

## **Management Aspects of Surface Irrigation-Yield Loss Due to Water Logging in River Godavari Basin-India**

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### **Abstract**

Sri Rama Sagar Project was constructed across river Godavari in Pochampad (V) to irrigate a total command Area of 0.67 mha.(1). There has been considerable progress in the creation and improvement of irrigation facility through both surface and ground water resources. As a result, irrigation intensity increased from 117 to 134 per cent and cropping intensity from 109 to 123 per cent. But simultaneously, the problems of water logging and salinity also increased alarmingly in the irrigated commands. To secure the food supply for an increasing world population increase of agricultural production on a global scale is necessary. (2). The Irrigation potential created under SRS project is about 0.67million hectares and it has fallen to 0.242 million hectares at present. It was observed that an area of 42,729 Ha. under G6-Godavari basin was identified as water logged and about 55,180 hectares was prone to water logging. Un controlled application of water in the command area of the major irrigation project generally lead to deleterious consequences like water logging, salinity and alkalinity problems. The fresh ground water is being polluted frequently by saline water. (3).On account of this fact, water-logged area has been increasing in G6-Godavari Basin. Excess salts, regardless of composition; generally keep the soil clays in a flocculated state. Since the problems of water logging and soil salinity were diagnosed in recent years, the several studies were conducted by visiting the sites and collecting the soil samples and tested in laboratories.

However, there is a decreasing trend in crop yields per hectare due to water logging salinity/alkalinity in Sri Ram Sagar Project Command. The results obtained suggest that about 39% of area is under water logging condition and affected by Salinity and alkalinity.

Hence, drainage is the tool to combat these twin problems of water logging and salinity and the way to sustain irrigated agriculture.

**Index Items:** Soil Salinity/Alkalinity, Water Logging, Reclamation. Leaching, Drainage, Crop Yield, Fertilizers

### **Introduction**

In General, water quality along the Corridors is good and complies with CPCB Surface Water Quality norms. Ground water is a major source of domestic as well as agricultural water supply in the area. Details of water quality features is obtained. Application of more irrigation water than required by crops is practiced in G6-Godavari basin. The introduction of irrigated agriculture in arid and semi arid regions of the country has resulted in the development

of twin problems of water logging and soil salinisation, with which considerable areas of canal commands either

have gone out of production or experienced reduced yields. (4).It is estimated that an area of 8.4m ha in India is affected by soil salinity and alkalinity, of which about 5.5 m ha water logged saline area is distributed in the irrigation canal commands .In addition to this, about 2.5 m ha area is estimated to suffer from coastal salinity problems in different states of India. The problems of increasing salinity caused by the rise of water table due to lack of drainage is considered as a major environmental problem that threatens the capital investment in irrigated agriculture and its sustainability.

In this research Method the change in soil profile has been studied. In addition, excess use of fertilizers like N, P &K during the past years has been increased from 11999578 tons to 1314572 tons under SRS Project command Area.. The case study of Sri Rama Sagar Project indicates that water logging is caused by the interaction of large number of factors such as ground water recharge, drainage, surface irrigation, cropping patterns, ground water with drawl for irrigation, soil characteristics, seepage, excess use of fertilizers from field channels and two distributaries. In command area of Sri Rama Sagar Project observation wells indicated water logged and non-waterlogged areas in the same command.

### **Significance of Study**

Large areas of prime agricultural land in most of the irrigation commands in Telangana are constantly water logged, while others are affected only during the post monsoon season. The water logged and salt affected areas in under SRS Project are estimated to be 42729 ha., respectively. The areas water logged in some of the important irrigation projects of Telangana as reported by project authorities is given in Table.1.The rise in water table and build up of salinity in these command areas has caused the following problems.

Poor and damaged root system of the crops.'

Reduction in crop yields and cropped areas..

No possibility for growing second crops.

Sriram Sagar Project is one of the important major irrigation project of Telangana. It is also estimated that the water table in this command area is raising an alarming rate and 55180 ha. is prone to salt affected..The ever increasing pressure on land and water resources demands that the areas affected by water logging and salinity are reclaimed for sustainable agriculture.

In this research Method the change in soil profile has been studied. In addition, excess use of fertilizers like N,P &K during the years 2015 to 2018 has been increased from 11999578 tons to 1314572 tons. The case study of Sri Rama Sagar Project indicates that water logging is caused by the interaction of large number of factors such as ground water recharge, drainage, surface irrigation, cropping patterns, ground water with drawl for irrigation, soil characteristics, seepage, excess use of fertilizers from field channels and 298 distributaries.In command area of Sri Rama Sagar Project observation wells indicated waterlogged and non-waterlogged areas in the same command..

Site investigation and site surveys were revealed the information like topographic details, soil profile, salinity/alkalinity, EC, pH and soil Texture in villages of Sri Rama Sagar Project Command. For delineating water logged area, dug wells are located in the command and depth of water table is observed season wise post monsoon depth of water table are generally considered for delineating water logged area.

It is seen that the expected yield of rice stages at 3.5 t/ha. and the average yield is 2.6 t/ha. Productivity and fertility is affected by water logging, if excess water is supplied to the fields (5). If capillary fringe raises 0.60 mts of ground then the field is water logged.

### **Objectives**

For achieving the objectives of the study, Sri Ram Sagar Irrigation Project was purposively selected where the problems were found passive. Water logging and soil salinity are the two major problems affecting the agricultural productivity and sometime becomes too severe to take it out from economic crop production. Data regarding the extent of water logging and soil salinity was compiled from the primary and secondary sources.

The relevant data of cropping pattern, yield and prices of important crops, infestation of weeds, diseases etc. under the project are collected from the official records and primary sources. The study was intended to examine the magnitude of the adverse effects of water logging and salinity due to mismanagement of surface irrigation. The main objective is

- 1) To suggest appropriate measures for overcoming the problems of water logging and soil salinity.
- 2) To suggest Leeching and drainage arrangements.

### **Methodology**

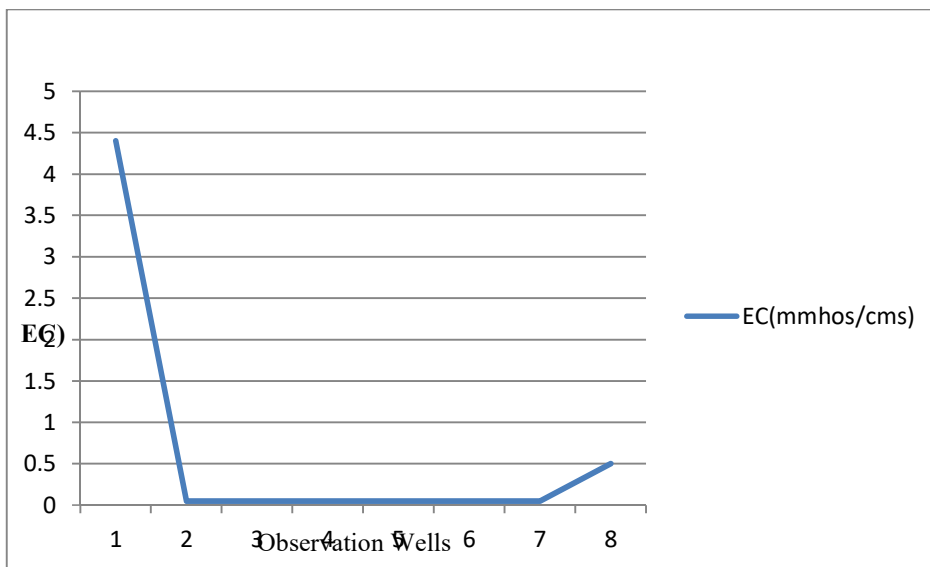
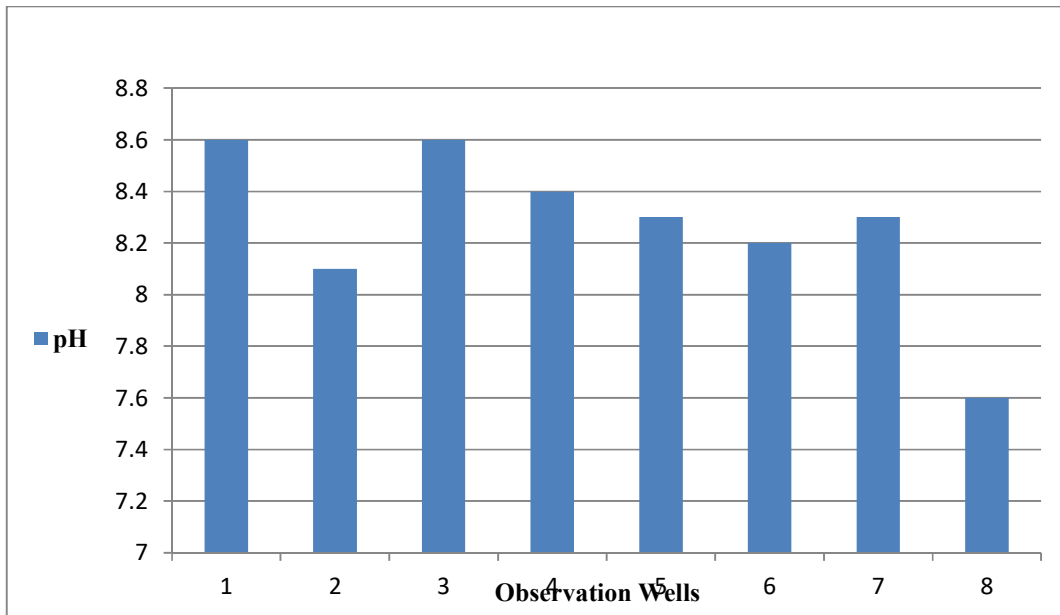
Soil pH is one of the most important parameters which influence plant growth. It is more related to the availability of nutrients. There are about 24 essential elements and each element becomes available in a certain range of pH. Each crop requires certain range of pH so that the growth of plants may be satisfactory. Chemical properties of the soil profile collected at a depth of 20-60 cm are furnished in Table.1

Table.1. Results of Observation Wells

SL.NO.	VILLAGE	OBSERVATION WELL	pH	EC (mmhos/cms)	REMARKS
1	Jagityal	1	8.6	4.4	Saline-Alkali Soils
		2	8.1	0.05	Slightly Alkaline
		3	8.6	0.05	Slightly Alkaline
		4	8.4	0.05	Slightly Alkaline
2	Metpalli	1	8.3	0.05	Slightly Alkaline
		2	8.2	0.05	Slightly Alkaline
		3	8.3	0.05	Slightly Alkaline
		4	7.6	0.05	Slightly Alkaline
3	Korutla	1	8.1	4.2	Saline-Alkali Soils
		2	8.2	0.05	Slightly Alkaline
		3	8.1	0.05	Slightly Alkaline
		4	8.6	0.05	Slightly Alkaline
4	Mallapuram	1	8.5	0.05	Slightly Alkaline
		2	8.3	0.05	Slightly Alkaline
		3	8.4	0.05	Slightly Alkaline
		4	7.9	0.05	Slightly Alkaline
5	Raikal	1	8.2	0.05	Slightly Alkaline
		2	8.4	0.05	Slightly Alkaline
		3	8.5	0.05	Slightly Alkaline
		4	7.8	0.05	Slightly Alkaline

It is evident that some village commands of S.R.S.P. are affected with salinity. The effect of soil salinity on crop growth is negligible when the electrical conductivity of the saturation extract is less than 2 mm hos/cm, yield of very sensitive crops area were affected when EC value is about 4 mmhos/cm. Many of the common field crops are affected when the Ec value is in the range of 4-8 mm hos/cm crops with high salt tolerance can grow satisfactorily when the Ec values are between 8 and 16 mm hos/cm.

Soil pH is one of the most important parameters which influences plant growth. It is more related to the availability of nutrients. There are about 24 essential elements and each element becomes available in a certain range of pH. Each crop requires certain range of pH. So that the growth of plants may be satisfactory. In addition to the availability of various essential nutrients, soil reaction plays important role in creating suitable environment. The trend showing Ec and pH values are shown in Fig.1.



**Fig.1.**Trend showing pH and Ec values

### Analysis

#### FertilizerUsage

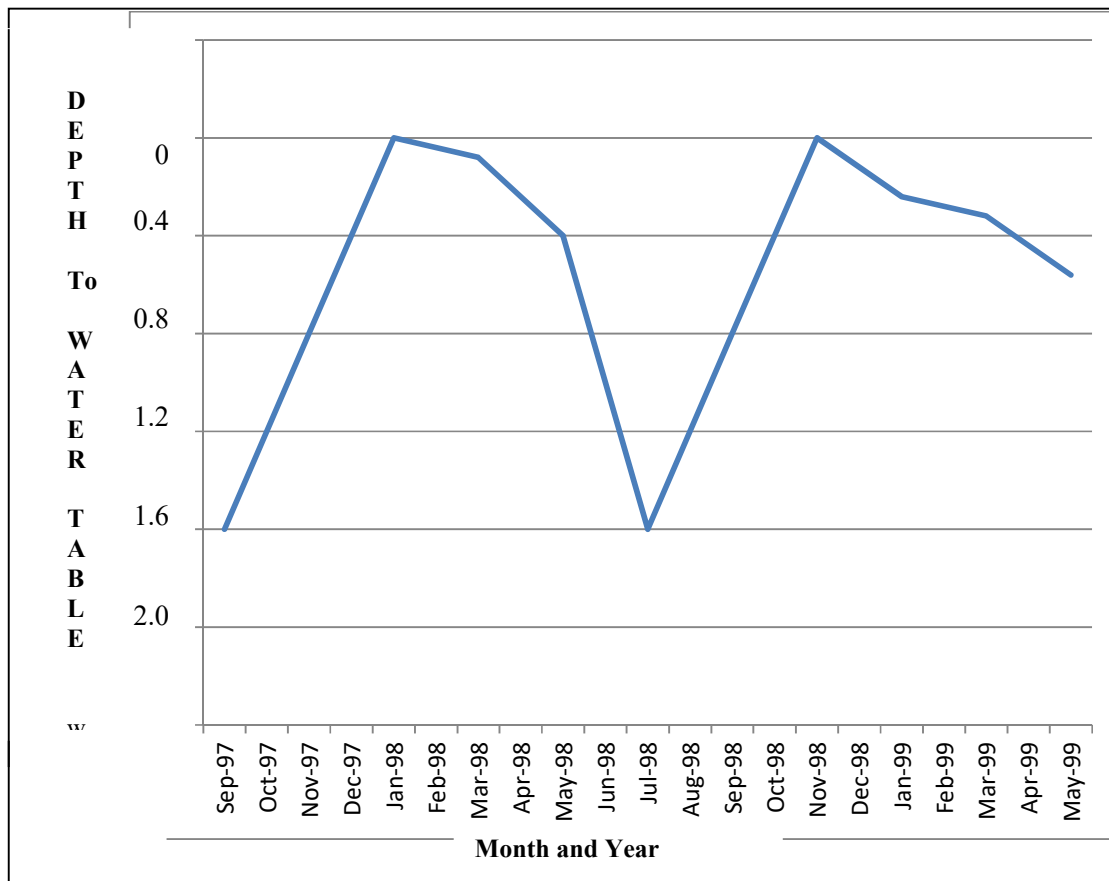
Under this project, paddy is the major crop and the command is deficient with N and P and rich in K. The consumption of Nitrogen fertilizers under Sriram Sagar Project Command Area has increased from 1199578 tons to 1314572 tons between 2015 to 2018.

During pre monsoon 41.5% samples had more nitrates while post monsoon 42.4% samples had more nitrates than the permissible limits. Sometimes the doses of N applied under irrigated conditions is much higher than the recommended dose. Such situations are leading to nitrates accumulation in the soil. Therefore un-utilized nitrogen may be available for dissolving in the water. Consumption of Fertilizers is projected in Table 2.

Table.2. Fertilizers Used

PROJECT YEAR	2021-2022			TOTAL	2022-2023			TOTAL
CONSUMED FERTILIZERS	N	P	K		N	P	K	
IN TONS	1199578	21530	133614	1354722	1314572	602960	201105	2118637

The introduction of canal irrigation not only brings the much needed water but also imports salts. Subsequently considerable amounts of salts are added to the soil profile. Salts accumulated in the profile, year after year and ultimately crop yield is affected. The rise in water table and built up of salinity reduce crop yields by causing damage to the root zone system of crop. Yields are reduced in proportion to the increase in the salt build up as per Fig 2



**Fig. 2** Fluctuations of Water Table

Production loss :

Production loss is estimated on the basis of the data collected from official records. Thus, the collected data supported by the farmers have been used for mathematical. The parameters considered are irrigated in ha., yield per ha., expected yield per ha. and the value for M.T. in to consideration.

$$\text{Loss} = (E_y - A_y)$$

(loss = production loss of yield in M.T. per ha. Per year).

$E_y$  = expected yield in M.T./ha./year

(Data is compiled from the Agricultural Research Station, Jagtial).

$A_y$  = Actual yield obtained from t/ha.

$TLM$  =  $A \times \text{loss}$

$TLM$  = Total loss per year

$A$  = Area irrigated per year.

$TAL$  =  $TLM \times AV$

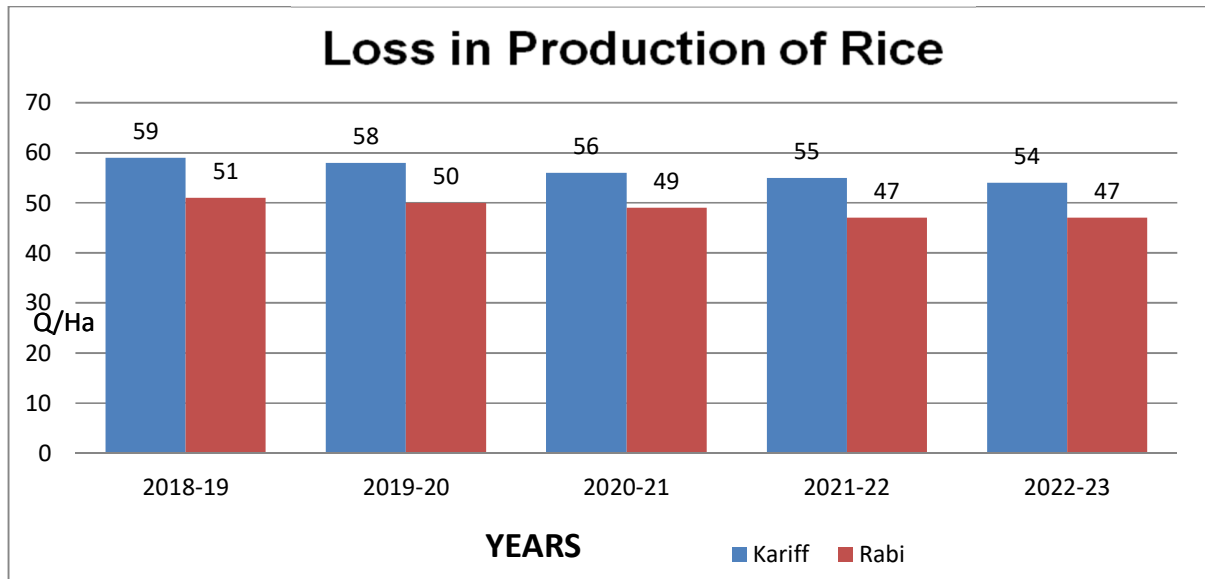
$TAL$  = Total amount of loss per year.

$AV$  = Average market price for the total product during the last 10 years.

Trend Showing the productivity, production and area covered in Sri Ram Sagar Project Command for Rice (Paddy) Crop is shown Table.3. The loss of production in rice(paddy) is exhibited in Fig.3.

Table.3. Productivity and production of Rice

Statement Showing the trend in productivity, production and area covered in S.R.S.P command for Paddy							
S.No	Year	Kharriff Area Ha	Productivity Qtl/ Ha	Total Production Quintals	Rabi Area Ha	Productivity Qtl/Ha	Total Production Quintals
1	2018-19	1257	59	74163	1257	51	64107
2	2019-20	1257	58	72906	1257	50	62850
3	2020-21	1274	56	71344	2500	49	122500
4	2021-22	1291	55	71005	4380	47	205860
5	2022-23	3138	54	199452	4175	47	196225



**Fig.3.** Loss of production in rice

### Results and Discussions

In addition to canal water all most 90% of the annual rainfall is received through the south west monsoon.

Drainage is essential for the reclamation of saline -alkali and water logged areas and it can be effective in order to overcome the problems of water logging and soil salinity, which removes excess water in water logged areas. It creates favorable conditions for crop production. Similarly, for the removal of excess water, installation of surface

and sub surface drainage is an important regulatory measure[6], drainage followed by leaching with good quality water removes excess salts from the root zones, of the crop. An efficient drainage system is essential for the quick disposal of the storm water and excess irrigation water[7]. Hence, drainage should be made a pre-requisite; at the stage of planning canal irrigation projects itself in order to avoid huge social costs due to water logging and salinity.

The improved drainage through artificial means is an essential pre-requisite to reclaim waterlogged salt-affected lands. Conventional surface drainage is essential but to reclaim these lands it needs to be augmented by some kind of subsurface drainage. Horizontal subsurface drainage has been found to be quite effective and eco-friendly technology in areas with poor quality ground water.

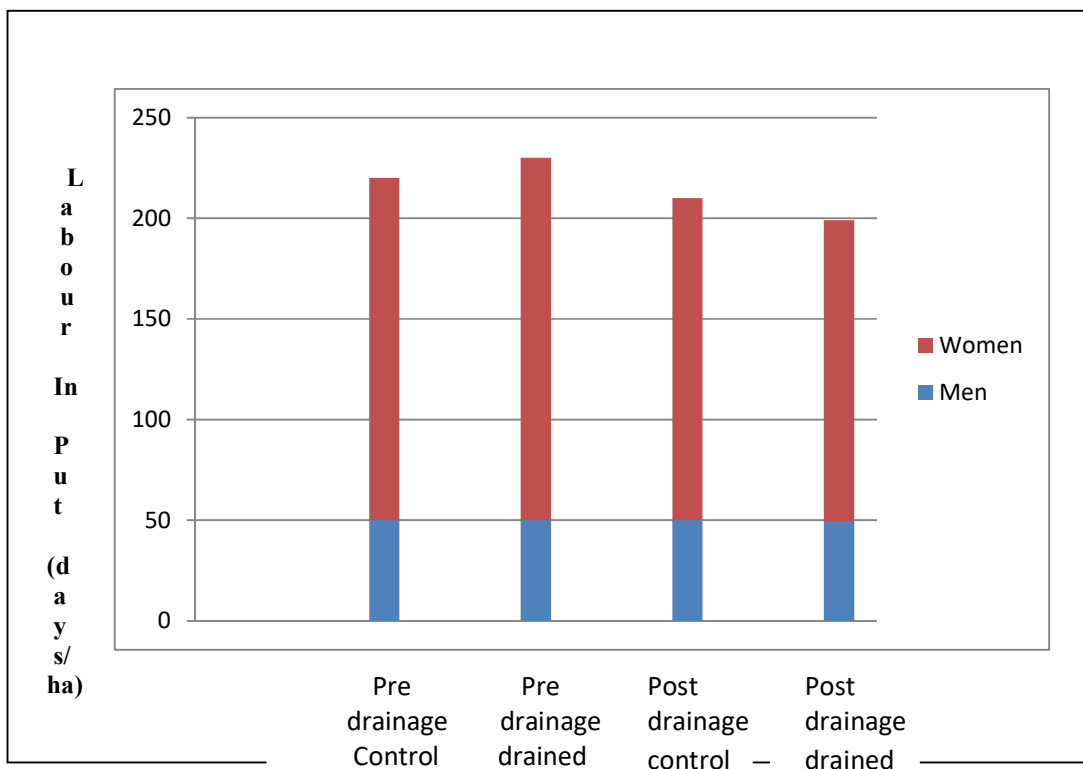
The studies conducted at Jagityal areas revealed that the subsurface drainage pipe or open drain is effective in controlling Water logging and salinity. Leaching is essential to all saline and saline sodic soil to flush undesirable salts. If the salinity is slight to medium level and the soil is well drained, reclamation through planned over irrigation is possible without drainage facilities. About 60 cms of water to a 60 cm. depth of soil can remove 80% salts in soil. Disposal of salts should be to a safe natural drain. If water table is within one meter, it should be constantly pumped through the dug-wells and the water pumped should be disposed off, to natural drains. If soils are saline sodic and



sodic in nature, there should be a provision of leeching. These soils in presence of gypsum, organic measures and the Leaching is essential to all saline and saline sodic soil to flush undesirable salts. If the salinity is slight to medium level and the soil is well drained, reclamation through planned over irrigation is possible without drainage facilities. It can be generally stated that in black soils with very poor permeability conditions. Lateral spacing can be kept varying between 30 to 60 m and the depth of drain at about 1.2 m

The introduction of drainage did not only increase yields, but also reduced farmer's input. In the pilot area, of all activities related to paddy production, 75% of the labour input is provided by the women (most of them are working for planting, weeding and harvesting) and only 25% by men (who mainly involved in irrigation and winnowing).

Introduction of subsurface drainage is a significant reduction in labour input (11 to 25 %). The women were benefited most, although more time was needed for harvesting (5 days/ha), considerable savings (35 days) were obtained in activities like planting weeding winnowing, etc ( (Fig.4).



**Fig.4.** Reduction in Labour Input after Drainage

## Research Methodology

Due to the influence of drainage systems, the water table, which used to be almost at the ground surface during paddy crop season, could be lowered up to 20 to 30cm below the ground surface and the soil salinity has been reduced considerably.

As a result, the yields of Paddy crop in the drained areas have significantly increased. For areas with high salinity problems, open drains lower the salinity levels quite fast. Even though open drains are much cheaper, farmers with small holdings may resist for their installation owing to the loss of cultivable land in construction of drains.

Whenever they are acceptable, the open drains with following specifications are recommended. In view of this a trail is also proposed for 2018 Khariff in one(1)hectare of land for excavation of the following specification open drains are recommended.

Drain Space : 75 m

Drain depth : 1.0m 1.2m

The cost of construction per hectare is costing and Rs.21500.00 the yield increased for year 2023 khariff is 48% and it may go to 65% by second year.

At Jagityal, the following design specifications for perforated pipe drainage system is proposed for testing as a trail

for Khariff 2023 for areas with sandy loam to clay loam soils in SRS Project command area having salinity, sodicity and water logging problems, a perforated pipe drainage system with the following specification is tested.

Drain spacing : 60m

Drain Depth : 1.0m

Water Logging is a form of natural flooding when underground water rises to surface levels as the result of over irrigation. It is observed at SRS Project Command Area at Jagityal(M) Karimnagar (Dist) in Telangan State-India India is shown in Fig.5



**Fig.5** Water Logged Area in Jagityal Mandal

#### **Conclusion**

It is also proposed to test with a composite pipe drainage system with spacing of 30 to 60 m to a depth of 0.9 to 1.1m and singular open drainage system with 100m spacing and 1m depth for this Khariff 2019.

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**Author Contributions:** Dhavaleswar Rao Bhandaru designed the research and wrote the paper and Dr.Sanjeet Kumar guided in research analysis.Dr DineshKumar helped in procuring the data and involved in conducting field tests

**Conflicts of Interest:** The authors declare no conflict of interest.

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