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Creating Irrigation Potential in Drought Prone Area through Lift Irrigation Project

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Abstract
Kadapa is an agricultural district and all the resources depend on the agricultural output. Farmers in upland area are raising rain fed crops which depend upon uncertain rains. Due to meager rainfall in the district, farmers are suffering with crop failures and shortage of fodder. Water plays the most important role for the life of plant. Water is basically delivered to the plants by nature through rains. But due to insufficient and ill-timed rains there is a eminent essential to make use of feasible water sources accurately and efficient to the adequate level for other purposes and irrigation.
The source like subsurface water and ground water can be haul out through infiltration wells, tube wells and bore wells. The surface source of water can be used through construction of Reservoirs, dams, Canal system and lift irrigation system. In lift irrigation and canal system the surface sources like lakes, rivers, small vagu etc., can be used and water will be lifted to the elevated points for irrigating up lands through distribution system.
In order to study the importance/necessity of creating Irrigation Potential by constructing a Lift Irrigation Project, it is proposed make a review on a Medium Lift Irrigation Scheme proposed on Kundu River near Vellala village, Rajupalem Mandal of Kadapa district. The scheme has been sanctioned by Andhra Pradesh Government to create an irrigation potential of 4525 Acres/1831 Hectares under Vellala L.I Scheme. The implementing agency of the scheme is the State Irrigation Development Corporation (APSIDC) with its Division office at Kadapa.

Keywords: *Irrigation, Command Area,Khariff Crop, Water Requirement*

I. INTRODUCTION

Lift irrigation (LI) is a process of irrigation in which water instead of being transported by natural flow (as in gravity-fed canal systems) requires external energy through diesel or electric power using pumps. The requirement of a Lift Irrigation System is continuous water source for the total irrigation season and the possibility to lift water to the desired location. Different kinds of Pumps are available with different Manufacturers for lifting of water and delivering through Pumping Mains depending on hydraulic parameters such as suction head, total pumping head, design discharge. The rising main may be any other suitable material, concrete, steel, depending on the hydraulic pressure.

LI schemes are beneficial wherever the target land is at upper level; the advantage of LI is the nominal land acquisition problem and low water losses. The LI scheme are instrumental in stabilizing agriculture production particularly in the years of droughts and increase food production as water is

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available whenever it is required and thereby increase in income level. LI schemes are either individually owned or owned by a group of farmers in a cooperative mode. For effective functioning of LI schemes, the required aspects are suitable technique, designing, planning, and execution through familiar technical person. Participation of recipient is moderately necessary. Cooperative LI schemes have the probable to be participatory in development and management.

OBJECTIVES

The following are the objectives of the present work:

- Detailed study of components of lift irrigation scheme
- Design of each component
- Evaluation of lift irrigation scheme
- To study the impact assessment before project and after project by using B/C ratio.

II. STUDY AREA

Vellala village is located about 79km for Kadapa and 1 km from Rajupalem, the Mandal headquarters and the population of the village lives on agriculture. The total ayacut under lift irrigation scheme is 4525acres which is belongs to about 200 families of small and marginal farmers. The ayacut is continuous block located 8km away from the source that is Kundu River. The head works are located on the right bank of Kundu River. The water flow in the river near the head works is about 60 cum/sec, during the monsoon period. The operation and maintenance of the scheme is being carried out by the farmers' committee. All the components of scheme are studied to assess the performance of the scheme. Prior to the implementation of the project, the farmers were rising rain fed crop, as the ayacut is not had an assured water supply. The contemplated ayacut proposed under these L.I scheme to irrigate I.D crops in Khariff season is 4525 acres. The farmers under the lift irrigation scheme are irrigating dry crops such as ground nut, sunflower, cotton, etc. The required discharge for this scheme is 72.40 cusecs. Sufficient discharge is available in Kundu River to irrigate 4525 acres in Khariff season.

III. DESCRIPTION OF THE COMPONENTS

The detailed description of each component of Vellala LI scheme has been studied and discussed below. The Schematic Diagram showing all the components of the Scheme is shown in Figure 1

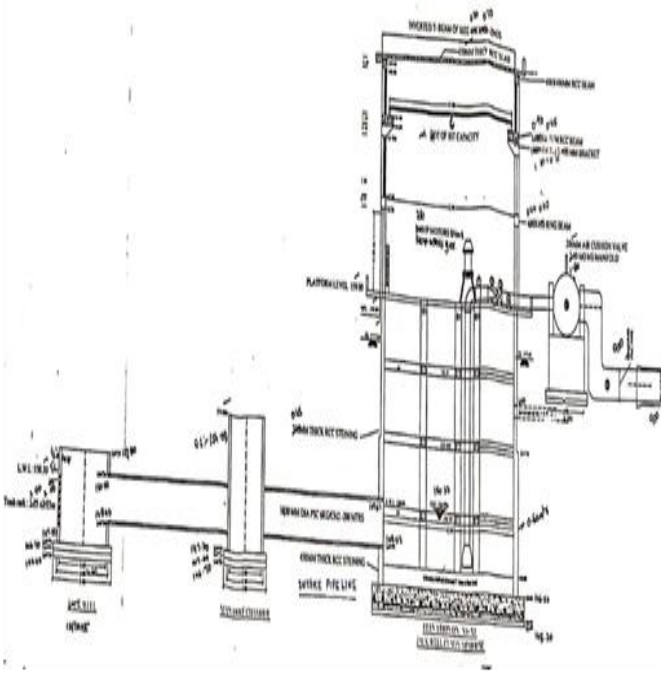

Figure 1 Schematic Diagram

3.1 Intake Well:

The Intake Well of 4 m internal diameter with steining thickness of 0.20 m (Figure 2) in M20 concrete was constructed to draw water from river at lowwaterlevel of +150.50 and to hold the Intake pipe line. To avoid the entry of debris and other foreign materials etc. a Trash Rack of size 2.0 m x 2.0 m at the entrance of the Intake pipe is provided.

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3.2 Intake Pipe Line:

An Intake pipe line (Figure3) of 200 m long was constructed with 1800 mm diameter PSC Pipes 6 kg/cm^2 over 0.30 M thick leveling course with Cement Concrete (1:4:8) to connect the Jack well with the Intake well. Inspection chamber at ch 100 m has been constructed for maintenance.

3.3 Jack Well:

The circular type Jack well with an internal diameter 12.50 m was constructed to accommodate 3 numbers (3+0) of each 240 HP VT Pump sets & 2 numbers (2+0) of each 210 HP VT Pump sets pertaining ayacut. The thickness of steining is adopted with a thickness of 0.60 m up to 6.00 m and then 0.45 m up to floor level with M_{20} grade Concrete. A raft/mat of Jack well was provided 1.00 m thick over Concrete grade (1:4:8) leveling course. The total height of steining is 11.90. The height of well was kept at 1.00m above at MFL of 158.00. M20 Concrete Baffle walls of 0.20m thick are provided to avoid interference of turbulences created during pumping. Suitable size pump supporting beams and bracings are provided to distribute the vibrated loads. (Figure 4 shows the work of Jack Well in progress.

Figure 4: Jack well

3.4 Pump House

The 1250 millimeter circular pump house was constructed above jack well with 23cm thick brick masonry walls to provide accommodation for valves, 3 numbers of pump sets, working space, and 500 mm diameter distribution pipes etc., Isolated panel room is provided to accommodate capacitors bank, soft starters , and three numbers of panel boards, etc. A framed structure in M_{20} concrete with columns size 0.30mx 0.30m and beams at lintel level, above lintel and roof level are proposed. 2nos of rolling shutters, two doors, one cup board and 6 Numbers of windows are provided. Gantry arrangement with 10.0 ton EOT is provided for lifting operations of pump sets and panels etc during the period of maintenance. The pump house is shown in Figure 5

Figure 5: Pump house

3.5 Pressure Main:

Two pressure mains of 900 mm diameter with Prestressed Concretepipes(PSC) are provided for 5200 M and 2900 M to deliver water to the Main Delivery Cisterns MDC-I and MDC-II respectively for creating irrigation facilities to the total extent of 4525 acres. Necessary Water Hammer Control devices such as Air Valves, Zero Velocity Valves are provided as per the surge analysis to control the negative pressure in the pressure mains. The required air valve chambers and zero velocity valve chambers were provided. The delivery pipes from the Pumps are connected to MS Manifold Chambers to supply water through pressure mains. The manifold chambers are shown in Figure 6.

Figure 6: Pressure main

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3.6 Main Delivery Cistern

Main Delivery cisterns are cons
end of Pressure Mains as double cistern type with 10.00 meters diameter inner cistern & 13.00 meters diameter outer cistern. The cisterns are constructed with 30 centimeters thick M20 concrete Mat foundation over 20 centimeters thick Cement Concrete (1:4:8) and 30 centimeters thick steining walls. Further 0.30 meter thick baffle walls are provided in between two stainings to create separate chambers for Gravity Mains those proceed from these delivery cisterns. The necessary required vents (rectangular notch) along with screw gearing shutters are provided in the steining of the inner Delivery Cistern at water level to discharge the proportionate water to each Gravity Main as per design shown in Figure 7.

Figure 7: Main delivery cistern

3.7 Gravity Main

In the ayacut, there are undulations with many gullies and Vagues apart from the rural roads and village roads. Hence the ayacut is divided into 72 blocks having each block with an extent of 35 acres to 90 acres considering gullies, vankas and roads as boundary. Each block is connected with suitable dia gravity main with one distribution cistern so as to command the entire ayacut in the respective block. The Gravity mains are provided with S/S RCC P1 pipes from 500 mm diameter and above. The PVC Pipes from 400 mm diameter and below are proposed in telescopic manner with intermediate cisterns to distribute water to each block.

The tail end Delivery Cisterns at end of the each Gravity Main are constructed with 1400 mm diameter NP2 pipe of 2.50 meters height. Notches ided for discharging water at required level. The pipe is proposed for erection above 20 centimeters dense Cement Concrete (1:4:8) leveling course and 0.30 meters thick sand filling as per site condition requirement.

Further the intermediate Deliver Cisterns i.e. Cisterns in between Main Deliver Cistern and Tail end Deliver Cisterns at the end of each Gravity Main are proposed with circular cisterns with baffle walls inside to create separate chambers and to disperse the require water to the individual Gravity Mains. The cisterns are designed for 60 seconds retention time as per standards. But slight higher size is adopted to accommodate baffle walls /Partition walls to create separate chambers to the individual Gravity Mains for easy distribution of required discharge.

IV. DESIGN OF PARAMETERS

4.1 Duty and Discharge Calculations

Ayacut		4525 acres
=		
Cropping pattern		Khariff ID
=		
Duty with 16 hours		100 Acres
=		
pumping per day		
Ref. No [11]		
Duty with 12 hours		
pumping per day		75 acres
= =100*12/16		
Discharge =		60.33 cusec
Extent/Duty =		
Add transmission losses		
@20%	=	12.07 cusecs
Total discharge		
requirement		72.40 cusecs
=		
Quantity of water		
required		281.490 Mcft
for Khariff season		
=		

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4.2 Design Guidelines

Various components of the Lift Irrigation scheme are designed for the required discharge of 72.40 cusecs as per the technical guidelines of NABARD. The design procedure is given below:

4.2.1. Intake Well:

Diameter not less than 1.5m or 2D

(Where D=Diameter of intake pipe)

Height:

- Minimum clearance between bottom of inlet opening and river bed = 0.5m
- Clearance of well top and opening top = 1m
- Entrance velocity not greater than 0.6m/s
- Grating 20% t050%.
- Scour depth R= 1.35 $(q^2/f)^{1/3}$

  Where q =cumec/m
  f =silt factor
- Well top 0.5 above LWL
- Opening top 0.5 below LWL
- Total height above river bed =height below river bed

4.2.2. Intake Pipe:

- Velocity not greater than 1.2m/s
- Gradient l:400 but not greater than 1:100 & Not less than 1:1000.
- Bottom of intake pipe 0.5 above bottom of intake well.
- Inspection chamber at every 100m.

4.2.3 GRAVITY MAINS

Loss of Head $h = (1 + f1 + f2 \times L/R) \times V^2/2g$

Where,

f1 = coefficient = 0.505

f2 = a (1 + (b/R))

a = 0.00316, b = 0.1

D = Diameter of pipe

R = Hydraulic mean radius = D/4

L = Length of the pipe line

V = Velocity of flow through the pipe

Driving head of 0.3 m should be added to loss of head in gravity mains.

4.2.4. Jack Well:

A) Diameter:

- Clearance between base plate and walls = 0.5m
- Chord 0.5m away from diameter
- Chord C = (2*number of pump sets + 1) *pump diameter

  Jack well diameter = $2*\sqrt{(C/2)^2 + (0.5)^2}$

B) Height:

- Top of jack well = 1.0m above H.F.L
- Pump submergence = 1.0 m
- Pump bottom 1.5 m above floor
- Jack well bottom 0.5 m below intake pipe
- Low water level – jack well bottom = 2.5m+L (Height of bell mouth)

4.2.5. Pump House:

- Shape: circular over sump well, rectangular by the side of sump well
- Circular pump house:

  Diameter = same as of sump well
  Height = 12.50m
- Rectangle pump house: -
- Length of pump house:-

Length is such that minimum clearance between two

as shall be 0.6

Clearance from wall = 0.6m.

- Width of pump house:

  Such as to accommodate
- 0.5m of inlet pipe'
- Reducer
- Pump assembly
- Enlarger
- Sluice value

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- Reflux value
- 0.5m of outlet value

- Height of pump house:
- For circular pump house, height = 5.0m
- For rectangular pump house, height =4.0m

V. BENEFIT COST RATIO ANALYSIS

The Cost Benefit In vellala lift scheme with and without project conditions before construction of project the farmers get the only one crop, after the construction of project to get the two crops. Ayacut and crops also increases and increasing the benefits of farmers. The cost benefit of vellala lift scheme are discussed in the below Table 1 and Table 2.

VI. INFLUENCING FACTORS ON THE PERFORMANCE OF THE LIFT IRRIGATION SCHEME

Subsequently detail inspection of several issues responsible for poor performance of Lift irrigation Schemes, reformative actions and their appropriateness are proposed below.

Maintenance of the Machinery

The overhauling and maintenance is to be implemented through the skilled agency. Loss due to tear and wear could be reduced by the consistent maintenance, periodical checking and observations.

Pipes and Pipe Joints:

Reinforced Cement Concrete pipes laid beneath the ground level depreciate with moisture effect and chemical. In order to remove the leakages, these pipes along with collars are to be replaced. Due to huge quantity of excavation this is expensive and time consuming also. The carrying of material and machinery for such repairs is expensive and difficult due to standing crop and wet soil. The methodologies are somewhat difficult to get to. Seeing these restraints, it would be better to replace Reinforced Cement Concrete pipes by Polyvinyl Chloride pipes. These Polyvinyl Chloride pipes are chemically inert and easy to handle, transport, and repair. Whenever considered diameter is more than 300 mm and required head is above 50 m, it would be better to use pre-stressed pipes with prior planning. In such conditions Pre-stressed pipes prove to be economical.

Reinforced Cement Concrete collar joints should be repaired with rich modified mortar using respective admixtures available in market. eddy setting time cement and Chemical attack resistant can be used. Use of lead and wool joint to pre - stressed pipe leakages, Mild Steel step collars for Reinforced Cement Concrete pipes depending upon site conditions are preferred. Anti -corrosive paint must be applied to Mildsteel components used in the scheme.

Cropping Pattern

If crop rotation is required, the variations must be made in planned manner considering duty, base period and delta, of crops. If water distribution to a specific crop is increased, it has to be waged by reducing requirement of another crop. For example 20% + 40 % + 40 % permitted pattern can be revised by plantation of Sugar Cane up to 40 % from 20 %. Other cash crops like Tobacco, Banana and Vegetables are entertained.

Water Management

To the farmers list of statement for watering is informed pasted on the office announcement sheet this is compulsory to farmers and employees. Immediate action and harsh steps towards the water theft and wastage of water are necessary. This can be accomplished over written notice and punishment in the form of currency.

Pecuniary funds in possible areas, provision of sinking fund, annual assessment, etc. lead the L.I. Scheme to assimilate the financial level. The teaching programs to functioning staff are to be made necessary to increase the administration level. Everywhere probable timeworn machinery must be changed by up-to-date machinery as these are very easy to handle and condenses required least possible manpower and energy System control switches are to be used.

Focus on Areas for Special Repairs

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		Without Project								With Project								
	Name of the crop grown	Area (Ha)	Yield per Ha (Qta)	Total yield (Qtl)	Price per / (Qtl)	Total income In Rs	Inv. Cost Per (Ha)	Total Cost (Rs)	Net Benefit (Rs)	Area (Ha	Yield per Ha (Qta	Total Yield (Qtl)	Price Rs/ qtl	Total Income (Rs)	Inv. Cost Per (Ha)	Total Cost (Rs)	Net Benefit (Rs)	Increment Income
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
KHARIEF																		
1	Jawar	250	12	3000	1800	5400000	8000	2000000	3400000	300	35	10500	1800	18900000	11000	3300000	15600000	12200000
2	Sunflower	0	5	0	2500	0	8000	0	0	150	30	4500	2500	11250000	14000	2100000	9150000	9150000
3	Maize	380	4	520	2500	3800000	8000	3040000	760000	450	30	13500	2500	33750000	15000	6750000	27000000	26240000
4	Cotton	450	20	9000	3000	2700000	8000	3600000	23400000	500	40	20000	3000	60000000	15000	7500000	52500000	29100000
5	Pulses	250	5	1250	3000	375000	8000	2000000	1750000	250	30	7500	3000	22500000	19000	4750000	17750000	16000000
6	Onions/ Vegetables	-	-	-	-	-	-	-	-	181.98	35	6369.3	4000	25477200	17500	3184650	222925	22292550
7	Keft fallow	501.98	-	-	-												-	-
	Total	1831.98				39950000		10640000	23910000	1831.98				171877720		27584650	14429255 0	114982550

Everywhere possible the poor areas to incorporate themselves are found out eg. Decrease in the static head by lowering down the invert level of rising main use in the case of ‘Ambap-Talsande Lift Irrigatio scheme. These benefits to decrease the head loss and to rise the discharge.

VII. CONCLUSIONS

The study has been conducted to identify the problems facing by these farmers for getting irrigation facilities under Kundu River and how these problems are solved by the implementation of the Lift Irrigation Scheme near Vellala village.

The commanded area under this L.I Scheme is about 4525 Acres/ 1831 Hectares.

The study on ground water table nearby villages, after and before accomplishment of the scheme, indicates that the ground water table will be reformation in the bore wells and another 5000 Acres will be benefitted indirectly. The drinking water problem of nearby village will also be solved.

Based on the cost benefit analysis intimidation LI is the most proficient method not only to reduce budgets, but also to protect the environment as well. This work was supported through “Putting into practice of Ecosystem Based Adaptation (EBA) approaches into the river basins which are very dicey to climate change” project, UNDP.

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VII. REFERENCES

[1] [1] Estimating and costing in Civil Engineering A.DATT & co., publishers, Lucknow by B.N. Datta,
[2] [2] "Irrigation and power Engineering" Standard Publishers & Distribution New Delhi, B.C. Punmia,
[3] [3] "Engineering Hydrology" Tata McGraw Hill Publishing Co. Ltd., New Delhi, K. Subramanian.
[4] [4] MODI & SETHI Hydraulic and Fluid Mechanics Standard book house, New Delhi
[5] [5] Patil R.J (2010)
[6] [6] M.R. Sharma, Quamrul Hassan, H.P. Singh, and Naved Ahsan (2013)
[7] [7] Umesh Desai, Mayuri Farmer (2000)
[8] [8] Chief Engineer, 1 & CAD Deptt., (2005)
[9] [9] K.J. Joy and Suhasparanjape (2002)
[10] [10] Apporva Oza (2001)
[11] [11] Minor Irrigation (MI) Guidelines (AP)

[12] Table 1: Cost Benefit Analysis of Vellala L.I. Scheme - with and without Project Conditions
[13] Table 2: BCR and IRR Calculations

S. No.	Description	Amount
1	BERFORE IRRIGATION	
A)	Total agriculture production	39950000
B)	Total cost of cultivation	10640000
C)	Net agriculture production	29310000
2.	AFTER IRRIGATION	
A)	Total agriculture production	171877200
B)	Total cost of cultivation	27584650
C)	Net agriculture production	144292550
3.	Net Agriculture Benefit	114982550
4.	Cost of capital outlay (Estimated cost)	451574349.3
5.		
A)	Interest on capital outlay @12%	54188921.92
B)	Depreciation @2%	9031486.987
C)	Maintenance expenditure @500/-hectare	915990
	Total of item 5 only	64136398.91
6.	BCR ON NET ANNUAL OUTLAY	
	BCR(3/5)	1.79
	BCR of the project (25 years)	
1)	Life of the project in years	25
2)	Benefit for 25 years	2874563750
3)	Add 10% for capital cost	45157434.93
4)	Total benefit from the project in 25 years	2919721185
5)	Invest on the project	
	A) Capital cost	451574349.3
	B) 80% 0f capital cost	361259479.5
	C) Interest + Depreciation + Maintenance for 25 years	1603409973
7.	Total investment 5B+5C	1964669452
8.	BCR ratio=Total benefit/Total investment.	1.49