



Study of Open Sub Surface Drainage System in Reclamation of Salt Affected and Water Logged Soils of Mutluru Channel Command in Krishna Western Delta of Andhra Pradesh

G Subba rao, S Ramesh Chandra, P R K Prasad, D Sreenivas, G Kishore babu and T V Satyanarayana

A P Water Management Project, Bapatla 522 101, Andhra Pradesh.

ABSTRACT

A study was conducted in the farmers fields of drainage pilot area located in pathareddy palem village under Mutluru channel command of Krishna Western Delta, Guntur District to evaluate the performance of Open Subsurface Drainage system (OSSD) for improving the grain yield of Rice under saline and water logged conditions for three consecutive seasons starting from Kharif, 2005. The grain yield increased from 2.2 t/ha to 4.5t/ha over a period of three years indicating an over all increase of 104% due to installation of OSSD. The cropping intensity and non saline area were also increased to 100-153% and 6-40% respectively.

Key words : Cropping intensity, Soil salinity and Water logging

The yields of major food grains have stagnated since 2000. One of the ways to improve the food grain production is, restoring degraded or problematic soils and improving quality of surface and ground water (Lal, 2008). The total salt-affected area in the state of Andhra Pradesh is estimated to be around 8.18 lakh ha. The irrigation induced water logging and salinity were estimated to be 2.72 and 1.15 lakh ha respectively and these are the two major causes reducing crop yields in most of the irrigated commands (Anonymous, 2006). It is also observed that continuous irrigation over the years without proper drainage also results in raising the ground water table to the root zone, thus leading to reduction in crop yields. From the results of the Reconnaissance Survey, an area of 35000 ha was identified as salt affected in the Krishna Western Delta (KWD) irrigated commands where the average grain yield of rice was as low as 1.5-2.5t/ha.

The problem of increasing salinity caused by the rise of ground water table due to lack of proper drainage is considered as a major environmental problem that threatens the capital investment in irrigated agriculture and its sustainability. Drainage has not been given importance as much as irrigation by the farmers as well as the Government Agencies. So, there is a great demand for the concerned research and development efforts to reclaim all the salt affected and water logged soils and bring them back to profitable farming with increased agricultural production as well as cropping intensity. The only means to overcome the salinity and water logging

permanently is selection and adoption of suitable Sub Surface Drainage systems. To test and demonstrate the drainage need for control of soil salinity and water logging, a collaborative project of Acharya N.G. Agricultural University with Alterra, ILRI, The Netherlands, was approved by the Government of Andhra Pradesh, Bapatla as a main center. The Bapatla center is entrusted with the responsibility of solving the water logging and salinity problems by installation of open subsurface drainage (OSSD) systems in the canal commands of Andhra Pradesh.

MATERIALS AND METHODS

A pilot area of 22.4ha was selected at Pathareddy palem village under Mutluru channel command of KWD in Guntur district to study the performance of open sub surface drainage system to overcome the severe problem of salinity and water logging.

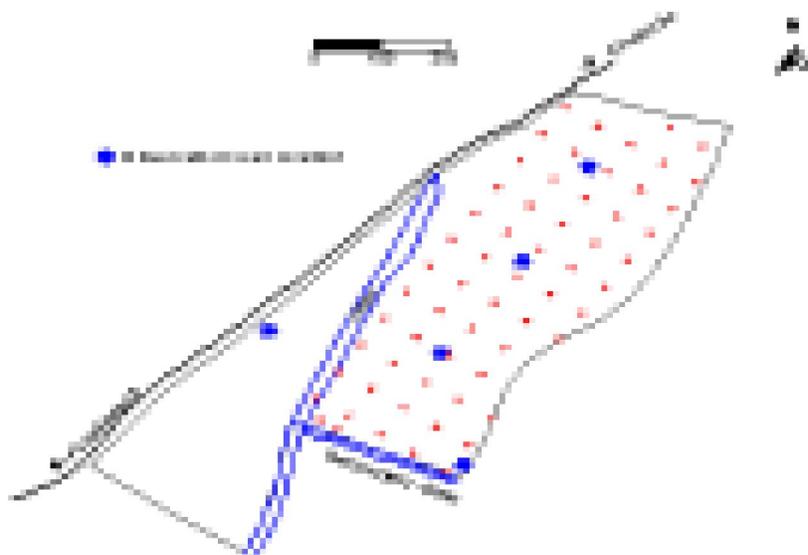
The soil samples collected from 62 grid points of the pilot area (Fig1) fixed at spacing of 60m apart were analyzed for pH, ECe, water-soluble cations and anions, ESP, and available macro and micronutrients following the standard procedures described by Black (1965) and Richards (1954). Crop cutting experiments have also been conducted at each of these grid points to estimate the crop yields during 2005-07.

The soils of the pilot area are deep and clayey in texture, with ECe ranging from 1.6 to 61.3 dSm⁻¹ and PH from 7.5 to 8.2. Sodium is the dominant

Table 1. Effect of Open Sub-Surface Drainage System on soil salinity, grain yield and cropping intensity during 2005-2007

Year	ECe dsm^{-1}	Grain Yield t ha^{-1}	Cropping intensity (%)
2004 (before installation)	21.7	2.2	100
2005	11.6	2.9	125
2006	14.2	3.8	146
2007	12.9	4.5	153

Figure 1. Map showing the grid soil sample locations at Pathareddy Palem drainage pilot area.



water soluble cation followed by Mg and Ca, while chlorides are the dominant water soluble anions followed by sulphates and bicarbonates. The ESP varies from 10.12 to 14.10 indicating that the soils are saline but not sodic in nature. The available nitrogen is low to medium, while the phosphorous and potassium are medium to high. The average values of ECe of ground water are highly saline and not suitable for agriculture. The soils are highly affected by water logging and salinity due to insufficient capacity of main drain to evacuate excess rainfall. The principal crop grown in the pilot area is rice during Kharif season.

The open sub surface drainage system (Fig 2) laid out during May, 2005 and it consists of 10 laterals covering a length of 1250 m and bottom width of 0.75 m with slope of 0.01% gradient, being properly dugged out with hydraulic excavator. The laterals

were first connected to a collector drain. The collector drain was connected to a secondary drain and then to the Mutluru side drain to convey drain water offsite. The drainage coefficient was 1mm/day. Eight observation wells were installed up to 3.4 m depth in Mutluru channel command and four out of eight falls in the experimental site to monitor water table fluctuations and for sampling ground water for water quality assessment.

RESULTS AND DISCUSSION

Monitoring of the open subsurface drainage system during Kharif 2005-2007 clearly indicated that the system effectively controlled the ground water table in the root zone at a relatively shallow depth of 0.5-1.5m. The shallow water table also avoids excessive drainage while at the same time harmful salts that are brought in by the irrigation

Figure 2. Map showing Open sub surface drainage system at Pathereddy Palem drainage pilot area under Mutluru Channel Command of Krishna Western Delta.

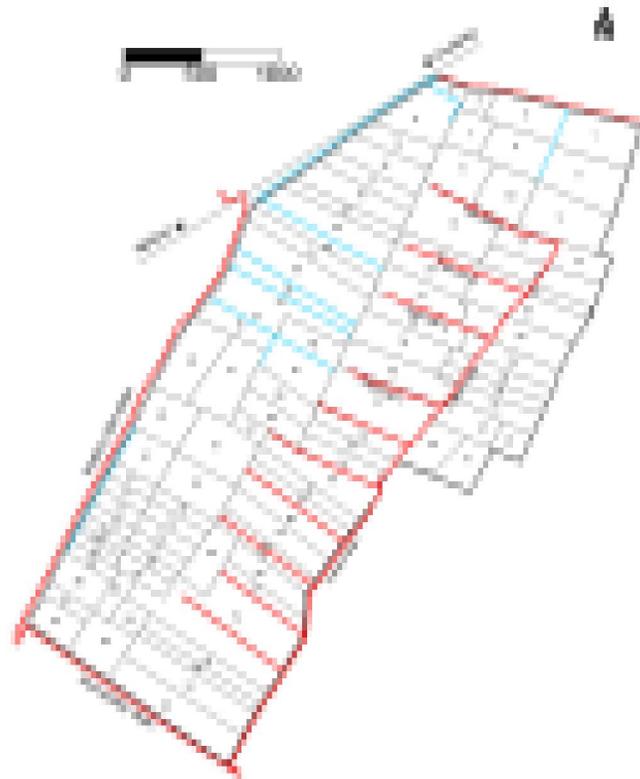
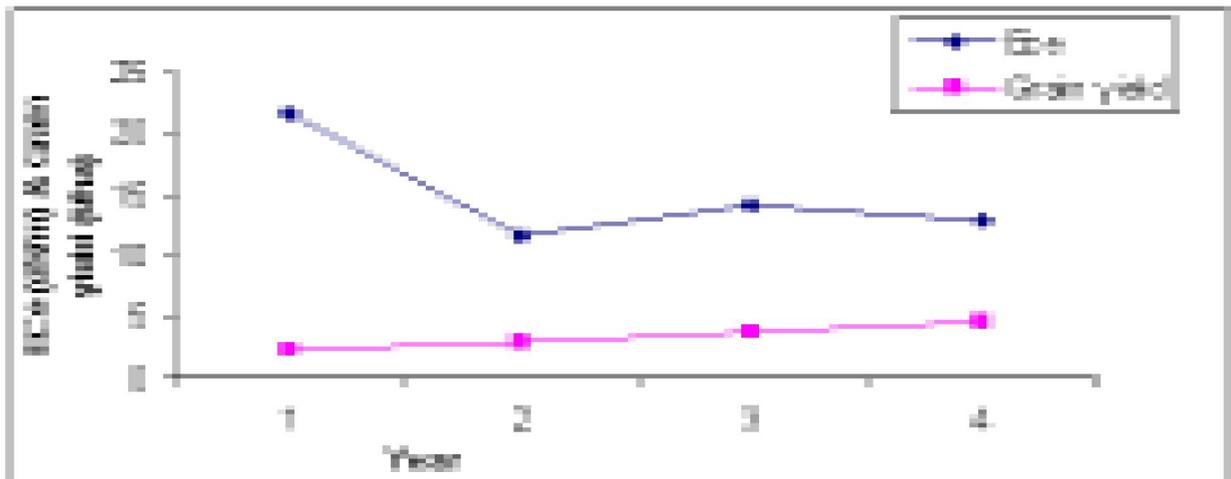


Figure 3. Relation between ECe and Grain Yield during 2004-07.



water were also reduced to a level ranging from 1.2 to 35.4 dS/m. Further the data on soil salinity at 62 grid locations showed a relative decrease in soil salinity during post drainage conditions with an average mean value of 11.6 and 14.2 dS/m and 12.9 dS/m (Table 1) during first second and third year after installation respectively which helped in increasing the grain yield. Prasad *et al.*, (2007) also reported positive results with open sub surface drainage system in reducing the salinity of problematic soils.

The grain yield (Table 1) data collected from 62 grid points indicated a steady increase from 2005 to 2007. The average grain yield obtained during Kharif 2005, 2006 and 2007 were 2.9 t/ha, 3.8 t/ha and 4.5 t/ha respectively as against 2.2 t/ha (2004) before installation of the system. Further, an overall increase of 104 per cent in grain yield was observed by the end of third year after installation of the drainage system. Similar positive results were reported by Konanki and Uppugundur drainage pilot areas of Indo-Dutch net work project. (IDNP Comprehensive Report, 1995)

The cropping intensity was 100% with Kharif rice only without any second crop before installation of the system where as the cropping intensity was also increased to 153 % by the end of third year after installation of the system allowing the farmers to raise Fodder Jowar, sunhemp and black gram as second crop during rabi season in 53% of the drainage pilot area. The significant increase in crop yield and cropping intensity can be attributed to the direct effects of the introduction of open subsurface drainage system which in turn lowered the water table and decreased the soil salinity by leaching out the soluble salts from the root zone, there by not only creating the favourable conditions in root zone but also making the nutrients available to the plants resulting in optimum plant growth and yield.

Further, the shallow water table helped to overcome the excessive drainage and also remove the harmful salts that are brought in by the irrigation water there by creating favourable conditions in the soil root zone to establish fodder crops successfully in the second season after harvest of Kharif rice.

The operational research conducted in the farmer's fields of drainage pilot area at Pathareddy palem also indicated that, under the prevailing soil and agro climatic conditions Open subsurface drainage system is technically feasible to reclaim water logged and saline soils and to sustain agricultural production in irrigated commands. Further, the Open Sub-surface Drainage System needs frequent de-silting of drains during summer months for effective functioning of the system though it requires a huge amount of labor. Thus, Open Subsurface Drainage system is one of the best tools for permanent reclamation of water logged and saline soils in Krishna Western Delta Commands.

LITERATURE CITED

- Annual reports 2002-2006.** All India Co-Ordinated Project on management of salt affected soils and use of saline water in Agriculture.
- Black C A 1965.** Methods of Soil Analysis, Part-1 & II American Society of Agronomy Madison, Wisconsin, USA. Comprehensive Report on Research Achievements of Indo-Dutch Net Work Project, Bapatla (1-4-96 to 31-3-2002) on "Drainage and Water Management for Salinity Control in Canal Commands".
- Lal R 2008.** Soils and India's food security. Journal of Indian Society of Soil Science, 56(2):129-138
- Prasad P R K, Srinivas D T V Satyanarayana, Ramesh Chandra S, Subba Rao G, Mukunda Rao B and Srinivasulu A 2007.** Reclamation saline and waterlogged soils in Mutluru channel command of Krishna Western Delta, Andhra Pradesh state, India Paper presented during 58th ICID meeting and The USCID 4th International conference on irrigation and drainage organized from 30-09-2007 to 06-10-2007 at Sacramento Convention Center, California-USA. Pp 321-334.
- Richards L A 1954.** Diagnosis and Improvement of Saline and Alkali Soils. USDA Handbook 60, US Department of Agriculture and Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi.