



Performance Study of Nagulapadu Lift Irrigation Scheme of Nallamada Drain in Krishna Western Delta

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ABSTRACT

In the present day context, the human right to water is indispensable for leading a healthy life. Only 0.016% water is available in lakes and only 0.0001% water is flowing in streams, rivers and drains. A study was conducted to quantify the irrigation needs and the availability of drain water and the evaluation of performance of a Lift Irrigation (LI) scheme namely Nagulapadu LI Scheme, Pedanandipadu on Nallamada drain in Krishna Western Delta. Drain flows were observed that during September to December month i.e. in the tune of 3 - 4.5 TMC. During January to April and August months the outflows were in the tune of 0.5 to 1.5 TMC. It was found that the total quantity of water flow in Nallamada command on average in a year was 43.84 TMC. Out of which only 6 TMC of water had been used for all the LI schemes and for all the crops under Nallamada command in Krishna Western Delta, the remaining 37.84 TMC of quantity of water flowing as environmental flows. Under the Nallamada command, it is estimated that the maximum water was utilized by Cotton crop and the minimum water was utilized by Bengal gram. It was observed that Nagulapadu LI Scheme pumps out 0.1507 TMC annually and crop water requirement is 0.135 TMC and was hence found in safe with an efficiency of 90 per cent.

Key words : Flow quantities, Lift Irrigation Scheme, Nallamada drain, TMC.

The relentless increase in population and the resulting spurt in the demand for water, require careful planning and management of the limited water resources. Total geographical area of the country is 328 million hectares, out of which 305.5 million hectares are counted for land use. In relation to population, India's population is 16% of that of the world, but water resources are hardly 5% of the average annual run-off of rivers in the world. Water is a dynamic resource and hence planning and policies have also to be dynamic. Thus the country has still a long way to go in its development of water resources, so as to optimize the benefits accruing from the available water. Lift Irrigation Schemes to provide water to the fields at higher level. In this work, the distribution of water is utmost important. Water can be lifted from wells, rivers, irrigation tanks etc. and conveyed through pipe line system made of cement, steel and PVC etc.

Hall and Dracup (1970) stressed the need for the application of systems engineering approach for planning water resources. It was necessary for treating the complex problem, the multiplicity of goals and alternatives, and the very real possibility of having only one chance at developing the best course of action. Kulkarni and Shahi (1997) have identified major difficulties encountered by the LI schemes in Maharashtra state and suggested that water availability shall be ascertained before

sanctioning the scheme. Hooda (1998) examined that cotton cultivation developed in the Aeolian plains and in undulating plains with high intensity irrigation, continued decreasing trend in the high dunal plains with the reduction in intensity of lift irrigation in the study region. Kunthy and Gupta (2000) evaluated a locally made low lift irrigation pump of 12 cm diameter and 3 m long discharge pipe for performance under 6 different speeds from 1250 to 2500 r. p.m. and 3 total static heads of 1, 1.5 and 2 m. The maximum efficiencies were 49.2, 47.1 and 44.3% at 2250 r.p.m.

MATERIAL AND METHODS

There are about 353000 and 19500 Lift Irrigation Schemes established in India and Andhra Pradesh respectively. In Andhra Pradesh, Andhra Pradesh State Irrigation Development Corporation (APSIDC) was established in 1974 to exploit the ground and surface water potential through lifts in a big way, till now APSIDC has constructed about 1150 Lift Irrigation Schemes, creating an irrigation potential of 4, 30,000 acres. In Krishna Western Delta Nallamada drain is located up-stream end at vogeru near chilakurupet 60.5 km length to the downstream end at zero face of the Bapatla jurisdiction close to sea mouth. There are 64 LIS established on Nallamadadrain, which one scheme covers maximum extent of 3200 ha and minimum

Table 1. Technical Details of Nagulapadu Lift Irrigation Scheme

S.No.	Item	Details
1	Project estimated cost	Rs. 179.68 lakhs
2	Area under project	1200 ac (480 ha)
3	Water source	Nallamada drain
4	Investment per one acre	Rs.14, 975/-
5	Discharge	17.60 cusec
Construction details		
1	Intake well	2.40 m dia
2	Intake pipeline	1200 mm dia
3	Length	45m
4	Jock well come pump house	6.00 m dia
5	Delivery tub	5.00 m dia
6	Gravity main	5.00 m dia
7	Gravity main 2	6.00 m
8	Pipe length	3600 m
9	Delivery tub 2	4.00 m dia
10	Gravity main3	700 mm
11	Pipe length	2610 m
12	Gravity main 4	400 mm
13	Pipe length	1248 m
14	Pump capacity	45 hp (33.12 KW)
15	No of pumps operated	3
16	Total lift height	12.54 m (41.13ft)
17	Drain minimum water table	+4.70 ft (1.43m)
18	Pipes height	+14.00 m
19	Delivery tub height	+15.60 m
Pump and Motor Details		
1	Company	Kirloskar
2	No of pumps	3
3	Motors	3 phase induction
4	Frame	Svh 200
5	Out put	37.0 KW
6	Speed	1470 rpm
7	Voltage	4151v-10%v
8	Current	62.5amps
9	M/c.no	0355p222-02
10	Frequency	50 Hz
11	Encl	1 0.12
12	Ampoc	50
13	Duty	51
14	Efficiency	90.5%
15	Ref:	15.325
16	Temperature rise	70 degree
17	Operation hours	6.00 am-2.00 pm

of 15.6 ha the commercial crops are cultivated mostly cotton, chilly, maize, tobacco and bengal gram. Keeping the cropping system water needs, drain water joining in the sea without usage and possibility of creating water resources for adjoining farmers' fields, a study was conducted in Nagulapadu LIs cheme command area for quantification of drain flow and efficiency of LI Scheme.

Study Area (Nallamada Drain)

In Krishna Western Delta Nallamada drain is located up-stream end at Vogeru near Chilakalurupet, 60.5 Km length to the downstream end at zero face of the Bapatla jurisdiction close to sea mouth. Nallamada drain water is the major source of irrigation for Narasaraopert and Pedanandipadu belt, where commercial crops like cotton, maize, chilli, tobacco and bengal gram are cultivated in both kharif and rabi seasons. There are 64 Lift Irrigation Schemes established in Nallamada drain command, covering an extent of about 20,000 ha, each scheme covering a range of minimum of 15.6 ha to maximum of 3200 ha. There are 64 no. of Lift Irrigation Schemes functioning in the study area. For the present study, Nagulapadu Lift Irrigation Scheme covering an area of 480 ha (1200 ac) was selected with a due relevance to suit the mandate of AICRP in Saline Water (Use of Saline Water in Agriculture), a Research Station of ANGRAU located in Agricultural College Farm, Bapatla.

The Nagulapadu LIS was constructed on Nallamada drain in Pedanandipadu Mandal of Guntur District under R.I.D.F VII (NABARD) Programme vide G.O. Ms. NO.64 dated 30.04.2002 with an estimated cost of Rs. 180.00/- lakhs to cater the needs of 1200 acres and the scheme was commissioned on 03.01.2005. The scheme was handed to the beneficiary committee for maintenance and now the scheme has been functioning and catering to the irrigation needs of the farmers.

The beneficiaries in the villages and in the adjoining farmer fields, the farms were cultivated mostly with commercial crops both in *kharif* and Rabi seasons. The irrigation water facility was very meager from canals and tanks and due to this, the command area completely became rain fed. Nagulapadu Lift Irrigation Scheme has become the only major source of water for irrigating 1200 acres of land benefiting to 600 farmers covering five villages namely Pedanandipadu, Chinanandipadu, Adusumalli, Garlapadu and Nagulapadu.

Accurate and precise crop water requirement data under varied situations are essential in irrigated agriculture not only for crop growth in field level but

also for water allocation among the beneficiary farmers. An appraisal of economic returns from irrigation projects, proper design and operation of irrigation scheme depends, to a large extent, on the reliability of available information on crop water requirements.

It is the sum of the volume of water used by vegetation (crop) over a given area in producing plant tissue, in transpiration (T) plus that evaporated (E) from adjacent soil or from moisture intercepted on plant foliage. Since the volume of water used in producing plant tissue is negligible (< 1 %) compared with the volumes used in Evaporation and Transpiration, the CU can be taken to be approximately equal to evaporation plus transpiration or evapotranspiration (ET).

Optimum water requirement it is the amount of water required during the growing season to produce highest yields of different crops, where the amounts include soil moisture supply by precipitation as well as water delivered by irrigation. Irrigation frequency It refers to the number of days between two successive irrigations (irrigation interval) during the periods without precipitation. It depends on the consumptive use rate of a crop and the amount of available soil moisture in the crop root zone. Sandy soils require more frequent irrigations than fine textured soil.

$$\begin{aligned} \text{Design frequency} &= (\text{Net amount of moisture between} \\ &\quad \text{FC and starting level}) / \\ &\quad \text{Peak period moisture use} \\ &= (\text{Net depth of application}) / \\ &\quad \text{Peak period moisture use rate} \end{aligned}$$

Irrigation period is defined as the number of days that can be allowed for applying one irrigation to a given design area during the peak period consumptive use of the crop is known as irrigation period. It is the basis for capacity and equipment design. Irrigation systems are to be designed in such a way that the irrigation period should not be greater than irrigation frequency.

Irrigation period = (Net moisture between start of irrigation and lower of depletion)/Peak period moisture use rate of the crop.

Precise knowledge of crop water requirements data and crop coefficients for various crops, available from standard FAO manuals which were published with lot of compilation of research data were utilized to estimate the irrigation needs of the study area and the LI scheme's performance in terms of under design or over design is

Table 2. Year wise Nallamada drain flow quantities during 2005-09

S. No.	Year	Yearly flow quantity (Cu. m)	Quantity (TMC)
1	2005-06	538549344	19.02
2	2006-07	1378965600	48.69
3	2007-08	1491723648	52.67
4	2008-09	1556647200	54.97
		Average	43.84

Table 3. Estimated water requirement of crops grown under Nagulapadu LI Scheme based on crop growth stages.

S.No	Crop	WR(mm)	No. of Stages	WR Stage wise (mm)					
				1	2	3	4	5	6
1	Cotton	743.0	4	185.75	375.5	557.25	743.0	—	—
2	Tobacco	505.0	4	126.25	252.5	378.75	505.0	—	—
3	Chilli	486.0	6	81.00	162.0	243.00	324.0	405.0	486.0
4	Maize	574.0	4	143.50	287.0	430.50	574.0	—	—
5	Bengal-gram	249.0	2	124.50	249.0	—	—	—	—

Table 4. Water requirement of total crops of villages under Nagulapadu LIS

Village	No. of crops	Extent(ha)	WR(TMC)
Chinanandipadu	5	157	0.032623342
Pedanandipadu	5	160	0.033311449
Nagulapadu	5	80	0.014538471
Adusumalli	5	40	0.007269236
Garlapadu	5	40	0.007269236
Total	5	480	0.095011734
Assuming conveyance losses @ 70%		Total	0.135

accordingly assessed.

RESULTS AND DISCUSSIONS

Quantification of drain water flow in Nallamada drain flow quantity, for close observation over the years, month wise total quantity of drain flows for the years 2005-09 were tabulated in Tables 2 The same data was represented pictorially in the form of histograms for easy understanding in Figures 1 & 2. From all the years of the data of drain flow quantities, it could be observed that during the months of May there were meager or no out flows in

the drain. As per the interaction with the farmers, the fields were kept without crop during this period. Peak outflow in all the years was observed in the month of November. High drain flows were observed during September to December month i.e. in the tune of 3 - 4.5 TMC. During January to April and August months the outflows were in the tune of 0.5 to 1.5 TMC.

From the above Table 2 it was observed that on an average about 43.84 TMC of water flows through the drain annually. But perhaps in the year 2005-06, very less drain flow was observed because

Table 5. Crop wise average water requirement of LIS on Nallamada drain.

S.No	Crops	Extent(ha)	Water requirement					TMC
			Mm	ha.mm	ha.m	cu.m	cu.ft	
1	Cotton	4528.6	743	3364750	3364.75	33647498	1187337835	1.187337835
2	Tobacco	4286.58	505	2164723	2164.72	21647229	763877719	0.763877719
3	Chilli	3830.24	486	1861497	1861.50	18614966	656876594	0.656876595
4	Maize	3884.26	374	1452713	1452.71	14527132	512626940	0.51262694
5	B.gram	3394.72	249	845285	845.28	8452852	298280482	0.298280483
			Sub-total					3.620824481
	Total command		19924.4	Assuming conveyance losses @ 60% ,				6.034
				Total estimated water requirement				

Table 6. Calculation of Nagulapadu LI Scheme field use efficiency

Designed discharge of LIS Project	=	17.60 cusec(Total 3 pumps)
1cusec	=	28.31lt/sec
1sec discharge	=	28.31lt
1 hour discharge	=	101916 lt
1 Day (8 hours discharge)	=	815328 lt
1 month discharge	=	24459840 lt
1 year (10 months) discharge	=	244598400 lt
1cu.m	=	35.29 cu.ft=1000lt
1 lt	=	0.0353cu.ft
244598400 lt	=	8634323.52 cu.ft
1TMC	=	1000000000 cu.ft
1 cu.ft	=	0.000000001 TMC
8634323.52 cu.ft	=	0.00856 TMC/ 1 cusec discharge for 1 year
Water pumped for utilization per year From Nagulapadu LI Scheme	=	0.150656 TMC

of low drain flow be due to deficit rainfall in the NSP command.

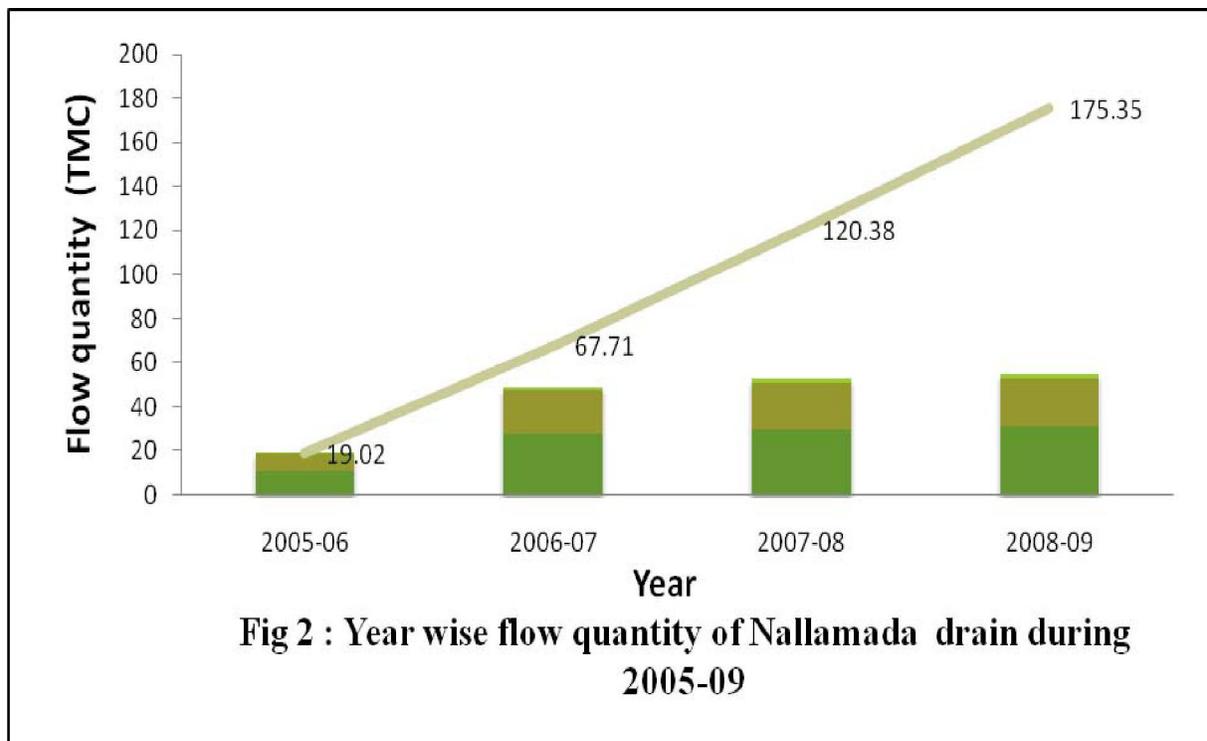
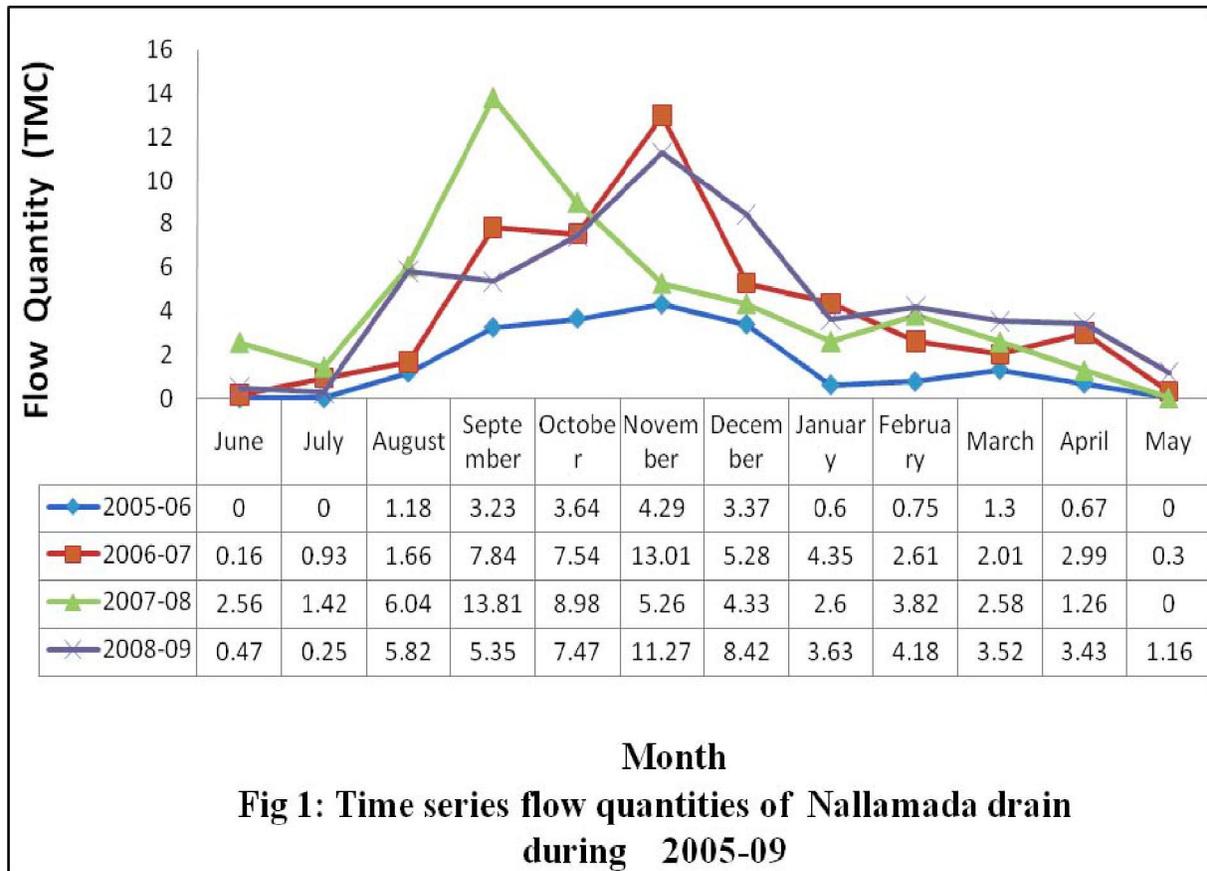
In the study area, paddy cultivation was not followed by the farmers though there was plenty of water in the drain, the farmers were not growing high water requirement crops like paddy and sugarcane in the study area like elsewhere practice generally followed. Almost 1/3rd of the command area was cultivated with tobacco which is a commercial crop and is mostly grown in other parts of the district. As majority of the water was joining the sea, the crop shifts might be recommended for better yield of the crops.

With a view to exactly assess the effective utilization of drain water, the water requirement of the crops were estimated using FAO standard published data on crop coefficients and was

presented in Table 3. It was found from the Table 2 , the total quantity of water flow in Nallamada command in a year was 43.84 TMC. Out of which only 6 TMC of water could be used for all the LI schemes and for all the crops under Nallamada command in Krishna Western Delta. The remaining 37.84 TMC of quantity of water joined with sea.

Efficiency of the Nagulapadu LI Scheme

APSIDC authority has designed and executed the LIS in Nagulapadu ayacut in the year 2005. As the authority might have considered about the then cropping pattern and farming conditions, there was every need to frequently retrospect and introspect the system performance. Further for any design, it is customary to keep a FS (Factor of Safety) and keep the system capacity. To know,



whether the LI scheme was under designed or overdesigned and also to fulfill the first objective of the study, the total capacity of the LI scheme with the design capacity was worked out with practically observed reasonable assumptions with a due feedback from the beneficiary farmers. If the system's water output and farmers' actual crop consumption in the field as per their practice and as per scientific approach was known, it was easy to assess the scheme's performance which would be a prerequisite for extending irrigation benefits to the other tail end of the command.

It was obvious that the Nagulapadu LI Scheme was functioning with 90 per cent efficiency and the remaining 10 % of the pumped water from the scheme was might be either used for ground water recharge or for deep percolation losses in all the fields or application losses within the fields.

CONCLUSIONS

Drain flows were observed and concluded that during September to December month i.e. in the tune of 3 - 4.5 TMC. During January to April and August months the outflows were in the tune of 0.5 to 1.5 TMC. It was observed that on an average about 43.84 TMC of water flows through the drain annually. It was found that the total quantity of water flow in Nallamada command on average in a year was 43.84 TMC. Out of which only 6 TMC of water could be used for all the LI schemes and for all the crops under Nallamada command in Krishna Western Delta. The remaining 37.84 TMC of quantity of water joined with sea. Under the Nallamada command the maximum water was utilized by Cotton crop and the minimum water was utilized by Bengal gram. It

was observed that Nagulapadu LI scheme was in safe design and the water efficiency was about 90 per cent. Similarly might be same with many LI Schemes in the drain. Similar may be the case with most of the LI Schemes on Nallamada drain.

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