increased the potential to grow crops in arid regions. A desert strip farming system which involves method of land shaping, catchment to cultivated area ratio, type of crop and feasibility of double cropping are among the principle variables under study in USA. The catchment area is prepared in a manner to induce run-off by clearing cactus and trees, ploughing and compating the cleared surface. By plowing on the contours a gendle sloping catchment area is created. A level terrace, constructed at the lower end of the harvested water. Soil levels are maintained using neutron probes. This is good for a spring variety of Durban wheat [14].

Critical Water Potential: There is currently no recommendation on irrigation schedule to disseminate to papaya growers [15]. Consequently, local papaya growers hardly practice irrigation. But to fully exploit the expanding market, papaya growers need to adapt irrigation. At University of Abeokuta, Nigeria, the critical soil water potential for the papaya mixture okra and papaya for effective water management have been studied. The critical soil water potential for the mixture is considered to be-0.20mpa. Thus, a papaya okra mixture requires irrigation when ever soil water potential exceeds-0.20mpa. With this, water was economically managed using irrigation schedule at-0.20mpa for two field crops okra and papaya with optimums yield on sandy loam which would have been very difficult because of high percolation in sandy loam leading to wastage of water. This has also help in maximising the land use.

Controlled Drainage: This is a practice that allows farmers to control drainage out flows, storing water in the soil profile for use by the crop and reducing loses from the system. Drainage flows are managed so that the drainage flow occurs only after the ground water level in a field has risen to the point where drainage is needed to prevent crop damage, or to provide salt leaching irrigation applications can thus be reduced and the relatively good quality water that is save becomes available for use by down stream irrigators. It improves crop yield, increased insurance against crop losses due to water shortage. Maintain soil nitrate and phosphate levels so that the fertility is not degraded in high irrigation or high rainfall areas. It reduce nitrate and phosphate losses to down

Table: Interaction between

Fertility rates	Weed Control treatments Diuron 2.0 kg a.1/ha(P.E) + Dimepax 3.0 kg a.1/ha(PE) + Supplementary weeding at 2,4,5,6 and 9MAP	Atrazine2.0kg a.1/ha (PE)+	Hoe weeding 1,2,3,4,5,6 and 9MAP Weedy check
0 (Control no cowdung and inorganic fertiliser)			
120N-60P_2O_5-90K_2Okg/ha(NCRI recommended rate)			
10ton/ha air dried cowdung (NCRI recommended rate)			
10ton/ha air dried cowdung+120N-60P_2O_5-90K_2Okg/ha			
10ton/ha air dried cowdung+60N-30P_2O_5-45K_2Okg/ha			
5ton/ha air dried cowdung+120N-60P_2O_5-90K_2Okg/ha			
10ton/ha air dried cowdung+60N-30P_2O_5-45K_2Okg/ha			
SE(±)			

MAP → Months after planting 2) P.E → Pro-emergence herbicide 3) P.O.E. → Post-emergence herbicide.
Means followed by the same letter(s) in both column are not significantly different at 5% level of probability.

Table: Influence of fertility and chemical weed control:

Treatments
Fertility rates (F)
0 (Control no cowdung and inorganic fertiliser)
120N-60P_2O_5-90K_2Okg/ha(NCRI recommended rate)
10ton/ha air dried cowdung (NCRI recommended rate)
10ton/ha air dried cowdung+120N-60P_2O_5-90K_2Okg/ha
10ton/ha air dried cowdung+60N-30P_2O_5-45K_2Okg/ha
5ton/ha air dried cowdung+120N-60P_2O_5-90K_2Okg/ha
10ton/ha air dried cowdung+60N-30P_2O_5-45K_2Okg/ha
SE(±)
Chemical weed control (H)
Diuron2.0kg a.1/ha(P.E)
+ Dimepax3.0kg a.1/ha(PE)
+Supplementary weeding
at 2,4,5,6 and 9MAP
Atrazine2.0kg a.1/ha (PE)+
Hoe weeding 1,2,3,4,5,6 and 9MAP
Weedy check
SE(±)
Interaction
F X H

MAP → Months after planting 2) F → Fertility rate H → Chemical weed control
* → Significant at 5%, ** → Highly significant at 1%.
Means followed by the same letter(s) within the same column and treatment are not significantly different at 5% level of probability.

stream water bodies. It is particularly applicable to areas that experience periodic water shortage and suffer from limits to crop production and high costs for water application [16].

Weed Competition: Weed Competition with crops for water, nutrients and light resulting in lower use by the crop and therefore lower yields. However, the main effect of water control is to increase the water supply available to the crop, although it also interacts with factors such as early sowing, which affect transpiration efficiency and mulching which reduces soil evaporation [17]. Weed control also interacts with management factors such as tillage, sowing date, seed density, fertiliser application and crop rotations to improve efficiency of soil water use [16]. Crop density improvement Millet/Cowpea intercrop, yields of millet were not reduced by increasing cowpea densities when soil moisture and fertility were adequate. Working on sparse millet crops in Niger estimated that about 76% irrigation water will be lost through direct evaporation from the surface. Higher plant density may therefore suppress weeds and conserve moisture through their canopy [17].

CONCLUSION

In conclusion, water management has played an enormous role in increasing agricultural output world wide. Scientific approach of recent years has selected and developed those water management methods and principles which are effective to make the best use of water and labour and avoid hazards of water logging and salinity.

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