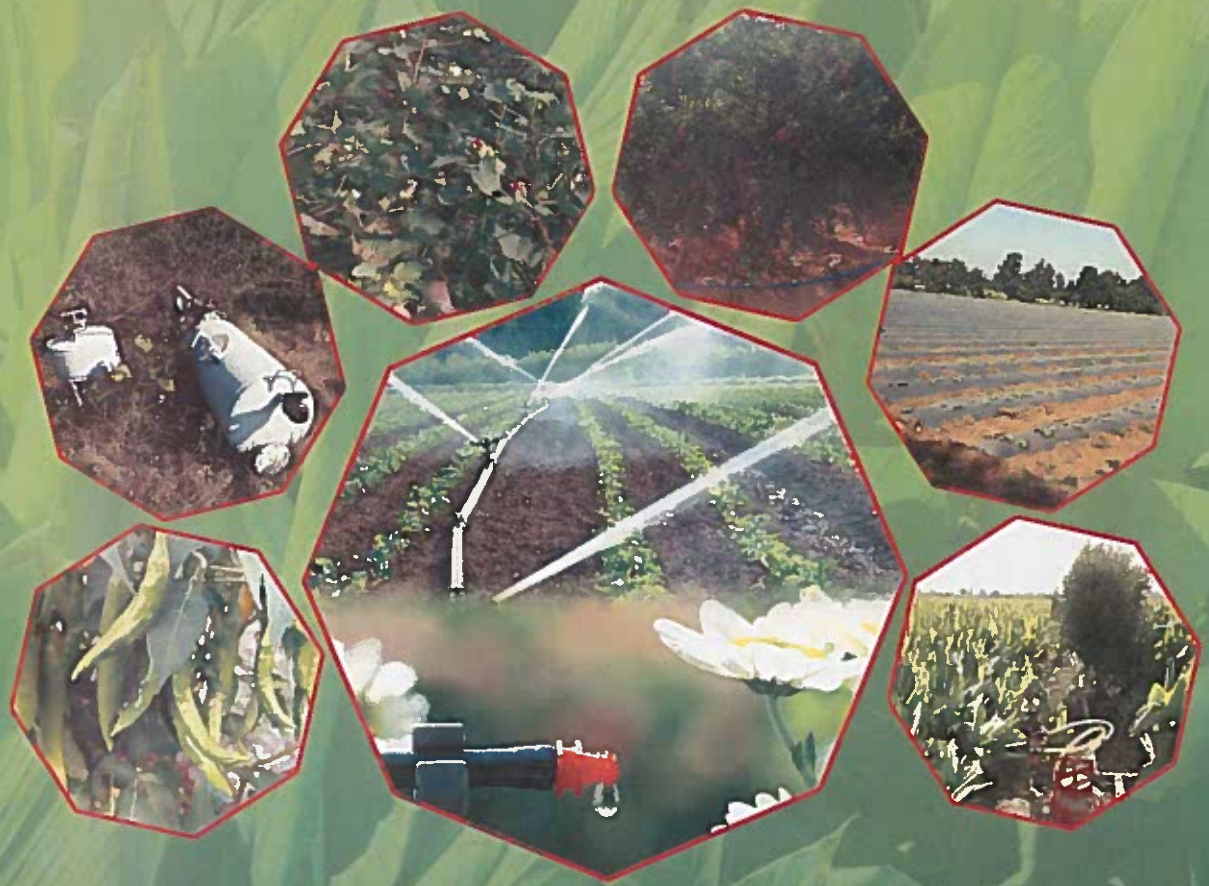
Agro-Economic Research Centre, Andhra University, Research Study No. 150

Working of Pressurised Irrigation Network Systems (PINS) in Telangana

Dr. K. Rambabu, Ph.D
Research Associate



Report submitted to the
Ministry of Agriculture and Farmers Welfare, Government of India

Agro-Economic Research Centre
For the states of Andhra Pradesh, Telangana and Odisha
(Ministry of Agriculture & Farmers Welfare, Government of India)

Andhra University, Visakhapatnam, Andhra Pradesh
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Preface

A pressurised irrigation system is a network installation consisting of Pipes fitting and other devices properly designed and installed to supply water under pressure from the source of the water to the irrigable area. In this system of irrigation water is pressurised, supplied to farm fields that uses MIS such as drip and sprinkler and thus precisely applied to the plants under pressure through a system of pipes. Pressurised irrigation system as opposed to the surface irrigation systems, are more effective in water saving and in increasing area under irrigation. These systems provide improved farm distribution, improved control over timing, reduced wastage of land in laying field distribution network, reduced demand for labour and better use of limited water resources.

In Telangana state, since there are no other public PINS programme, alternatively the private PINS with MIS connected to tube-wells irrigation are taken for the analysis of the present study. The present study is mainly based on both primary and secondary data. The study analyses the benefits of micro-irrigation system viz., drip and sprinkler systems. All the beneficiary farmers are provided with drip system, while only five farmers are provided sprinkler system. All the beneficiary farmers realised the benefits of MIS and could achieve better economic status.

In this connection, I thank the Ministry of Agriculture & Farmers' Welfare, Government of India, for assigning the study to Agro-Economic Research Centre, Waltair. I also thank all the officials of Telangana state MIP Deputy Director, Smt. Bhagya Lakshmi and other officers and the staff for their continuous co-operation and help while conducting the study in the selected districts of Telangana. I appreciate the author and research team for taking meticulous care at every stage of field work and analysis of the study. I also thank Sri K. Ramesh for neat typing of the report. I hope that this report will be useful for the policy makers and researchers.

(Prof. T. Koteswara Rao)
Honorary Director

PROJECT TEAM

Project Leader	**:**	**Prof. T. Koteswara Rao**
Analysis and Drafting of the Report	**:**	**Dr. K. Rambabu**
Data Processing and Statistical Analysis	**:**	**Dr. P. Ramu** **Dr. K. Rambabu**
Computerization	**:**	**Sri K. Ramesh**

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Introduction:

A pressurized irrigation system is a network installation consisting of pipes, fittings and other devices properly designed and installed to supply water under pressure from the source of the water to the irrigable area. In this system of irrigation water is pressurized, supplied to farm field that uses MIS (Micro-Irrigation System) such as drip and sprinkler and thus precisely applied to the plants under pressure through a system of pipes. Pressurized irrigation systems as opposed to the surface irrigation systems, are more effective in water saving and in increasing area under irrigation. These systems provide improved farm distribution, improved control over timing and reduced wastage of land in laying field distribution network, reduced demand for labour and better use of limited water resources.

The objectives of the presented study are:

a. To analyse various private PINs programmes implemented in the selected districts of Telangana;
b. To assess the extent of adoption and performance of PINs in different scenarios;
c. To analyse the arrangements for management, operation and maintenance of private PINs;
d. To identify the major constraints in adoption management, operation and maintenance of PINs and
e. To recommend suitable policy measures to enhance the effectiveness and techno-economic performance of private PINs.

Limitation of the study:

Since there are no other public PINs programmes available in Telangana state, alternatively the sample size was taken from private PINs with MIS (Micro Irrigation Systems) with a condition of sharing each system by two or three farmers. In this connection the available beneficiary and non-beneficiary households in each district were taken as sample.

Summary of Findings

- For the study, the data is collected from beneficiary and non-beneficiary households in four selected districts viz., Vikarabad, Adilabad, Nirmal and Nalgonda. As said earlier the available beneficiary and non-beneficiary households, in each district are

canvased to account to a total sample of 200 beneficiaries and 100 non-beneficiaries for the study in the state of Telangana.

- **Irrigation Development and Management in Telangana:** Out of the total geographical area 40.5 per cent is net area sown, 23.9 per cent is under forests 10.5 per cent is under current fallows 7.7 per cent of area is towards non-agricultural uses and 5.4 per cent of area is barren and uncultivable land. The net cropped area is 46.54 lakh hectares. The influence of south-west monsoon is predominant. The increase in intensity of irrigation between 2010-13 and 2013-16 is 1.86 per cent. Due to inadequate water supply from different sources of irrigation the land cannot be substantially irrigated in the second season of the crop.
- The intensity of cropping is decreased by -2.77 per cent between 2010-13 and 2013-16. The reason may be attributed to the failure of some irrigation sources all over the state. The reason may be accelerated growth in the second sub-period, might be the result of the renovation tanks and creation of new ground water was due to lack of rainfall or inadequate rainfall. Observing across the sources, it is observed that the area under tanks, tube-wells and other sources has decreased from 2005-06 to 2010-11. The reason for the decrease in area may be attributed to the disrepair state of tanks and failure of tube-wells and other sources.
- It is observed that the number of farmers used drip has increased in 2015-16 by 76.13 per cent while the number of farmers used sprinkler system has decreased by 27.84 per cent in 2015-16. The reason for the decrease in the number of sprinkler systems is the problems in maintenance of the sprinkler system. Moreover, the area under drip irrigation system has increased by 81.45 per cent while the area under sprinkler system has decreased by -28.29 per cent from 2014-15 to 2015-16. Across the districts, the area under drip irrigation has increased in all the districts from 2014-15 to 2015-16. On the other hand the area under sprinkler irrigation system has substantially decreased from 2014-15 to 2015-16 in all districts except in Mahabubnagar and Nizamabad districts. In view of formation of Telangana state on 2nd June, 2014 the proposals for adopting the APFMIS Act, 1997 for implementation of Participatory Irrigation Management in Telangana state is under process.
- **Overview of PINS Programmes in Telangana:** The MIS scheme was installed and implemented by twelve private agencies. From 2014 onwards the MIP scheme (NMMI) was subsumed into National Mission for Sustainable Agriculture (NMSA) as one of the components as on Farm Water Management (OFWM) and the modal department is agriculture department (HOD).

- Out of 17.12 lakh hectares of net irrigated area irrigated with ground water only 5.73 lakh hectares are covered under micro-irrigation, leaving a balance potential of 11.39 lakh hectares for micro-irrigation. In all the districts the MIP projects through MIS scheme connecting to tube-well irrigation are implemented. About 5,50,212 numbers of micro-irrigation systems were installed with a coverage of area of 5,50,212 hectares the total number of beneficiaries being 2,96,436.
- The drip system of MIS is provided for cotton crop with a total initial fixed cost of Rs. 1,06,120 of which 10.612 is given subsidy for BCs small/marginal farmers and for others the subsidy is given to a maximum of Rs. 21,224. Moreover, the sprinkler irrigation system of MIS is provided for groundnut crop with a total fixed cost of Rs. 17,880 of which Rs. 4,470 is given as subsidy for SC/ST, BCs small/marginal and for others. MI project in Telangana is mainly based on well and tube-well irrigated areas. The mechanism of supply/purchase of MIS equipments/material installations on fields are all through the empanelled MI companies. The area under fertigation is approximately 10 per cent of the sanctioned area in the state.
- Total of 2,96,434 farmers are benefitted through MIP covering an area of 5,50,212 hectares in the state. The percentage of saving of water varied from 49 per cent in case of tomato to 54 per cent in case of Vegetables and sugarcane. On the other hand, the percentage of energy saved from a low of 49 per cent in case of tomato to 54 per cent in case of Vegetables and sugarcane.
- **Adoption, Performance and Management of PINS (MIS) by Farmers:** The per household area under drip system is reported to be 1.12 hectares. On an average the per household total amount borrowed from all sources per beneficiary farmer is reported to be Rs. 10,23,879 and the outstanding loan amount is Rs.94,315. Moreover the per household total outstanding loan amount per non-beneficiary farmers is Rs. 1,17,667. On the whole, it is observed than there is no proper repayment of loan amount either by beneficiaries or by non-beneficiaries towards any source of credit. Out of the total sample of 149 beneficiaries, 89.26 per cent of farmers availed the loan for seasonal crop cultivation and 10.74 per cent of farmers spent the loan amount towards purchase of tractor and other implements. On the other hand out of 72 non-beneficiary farmers 83.33 per cent of farmers availed the loan for seasonal crop cultivation and 16.67 per cent of farmers utilized the loan amount for the purchase of tractor and other implements.
- The higher percentage of area under irrigation is reported to be under tube-wells for both beneficiary and non-beneficiary farmers. The percentage of irrigated area for

beneficiary farmers ranged from 0.35 per cent under tanks to 63.84 per cent under tube-well. On the other hand the percentage of irrigated area for non-beneficiaries ranged from 0.95 per cent under tanks to 62.98 per cent under tube-wells.

- On an average the area under PINS (MIS) is reported to be 1.11 hectares. All the 200 sample farmers are provided drip system and the sprinkler system is provided only for five farmers. On the whole, the per household amount spent on MIS is reported to be Rs. 8,443. The per household spent on MIS varied from Rs. 6,660 in case of marginal farmers to Rs. 10,000 in case of large farmers.
- There are three main reasons behind the adoption of PINS (MIS) programme. They are: 1. To get assured amount of water for irrigation. 2. To get better and stable crop yield and farm income and 3.To save more water and to cover more area under irrigation. All the sample beneficiary farmers are benefitted by participating in Tube-well User Association (TUA). Out of 200 sample beneficiary farmers, forty number of farmers are participatory in four TUA of which one TUA is not functioning properly.
- Across the crops the per hectare cost of cultivation varied from a low of Rs. 3,768 in case of redgram to a maximum of Rs. 1,82,974 in case of ginger. On an average, the per hectare cost of cultivation in rabi season reported from a low of Rs. 19,466 in case of bengalgram to a high of Rs. 1,53,712 in case of cucumber. Moreover, the average per hectare cost of cultivation of perennial crops reported to be a high of Rs. 22,10,210 in case of sweet orange, while a low of Rs. 1,17,686 in case of papaya.
- Observing between beneficiary and non-beneficiary farmers the percentage change in area is reported as -9.50 per cent for kharif crops and 420.95 per cent for rabi crops. Between beneficiary and non-beneficiary farmers, the beneficiary farmers could achieve more production of respective crops in respective seasons than the non-beneficiaries. Moreover the percentage of change in beneficiaries over non-beneficiaries in achieving production ranged from 30 per cent in case of paddy to 100 per cent in case of redgram.
- All the crops under drip irrigation have achieved more per hectare production than the yield achieved under the other sources of irrigation other than drip.

- The probit model analysis explains that among the explanatory variables the marginal effect of operated area is positively associated with increase in agricultural yield, income, water and energy saving but negatively associated with fertilizer and pesticide use. The positive association implies that due to the marginal effect of operated area, the yield, income, water and energies are saved to a significant level.

On the other hand, the negative association inferences that the fertilizers and pesticides are being used more than the required doses. Hence the model finally explains that the positive change in required amount of water will be resulted in an increase in agricultural yield, income and energy saving to a significant level.

- **Adoption, Performance and Management of PINS (MIS) By Tube-well Users Associations (TUAs):** The average life span of PINS is about 7-8 years (it is properly maintained the life span of PINS may be upto 15 years so the life span of PINS extends subject to the maintenance). About 65 per cent of tube-well users reported that their land in command area of the PINS project is moderately fertile, while 35 per cent of the users reported to have less fertile land. All sample farmers followed crop rotation.
- Out of the total cost of Rs. 5,50,000 of the PINS system per TUAs, 44.45 per cent was invested on pumpsets and power units, while 54.55 per cent of the amount expended towards system layouts. Moreover the per TUA installation cost is reported to be Rs. 60,000 of which 83.33 per cent is expended towards installation of pumpsets and power units, while 16.67 per cent is towards system layouts.
- On an average, the total annual operation and maintenance cost of PINS per TUA accounts for Rs. 8,000 of which 87.50 per cent towards repairing and maintenance of tube-wells and 12.50 per cent towards electrical charges.
- All the water users expressed the need of assistance from NGO. The inflow of income is due to collection of annual maintenance fees, while the outflow of income is through expenditure on electricity bill and repairing expenses.
- The office bearers of TUAs expressed that about 66.67 per cent of management is transferred to TUAs and remaining 33.33 per cent of management is under the control of individual farmers. Those farmers that are involved in TUAs only are being regular in maintaining or paying water rates regularly, while those farmers who are under the control of management of individual farmers are not regular. Out of four TUAs, one TUA consisting of ten members is not functioning properly. As a result, the PINS project was not implemented properly.
- About 66.67 per cent of TUA members reported to have received sufficient water throughout the year. Nearly 33.33 per cent of water users reported that the PINS system is not functioning properly and also due to improper management of PINS system, they received inadequate water to their farm plots. Non-payment of water rates and maintenance charges by the members is also another reason for getting inadequate supply of water to their fields.

- Among the problems faced by the TUAs, 32 per cent of the problems arose out of the fund constraints. Nearly 30 per cent of the problems are due to water availability. About 18 per cent of the problems are due to maintenance and repair of PINS and only 10 per cent of the problems arose due to poor participation of TUAs' members. Nearly 70 per cent of the users reported that there is less water logging problem prior to formation into TUA. 50 per cent of the users reported that there were no labour problems and no problems in crop yields.

Policy Implications:

1. Though the MIS scheme is being implemented by private agencies, the subsidy is being released by the Telangana state micro-irrigation project. Due to delay in release of funds from Central government the release of subsidy to farmers is accordingly delayed. As a result the farmer could not receive the benefit in time and could not proceed further.
2. In recent years, the tanks in Telangana are being renovated through the programme of Mission Kakatiya. This renovation should be extended to all other tanks which in turn be useful to irrigate more land in various parts of Telangana. Thus, the MIS scheme could be initiated through this source of irrigation.
3. The amount of subsidy for all inputs and also to the machinery should be enhanced.
4. Awareness about the MIS must be created by conducting more training programmes i.e., once in a month in every mandal head-quarters.
5. Training programes to farmers to create awareness about fertigation and chemigation must be conducted.
6. The department officials (TS-MIP) must thoroughly check the operations of drip and sprinkler systems at frequent intervals.
7. After sales service should be done by the companies efficiently they should visit the farmers field frequently to give acid treatment & explain the farmers about the advantages of this treatment so that farmer should use this drip system efficiently.

* * *

CHAPTER – I

PRESSURISED IRRIGATION NETWORK SYSTEMS (PINS)

1.1 Background:

Irrigation is the artificial application of water to soil for the purpose of crop production. In many parts of the country the amount and timing of rainfall are not adequate to meet the moisture requirement of crops and irrigation is essential to raise crops necessary to meet the needs of food and shelter. The increasing need for crop production for the growing population is causing the rapid expansion of irrigation throughout the country. In the present conditions of Indian agriculture it is necessary to increase agricultural production per unit volume of water, per unit area of cropped land per unit time. Large public irrigation systems coupled with the Green Revolution have contributed to a large extent in initially stabilising and then expanding food production, whereby India's growing population has remained self-sufficient in food. However, increasing population requiring food and fibre in larger quantities and increased competition for water amongst various uses of water, amongst various regions, are gradually ensuring that the issue of improved and efficient land, water, management assumed significance. Moreover, over exploitation is depleting the existing water resources at critical rates even in areas hither to known for their having irrigation water in plenty, resulting in irrigation water becoming both scarce and expensive. To meet the food needs of growing population, the agricultural production needs to be boosted by following better soil-water management techniques that could provide the arid and semi-arid lands, better access to irrigation water without actually increasing the stress on available water resources using pressurised irrigation system. A pressurised irrigation system is a network installation consisting of pipes, fittings and other devices properly designed and installed to supply water under pressure from the source of the water to the irrigable area (FAO, 2000). In this system of irrigation, water is pressurised, supplied to farm fields that uses MIS such as drip and sprinkler and thus precisely applied to the plants under pressure through a system of pipes. Pressurised Irrigation Systems as opposed to the surface irrigation systems, are more effective in water saving and in increasing area under irrigation. These systems provide improved farm distribution, improved control over timing, reduced wastage of land in laying field distribution network, reduced demand for labour and better use of limited water resources.

In the last 50 years there has been a major shift in the pattern of irrigation in Telangana making it more costly for the farmers, highly uncertain and unsustainable. There was a steep decline in the area under tank irrigation and a slow increase in irrigation under major and medium irrigation projects, leading to a sharp use in area irrigated through private tube wells (TDF,2000).

1.2. Importance of PINS:

There are two main types of irrigation systems used in both horticulture and agriculture. These are pressurised and gravity fed. The present study is focused on pressurised irrigation network systems. In pressurised irrigation systems water is pressurised and precisely applied to the plants under pressure through a system of pipes, pressurised irrigation systems as opposed to the surfaced irrigation system are more effective in application of irrigation water to the crops. These systems provide improved farm systems, improved control over timing, reduced wastage of land in laying field distribution network, reduced demand for labour and better use of limited water resources.

There are many variations of pressurised irrigation systems but the two major ones are: drip irrigation systems and sprinkler systems. Pressurised irrigation systems have the potential to avoid the water loss related to surface irrigation increasing the open irrigation application efficiency from 45 percent to 60 percent to pressurised irrigation with the efficiency in the range of 75 percent to 95 percent. While open canal systems have high labour requirement for maintenance pressurised systems, pressurised systems have skilled labour requirements of the man hours require in canal systems, pressurised irrigation systems need from one tenth to one quarter of the man hours. Driven of needs to reduce labour input into agriculture and the love of high technology, pressurised irrigation system, are costly and out of reach of small holder farmers in developing countries. Water quality and energy are crucial to the sustainability of pressurised irrigation system. Water with high dissolved minerals leads to frequent blocking of emitters. Routine maintenance is needed to unblock delivery fittings and to maintain pumps and fertigation units.

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1. PDF India, 2010, deprivation to Telangana: Case for separate statehood, Telangana development forum, memorandum prepared by the working group for submission to Justice Sri Krishna Committee, Hyderabad. Paper published by Ch. Hanumantha Rao, March 1, 2014, Volume XLIX, No.9, Economic & Political Weekly.

1.3 Review of Literature:

Several works have been done since so many years on irrigation development process. Among them some of the works are reviewed in this section for the purpose of the study.

B.D. Dhawan (1974)[1] in the paper on "Utilization of ground water resources" says that the private tube wells are superior to public tube wells appeared to be weak on closer scrutiny. He also examined the problem of mismanagement of state tube wells, which is the root cause of disenchantment with them in several quarters. He concludes that the financial performance of state tube wells is a problem as much of correct price policies for irrigation water as of managing the cancer of corruption.

In 1975[2] in his paper on "Economics of ground water Utilization," mentions that, given the skewed distribution of land ownership and the small size of the average farm, the adverse externalities of the tube well technology cannot be completely avoided in a free enterprise framework, even if the state legislatures pass legislation to control and regulate the use of ground water. However the externalities can be internalised if a public agency undertakes to supply ground water. In fact, public tube wells – wherever they are feasible are not only the best means for managing ground water resources efficiently, but also the only way to overcome the problem of lack of utilization of ground water resource in certain areas afflicted by fragmented, tenanted, small holdings.

In 1993, Dhawan[3] in his article "ground water depletion in Punjab" he expressed that while the cultivation of paddy in Punjab (and Haryana) thus need some curbing, the extreme forebodings of either total ground water exhaustion in Punjab are of the state turning into a desert if paddy growing is not curbed forth with are unwarranted.

In 1995 Dhawan[4] in his paper on "Magnitude of groundwater exploitation" explains that the official statistics indicate a rather confusing picture of groundwater exploitation in India. As per the irrigated area figures of the planning Commission, Development of groundwater irrigation has reached disturbing levels in many states, notably Uttar Pradesh, Gujarat, Punjab and Tamilnadu. But the less known volumetric statistics in respect of groundwater irrigation complied at the behest of the Central groundwater board are rather

[1] "B.D. Dhawan – "Utilization of groundwater resources", Economic and Political Weekly, September, 1974.
[2] "Economics of Groundwater Utilization" Economic and Political Weekly, June, 1975.
[3] "Groundwater depletion in Punjab", Economic and Political Weekly, October 30, 1993.
[4] "Magnitude of Groundwater exploitation", Economic and Political Weekly, April 8, 1995.

reassuring. Barring a dozen districts of West Indo-Gangetic Plains, no state as a whole appears to have reached the danger mark of groundwater over exploitation. The realty is somewhere between these extremes, more likely nearer to the board's than the Commission's assessment. Because of non-availability of estimates of reserves of ground water resources, over exploitation of groundwater for irrigation purpose is usually examined through indirect approaches and through analysis of groundwater related statistics. This can give rise to conflicting results for a variety of reasons, for one, the data base one uses may suffer from infirmities, say, motivated attempts by the data compiles to deliberately over-project or under-project things. For another, an indirect method may fail to reck on with all factors that influence a given static, say, declining water table. This decline could be as much because of over development of ground water based farming is a given tract as due to occurrence of drought. Thus any evidence on groundwater depletion needs to be viewed with abundant caution.

* Rakesh hooja (2002)[5] in his article on "Participatory Irrigation Management in the Indian Context" says that a joint government and water users partners for improved water management must go hand in hand with sustained and Judicious investments in water resource development and maintenance to ensure that the water related global challenges facing us in the present century do not become insoluble (2002).

* G.S. Narwani (2005)[6] in his book on "Community Water Management" analysed that in view of battle of community for water his book traces the attempts of community Participation in management water resources through irrigation tanks, lift irrigation projects, irrigation tube-wells, water harvesting structures in watershed development Projects, ground water resources, multi-purpose irrigation projects and Sajal Dhara Scheme under Rajiv Gandhi Drinking Water Mission.

[5] Rakesh hooja – "Participatory Irrigation Management in Indian Context" paper published in "Users in Water Management edited by Rakesh hooja, Ganesh Pangare and K.V. Raju Rawat Publications, New Delhi 110002.
[6] G.S. Narwani "Community Water Management", Rawat Publications, Jaipur and New Delhi, 2005.

Mohammad Abuarab, Ehab Mustafa and Mohammad Ibrahim (2013)[7] have conducted a field study in 2010 and 2011 to evaluate the effect of air-injection into the irrigation stream in Sub-surface Drip Irrigation (SDI). On the performance of corn-experimental treatments were drip irrigation, sub-surface drip irrigation and sub-surface drip irrigation with air injection. Air injection has the highest Water Use Efficiency (WUE) in both growing seasons: with values of 1.442 and 1.096 in 2010 and 1.463 and 1.112. in 2011 for Water Use Efficiency and IWUE respectively. In comparison with drip irrigation and sub-surface drip irrigation, the air injection treatment achieved a significantly higher productivity through the two seasons. Data from this study indicate that corn yield can be improved Under SDI if the drip water is aerated

Xiaonia Zou, Yu'e Li, Roger Cremades; Qingzhu Gao, Yunfan Wan and Xiaobo Qin (2013)[8], their study provide a cost effectiveness analysis of four water saving irrigation techniques that are widely implemented in China to address the impacts of climate change: Sprinkler irrigation, micro-irrigation, low pressure pipe irrigation and channel lining. The aim of the study is thoroughly understand the economic feasibility of water saving-irrigation at an approach in coping with climate change. Based on the cost effectiveness analysis, this study finds that water saving irrigation is cost effective in coping with climate change, has benefits for climate change mitigation and adaptation, and for sustainable economic development. The results suggest that for mitigation and adaptation objectives micro irrigation performs best. From an economic perspective channel lining is recommended. Therefore, a balanced development of channel lining and micro irrigation according to different geographical conditions is recommended.

Les Levidow, Daniele Zaccaria, Rodrigo, Maia (2014)[9] Eduardo Vivas, Mladen Todororic, Alessandra Scardigno[9]: the authors say that innovative irrigation practice can change water efficiency, gaining an economic advantage while also reducing environmental burdens. In some cases the necessary knowledge has been provided by extension services, helping farmers to adapt and implement viable solutions thus gaining more benefits from irrigation technology. They further say agricultural water management will maintain the unknown

[7] Mohammed Abuarab, Ehab Mustafa, Mohammed Ibrahim "Effect of air injection under sub surface drip irrigation on yield and water use efficiency of corn in a sandy clay loam soil" Journal of advanced Research, Cairo University, 2013.

[8] Xiaonia Zou, Yu'e Li, Roger Cremades; Qingzhu Gao, Yunfan Wan and Xiaobo Qin "Cost effectiveness analysis of water-saving irrigation technologies based on climate change response": a case study of China, Agricultural Water Management, 2013.

[9] Les Levidow, Daniele Zaccaria, Rodrigo, Maia (2014) Eduardo Vivas, Mladen Todororic, Alessandra Scardigno (2014): "Improving Water-Efficient Irrigation Prospects and difficulties of Innovative Practices" Agricultural Water Management, Journal home page, 2014.

water efficiency level and farmers will have meagre incentive to make efforts for more efficient practices. A continuous knowledge exchange is necessary so that all relevant stakeholders can share greater responsibility across the entire water supply chain. On this basis, more water efficient management could combine under environmental benefits with economic advantage for farmers.

Mrs. Seema A. Rathod, Mrs. Suvarna D. Shah[10] (2013) the authors in their paper say that the need of the hour is to increase irrigation efficiency of existing projects and use saved water for irrigating new areas or meeting the demand of the non-agricultural sector. The contribution of applications efficiency to poor irrigation efficiency is quite high and therefore increasing application efficiency by a shift in application method from surface to pressurised system has potential of vastly improving irrigation efficiency. To evaluate the feasibility of this concept a study was initiated at one outlet of a minor irrigation canal command area. The system has been designed in such a way that it provides pressurised irrigation network system upto farmers' field and micro irrigation system in each field of farmers.

Rahul Chawan (2016)[11]: in his paper on "Irrigation Management along with micro irrigation system (MIS) community tube wells in Gujarat", says that the government of Gujarat aggressively promoted micro irrigation technologies in Gujarat by providing hundred percent (100%) subsidy through Gujarat Water Resource Development Corporation Limited operated tube wells by implementation of PINS (Pressurised Irrigation Network Systems) along with MIS (Micro Irrigation Systems). These tube wells had been in operation by farmer Co-operative societies in Gujarat by Participatory Irrigation Management (PIM) since long and used to deliver the water with flow irrigation. Now introduction of micro irrigation aims to provide timely adequate supply of water to crops for improving the agricultural production. Tail end reaches of command of the tube well used to suffer from inadequate and unreliable supplies. Most of the area was deprived of irrigation facilities. This gap is now filled up by implementing Pressurised Irrigation Networking along with Micro Irrigation Systems. It is found that there is a substantial improvement the operation, maintenance and management of the system by involving both the water users groups (farmers) and Gujarat Water Resource Development Corporation Limited (GWRDC) (the owner of the tube well). He finally suggests that it is necessary that the behaviour and attitude of the government officers need to be changed and make conducive to work with farmers and users in order to

[10] Mrs. Seema A. Rathod, Mrs. Suvarna D. Shah: "Design principles and consideration for Pressurised Irrigation System – A case study, paribex: Indian Journal of Research, Volume 2, issue 3, March, 2013.

[11] Rahul Chawan – "Irrigation Management along with Micro Irrigation System (MIS) Community tube wells in Gujarat" – International Journal of Agricultural Engineering Volume 9, issue 1, April, 2016 – pages 109 to 117.

develop a collective and self- regulative work culture. This should ultimately result into improvement "on farm water use efficiency" and affordability for the farmers to adapt the systems and doing irrigation through micro irrigation only. The multi-fold advantages of drip and sprinkler irrigation system over conventional flow irrigation would bring large scale adaption of these technologies.

P. Narasimha Rao(2007)[12] in his book "Irrigation Development – issues and challenges" attempted to identify the gaps in approaches to irrigation development in Andhra Pradesh and would help the government in strengthening the policy making process so that policies gained relevance.

B. Chinna Rao and K. Madhu Babu[13] in their paper on "transferring irrigation management responsibility in Andhra Pradesh: Performance of the Water Users' Associations" they attempted to evaluate Participatory Irrigation Management in Andhra Pradesh covering a wider area under three irrigation systems namely major, medium and minor. They suggested that there is a immediate need to bring the balance between minor, medium and major irrigation systems through judicious fund allocation and make the institutions self-sufficient are financially independent. Further they say that the weaknesses which need to be taken care are political interference, presidents of Water Users' Associations turning out to be contractor's lack of operational plans etc. Moreover, they further recommended that the Water Users' Associations formed under minor irrigation need special attention by the government as well as the Users to make them vibrant and responsive. The programme is said to be success only when these groups work efficiently in Water Management as more than 80 percent of total Water Users' Associations in the state come under this category.

K. Adiseshu and K. Madhu Babu(2007)[14] in their paper on "Groundwater Market Dynamics in the villages of Andhra Pradesh" they aimed to present the ground water market dynamics i.e., 1. The crop-wise number of irrigation required and 2 the number of irrigations actually provided by the farmers to the important crops like sugarcane, paddy and groundwater to the conditions imposed by the owners of water extracting devices on non-owners to release water and 3. The extent of water rates demanded by the owner partners. They finally

[12] P. Narasimha Rao12 "Irrigation Development – issues and challenges, discovering publichsing house, New Delhi , 2007.

[13] B. Chinna Rao and K. Madhu Babu: "Transferring irrigation management responsibility in Andhra Pradesh", published in irrigation development issues and challenges edited by P. Narasimha Rao, discovery publishing house, New Delhi, 2007.

[14] K. Adiseshu and K. Madhu Babu – "Ground Water Market dynamics in the villages of Andhra Pradesh" paper published in Irrigation Development – issues and challenges edited by P. Narasimha Rao, discovery publishing house, New Delhi, 2007.

suggested for improvement that 1. The Watershed development programmes should be implemented by the government, to improve the ground water potential 2. The tank bunds must be repaired and strengthened to improve the storage capacity of the tanks 3. The bore-wells with water extracting devices must be provided to small and marginal farmers on subsidised basis so that their dependence on owners can be avoided and 4. Continuous power supply, at-least in the crucial periods of the crop conditions must be provided.

M. Srinivasa Reddy, Sanjit Kumar Rout and V. Ratna Reddy (2016)[15] they published a book on "Ground Water Governance – development, degradation and Management (a study of Andhra Pradesh)". In their book an attempt has been made to understand and identify the gaps in ground water development as well as management in terms of technical knowledge, scale, and Participatory approaches. Moreover their book calls for wide ranging policy changes so as to adapt the initiatives in a wider scale as the demand management models cannot be effective as long as policy environment is supply sided and thus provides valuable suggestions to policy makers.

Vamsi Vakulabharanam (2004)[16] in his paper on "Agricultural growth and irrigation in Telangana – a review of evidence" studied the state of agriculture and irrigation in Telangana especially from the point of view of agricultural growth corresponding growth in irrigation. He says that Telangana's agricultural growth has been accompanied by an increase in rural poverty as well as significant decline in the consumption levels of both marginal peasantry and agricultural labourers during the last decade (as NSS 55th round data suggests). The developments suggest that a process of immerserising growth is taking place in this region. While agricultural globalization policies contribute partially to this tragic phenomenon, a rapid growth of well irrigation is also responsible for the Immerserisation of small and marginal peasantry. Finally he says that significant policy remedies have to be undertaken in irrigation in order to counter the welfare losses of the poorest cultivators in the region.

Gautam Pingle (2011)[17] In his paper on "Irrigation in Telangana: the rise and fall of tanks", he proposed to concentrate largely on the Telangana region and examine its three sources of irrigation and explain their variation over time. He concludes that whatever the future

[15] M. Srinivasa Reddy, Sanjit Kumar Rout and V. Ratna Reddy, Groundwater Governance – development, degradation and management (a study on Andhra Pradesh), Rawat publications, Jaipur, 2016.
[16] Vamsi Vakulabharanam: "Agricultural growth and irrigation in Telangana – a review of evidence", Economic and Political Weekly, March 27, 2004.
[17] Gautam Pingle: "Irrigation in Telangana: The rise and fall of tanks", Economic and Political Weekly (supplement) volume XLVI Nos.26&27, June 25, 2011.

irrigation policy and its implementation by whatever government structure that may preside over it – it will need close ground level, local district and regional efforts to balance the delicate surface and ground water situation in Telangana with the need for farmers to access irrigation in order to improve their livelihoods and raise their incomes. Finally he says that "Like all politics, all irrigation is local".

Ch. Hanumantha Rao (2014)[18] in his paper on "the new Telangana state – A perspective for inclusive and sustainable development" he says that a new social framework that is participatory and accountable to stakeholders is a prerequisite for inclusive and sustainable development. Sorting out the pending, land issues will provide security for rural livelihoods and the necessary means for raising the incomes of the tribal population – the most marginalised section of rural society. Reducing excessive dependence on well irrigation by expanding surface irrigation through the renovation of tanks and harvesting river waters will contribute immensely to sustainability, apart from reducing farm costs and uncertainty. The development of power on a priority basis will be indispensable in the new state of Telangana for overcoming inherited shortages for lifting river waters for irrigation and to facilitate the growth of manufacturing as well as rural industrialization in general. The government should shoulder much greater responsibility towards providing primary and secondary education as well as primary health care by making them accountable to the stakeholders through the elected local institutions and by regulating the private players in these fields. Restoring land to the tiller, especially in tribal areas, decentralising development by empowering elected local institutions and stepping up public investment for essential physical and social infrastructure are the three major challenges in the new Telangana state.

[18] Ch. Hanumantha Rao, "The new Telangana state, a perspective for inclusive and sustainable Development" Economic and Political Weekly, Vol. XLIX No.9, March 1, 2014.

Keeping the earlier works in view, the present study is analysed with the following objectives.

1.4 Objectives of the study:

The major objectives of the study are:

a) To analyse various private PINS programmes implemented in the selected districts of Telangana;
b) To assess the extent of adoption and performance of PINS in different scenarios
c) To analyse the arrangements for management, operation and maintenance of private PINS;
d) To identify the major constraints in adoption, management, operation and maintenance of PINS; and
e) To recommend suitable policy measures to enhance the effectiveness and techno-economic performance of private PINS.

1.5. Limitations of the study:

Previously under SC (Scheduled Caste) sub-plan the government PINS were initiated in Medak and Adilabad districts of Telangana. However, in due course due to lack of proper maintenance and these programmes have become defunct. As such, since there are no other public PINS programmes available in Telangana state, alternatively the sample size from private PINS with MIS (Micro-Irrigation Systems) with a condition of sharing each system by two or three farmers. In this connection the available beneficiary and non-beneficiary households in each district were taken as sample. The details of sample size for the selected districts are presented in Table 1.1.

1.6. Data & Methodology:

The present study is analysed through both secondary and primary data. The secondary data is collected from Telangana state Micro-Irrigation Project for the state as well as in the selected districts, Directorate of Economics and Statistics, Hyderabad, WASSAN, NGO, Tarnaka, Hyderabad and Vikarabad and Water Users' Associations (WUA) in Vikarabad district. Moreover the primary data is collected from beneficiary and non-beneficiary households in the selected districts with a structured questionnaire. As said earlier the available beneficiary and non-beneficiary households in each district are

canvased. Thus the total sample of 200 beneficiaries and 100 non-beneficiaries are taken as sample for the study in the state of Telangana. The log linear growth rates for source wise irrigated area are estimated (using the equation $Y = ae^{bt} + u_t$). Moreover to assess the benefits accrued from adoption/non-adoption of PINS, a probit analysis is used to analyse the determinants.

1.7. Chapter Scheme:

The present study is divided into six chapters. The first being the introductory chapter, the second chapter deals with irrigation development and management in Telangana. Overview of PINS programmes in Telangana is presented in chapter three, while adoption, performance and management of PINS by farmers are presented in chapter four. The fifth chapter deals with the adoption, performance and management of PINS by Water Users' Associations (WUAs) and finally chapter six provides conclusions and policy implications.

* * *

CHAPTER – II

IRRIGATION DEVELOPMENT AND MANAGEMENT IN TELANGANA

2.1. Introduction:

In 2014 Telangana[1] was formed as 29th state of India with Hyderabad as its capital. The movement for a new state of Telangana gained momentum over the decades. In 2009 the Government of India announced the process of formation of the Telangana. Violent protests led by people in Coastal Andhra Pradesh and Rayalaseema regions occurred immediately after the announcement, the decision was put on hold in December, 2009. The movement continued in Hyderabad and other districts of Telangana. There have been large scale strikes, protests and demonstrations coupled with many suicides also demanding separate state hood. In July, 2013 the process of formation of a separate state gained momentum. After various stages, the Bill was placed in the Parliament in February, 2014 Andhra Pradesh Reorganization Act, 2014 Bill was passed by the Parliament for the formation of Telangana state comprising 10 districts from north-western Andhra Pradesh.

2.1.1 Geography:

Telangana is situated on the Deccan Plateau in the central stretch of eastern sea board of the Indian Peninsula. It covers 114,800 square Kilometres (44,300 sq. miles). The region is drained by two major rivers, with about 79 percent of the Godavari river catchment area, and 69 percent of the Krishna river catchment area, but most of the land is arid due to higher elevation of most of the state compared to rivers. Telangana is also drained by several minor rivers the Bhima, the Manjira and the Musi. The state is surrounded by Maharashtra on north and north-west: Karnataka on the West: Chattishgarh on the north-east and Odisha lies on its west.

2.1.2. Agriculture:

Rice is the major food crop of the state. Other important crops are tobacco, mango, cotton and sugarcane. The major kharif coarse cereals maize, jowar, bajra, ragi are produced in the state. Out of the total geographical area 40.5 percent is under net area

[1] India 2017 Conference annual completed by New Media Wing, Publications Division, Ministry of Information & Broadcasting, Government of India.

sown, 23.9 percent is under forests, 10.5 percent is under current fallow lands, 7.7 percent is under non-agricultural uses and 5.4 percent is under barren and uncultivable land. Net cropped area is 46.54 lakh hectares. Agriculture production depends upon the distribution of rainfall. The influence of south-west monsoon is predominant.

2.2 Irrigation Development in Telangana:

As said earlier that there are two major rivers Godavari and Krishna flow through the state. But still the agriculture sector of Telangana depends primarily on rainfall. Though there are other sources of irrigation, well irrigation is the main source in Telangana. The net irrigated area in Telangana increased from 16.82 lakh hectares in 2000-2001 to 20.04 lakh hectares in 2010-2011. The extent of irrigation i.e., percentage share of area under irrigation in total net sown area in the state stood at 44.61 percent in 2010-11 and had increased from percent in 2000-2001. Adilabad, Rangareddy, Mahaboobnagar and Medak districts are low irrigation intensity districts. Moreover the triennium 2010-13 before bifurcation, the net area irrigated was 20.35 lakh hectares and increased to 21.01 lakh hectares in the triennium 2013-16 ie., the increase is about 3.26 percent. Similarly the increase in gross irrigated area from 2010-13 to 2013-16 is reported as 5.19 percent. The increase in intensity of irrigation between the two triennia is 1.86 percent. The details of net and gross irrigated areas in Telangana state are presented in Table 2.1.

Table – 2.1
Intensity of Irrigation

S.No.	Period	Net Irrigated Area (ha)	Gross Irrigated Area (ha)	Intensity of Irrigatiojn %
1	2010-13	2035053	2806648	137.92
2	2013-16	21-1545	2952315	140.48

Source: Statistical Abstract of Telengana

2.2.1 Growth of Irrigation:

The log linear growth rates $Y = ae^{bt} + u^t$ for net and gross area irrigated are estimated to identify the states of irrigation in Telangana state. In this connection time series data from 1991-1992 to 2014-15 for net and gross area irrigated are taken for the analysis. To observe the variation the total period is divided into two sub-periods viz., 1991-92 to 2002-03 and 2003-04 to 2014-15. The details of growth rates are presented in Table 2.2. The growth of net area irrigated is statistically found to be significant in the second

sub-period and the total period. This inferences that there is no significant growth in the first sub-period i.e., the initial years of post-reform period. Similar result is also found in case of gross irrigated area. The intensity of irrigation is not found to be statistically significant in any sub period and the total period. This inference that due to inadequate water supply from different sources of irrigation, the land cannot be substantially irrigated in the second season of the crop. The details of Log-Liner Growth rates of Irrigation in Telangana state are presented in Table 2.2.

Table – 2.2

Log-Liner Growth rates of Irrigation in Telangana

S.No.		1991-92 to 2002-03	2003-04 to 2014-15	1991-92 to 2014-15
1	Net Area Irrigated	0.013 (1.386)	0.038* (3.301)	0.019* (4.992)
2	Gross Area Irrigated	0.016 (1.470)	0.040* (3.523)	0.024* (5.990)
3	Intensity of Irrigation	0.003 (1.416)	0.002 (0.201)	0.005 (1.703)

Source: Statistical Abstract of combined Andhra Pradesh

() figures in 't' values

* 1% level of significance

2.2.2 Cropping Intensity:

The intensity of cropping is estimated to be 125.56 percent in the period 2010-13 and 122.08 period in the period 2013-16 which means the intensity of cropping is decreased by -2.77 percent between the two triennia. The reasons may be attributed to the failure of some irrigation sources all over the state. The details of Cropping Intensity in Telangana state are presented in Table 2.3.

Table – 2.3
Cropping Intensity

(Area in lakh ha.)

S.No.	Period	Net Area Irrigated	Gross Area Irrigated	Intensity of Irrigation
1	2010-13	45.82	57.53	125.56
2	2013-16	44.92	54.84	122.08

Source: Statistical Abstracts of Telangana

To observe the nature of growth of irrigation, the* accelerated/decelerated growth of irrigation is estimated for the two sub-periods and the total period.

It is observed that among the periods, the growth of net area and gross area irrigated is statistically found to be significant in the second sub-period and overall period of

24 years. The reason for the accelerated growth might be the result of the renovation of tanks and creation of new groundwater sources in the state. The details of Accelerated/Decelerated growth of Irrigation in Telangana state are presented in Table 2.4.

Table – 2.4

Accelerated/Decelerated growth of Irrigation

S.No.	Period	Net Area Irrigated		Gross Area Irrigated	
		t	t^2	t	t^2
1	1991-92 to 2002-03	2.050 (1.090)	4.010 (1.090)	2.601 (1.245)	4.003 (1.245)
2	2003-04 to 2014-15	2.916* (3.471)	5.831* (3.471)	3.146* (4.521)	6.293* (4.522)
3	1991-92 to 2014-15	2.646* (3.549)	5.292* (3.549)	2.562* (4.237)	5.124* (4.237)

Source: Statistical Abstract of combined Andhra Pradesh
() figures in 't' values
* 1% level of significance

2.2.3 Growth in area under different sources of irrigation in Telangana:

The total net area irrigated from all sources of irrigation was 14.74 lakh hectares in 1991-92 decreased to 12.60 lakh hectares in 1994-95. From there it has continuously increased upto 16.82 lakh hectares in 2000-2001 and again a decrease in area was observed upto 2004-05. A fluctuating trend is observed from 2005 -06 to 2011-12. In 2012-13 the total net area irrigated was recorded as 24.50 lakh hectares. From there a continuous decrease is observed upto 20.08 lakh hectares in 2015-16. The reason for the fluctuations in net area irrigated for several years was due to lack of rainfall or inadequate rainfall.

Table -2.5

Growth in area under different sources of irrigation in Telangana

S.No	Year	Canals	Tanks	Tube wells	Other wells	Other sources	Total	Area irrigated more than once	Gross area irrigated
1	1991-92	324670	368126	81130	638477	61741	1474144	433842	1907986
2	1992-93	266999	226193	98872	601579	57145	1250788	357151	1607939
3	1993-94	238852	210117	162851	542150	55231	1209201	341686	1550887
4	1994-95	231417	218440	207652	540570	61951	1260030	389280	1649310
5	1995-96	209389	249816	266993	581788	58341	1366327	382048	1748375
6	1996-97	249665	284919	280912	627311	57861	1500668	531766	2032434
7	1997-98	205082	107715	298430	555187	48198	1214612	384880	1599492
8	1998-99	253361	282557	383333	639137	61321	1619659	626693	2246352
9	1999-00	278577	228238	427750	571968	63421	1570314	509686	2080000
10	2000-01	300261	269492	463390	588884	60351	1682378	559213	2241591
11	2001-02	248091	192814	485642	545551	52033	1524131	504357	2028488
12	2002-03	148815	153090	484238	442492	38845	1267380	364993	1632373
13	2003-04	136151	618758	496738	446281	38692	1306620	449691	1756311
14	2004-05	116203	126511	535474	460483	41614	1380285	380899	1661184
15	2005-06	263422	253855	621264	476136	53098	1667775	683025	2350800
16	2006-07	279000	228000	728153	420847	53000	1499000	705000	2414000
17	2007-08	222023	161587	750536	563707	51214	1749067	696356	2445423
18	2008-09	273579	238019	730437	579837	110518	1882390	838612	2721002
19	2009-10	137452	56852	777663	481724	39135	1492826	638456	2131282
20	2010-11	237968	315754	881918	513688	54659	2003987	994811	2998798
21	2011-12	325317	182702	965491	457768	53340	1651395	879423	2864041
22	2012-13	90296	157662	972427	513421	40311	2449778	782987	2557104
23	2013-14	289823	229561	1082435	630118	57395	2289332	874658	3163990
24	2014-15	173688	96780	948001	465095	42739	1726303	802653	2528956
1991-92 to 2000-01		-0.25	-2.00	16.18	-0.08	0.21	2.64	5.04	3.22
2001-02 to 2014-15		1.19	-4.38	6.27	0.87	0.87	3.59	5.60	3.85
1991-92 to 2014-15		-1.02	-1.76	7.60	-0.85	-0.56	2.05	3.99	2.47

Source: TSMIP, Hyderabad

2.3 Policies and Programmes on Irrigation development in Telangana:

There are two missions introduced for supplying water to agriculture and drinking water purposes. These missions are 1. Mission Kakatiya and 2. Mission Bhagiratha.

2.3.1. Mission Kakatiya:

The "Mission Kakatiya" is introduced in Telangana state for the development and restoring of 46,300 tanks. For this project the government of Telangana state is spending about Rs. 20,000 crores. The main purpose of this mission is to provide water for various sectors like farming sector, livestock sector, and many more. By this mission there will be more economy to Telangana and the production values will also be increased in a positive

way. This mission is also known as "Mana Uru Mana Cherruvu". The name Kakatiya for the mission was taken from our ancient Kakatiya rulers who had a great vision for improving irrigation facilities at Telangana state. This project was started in the month of July, 2014.

2.3.2. Mission Bhagiratha:

The "Mission Bhagiratha" was launched by Prime Minister Narendra Modi, the Rs. 42,000 crore piped drinking water project on 7th August 2016. The Mission Bhagiratha situated at Komatibanda village of Gajwel Constituency which is part of Medak district in Telangana. The ambitions piped drinking water supply project will cater to the drinking water needs of 67,000 urban households and 25,000 rural households in the Gajwel assembly Constituency. The massive drinking water supply project was desperately needed for a state that has been a victim of erratic monsoon and poor infrastructure in harvesting rain water. Mission Bhagiratha is stated to be completed in 2018, by then a large part of the state will get not just piped drinking water but also water to meet the industrial and agricultural needs. Though two perennial rivers Godavari and Krishna flow through the state, still the state has suffered from erratic monsoons that have resulted in drought like situations in a large parts of the state. Corresponding the problem, around 973 villages have been dealing with the contaminated ground water due to presence of high fluoride context. As a result, the people have suffered from resulting diseases like fluorosis.

Highlights of Mission Bhagiratha:

The highlights of Mission Bhagiratha are as follows:

- Interlinking Krishna and Godavari rivers with reservoirs in the state to collect conserve and supply much needed water to the state.
- Total water pipeline length:1,30,000 km-covering 26 internal grids, 62 intermediate pumping stations, 16 intake wells, 110 water treatment plants and 37,573 overhead service reservoirs.
- Total cost: Rs, 42,000 crore
- Year of completion: 2018
- Based on detailed topography analysis, water to be pumped using gravity and minimal electricity (182 MW)

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* $\ln Y = a+bt+ct^2+u_t$ (log quadratic form of the trend curve)

- Piped drinking water supply to: 67,000 Urban households in Gajwel Constituency at the rate of 150 litres per days per household, in areas Urban Municipal Corporations
- Piped drinking water supply to: 25,000 rural households at the rate of 100 litres per day household
- Project water allocated for industrial use:10%
- Women in villages empowered to oversee allocation and distribution of water in villages and collection of taxes
- Water drawn from Godavari river: 19.62 thousand million cubic feet (TMC)
- Water drawn from Krishna river: 19.65 thousand million cubic feet (TMC)

2.4 Growth in Area and farmers covered under different sources of irrigation in Telangana:

The details of area and farmers covered urban different sources of irrigation in Telangana for two different census periods i.e., 2005-06 and 2010-11 are presented in the following Tables 2.6 & 2.7.

Table 2.6

Growth in Area and Farmers Covered Under Different Sources of Irrigation in Telangana

Census period	Total		Canals		Tanks		Wells		Tube wells		Other sources		Total exclusive No. holdings receiving irrigation	Area (Ha)
	No. of farmers	Area (Ha)	No. of farmers	Area (Ha)	No. of farmers	Area (Ha)	No. of farmers	Area (Ha)	No. of farmers	Area (Ha)	No. of farmers	Area (Ha)		
2005-06	4827747	6299501	345589	297630	694774	240045	448256	512025	596012	749431	81828	71298	1927339 (39.92)	1870425 (29.69)
2010-11	5553982	6196825	584964	439161	338911	216465	774270	697721	844966	740919	58637	59569	2467988 (44.44)	2153836 (34.76)

Source: Agricultural Census

Note: Figures in brackets are percentages to total number of farmers and area.

TABLE - 2.7

Farmers receiving irrigation and area irrigated from all sources

Census period	Total Holding		Exclusive No. of receiving Irrigation	
	No.	Area irrigated	Exclusive No. of holdings from all sources actually receiving irrigation	Area irrigated
2005-06	4827747	6299501	1927339	1870425
2010-11	5553982	6196825	2467988	2153836

Source: Agricultural Census

As per two census periods 2005-06 and 2010-11, the total number of holdings increased from 48.28 lakhs to 55.54 lakhs in 2010-11, which shows an increase of 15.04 percent. Out of the total number of holdings in 2005-06 only 39.92 percent of holdings received irrigation from all sources while in 2010-11, out of 55.54 lakhs of holdings only 44.44 percent of holdings received irrigation from all sources. Similarly out of 62.99 lakh hectares in 2005-06 only 29.69 percent of area was irrigated and in 2010-11, of the total 61.97 lakh hectares, 34.76 percent of the area was irrigated. This inferences that there is an increase in irrigated area from 2005-06 to 2010-11 by 15.15 percent from all sources of irrigation.

TABLE 2.8
Increase in area and farmers under Sprinkler and Drip Irrigation

Name	Drip		Sprinkler		Total	
	No.	Area(Ha)	No.	Area(Ha)	No.	Area(Ha)
2014-15	17385	17190.39	12368	12084.18	29753	29274.57
2015-16	30620	31191.41	8925	8665.72	39545	39857.13

Source: Telangana State Micro Irrigation Project, Hyderabad

2.5. Growth in area and farmers covered under sprinkler and drip in Telangana:

Out of the total number of 29753 farmers, 58.43 percent of farmers have used drip and 41.57 percent have used sprinkler irrigation system in 2014-15. In 2015-16, out of a total of 39,545 farmers 77.43 percent have utilized drip irrigation and 22.57 percent have utilized sprinkler irrigation system. It is observed that the number of farmers used drip have increased in 2015-16 by 76.13 percent while the number of farmers used sprinkler system have decreased by -27.84 percent in 2015-16. The reason for the decrease is the problems of maintenance of sprinkler irrigation system.

2.6. District-wise Distribution of Sprinkler and Drip in Telangana:

The details of District-wise distribution of sprinkler and drip systems are presented for the old 9 districts of Telangana for the year 2014-15 and 2015-16 in Table 2.8. Observing the district-wise use of sprinkler and drip irrigation systems in 2014-15 and 2015-16, both the number of farmers and area under these two systems of irrigation showed a significance difference from 2014-15 to 2015-16. On the whole in Telangana state the number of farmers under drip irrigation has increased from 17385 in 2014-15 to 30620 in 2015-16 i.e., an increase by 76.13 per cent, while the number of farmers under sprinkler system has decreased by -27.84 per cent between the two periods. Moreover the area under drip irrigation is increased 81.45 per cent in 2015-16 while the area under sprinkler irrigation has decreased by 28.29 per cent. Across the districts, the area under drip irrigation has increased in all districts from 2014-15 to 2015-16. On the other hand, the area under sprinkler irrigation system has substantially decreased from 2014-15 to 2015-16 in all districts except in Mahboobnagar and Nizamabad district.

TABLE 2.9

District-wise distribution of Sprinkler and drip in Telangana

District Name	Drip				Sprinkler			
	2014-15		2015-16		2014-15		2015-16	
	No.	Area(Ha)	No.	Area(Ha)	No.	Area(Ha)	No.	Area(Ha)
Adilabad	930	858.97	2062	2048.98	2068	1977.61	1403	1326.85
Karimnagar	1646	1529.42	2494	2350.28	1986	1961.16	548	537.1
Khammam	671	896.49	1200	1632.29	200	193.7	68	55.23
Mahabubnagar	2605	2926.54	7285	7041.82	1640	1615.1	2914	2874.78
Medak	3763	3612.54	5463	5828.94	4018	3966.7	1769	1743.34
Nalgonda	2211	2229.22	2840	3194.29	809	783.11	582	556.13
Nizamabad	1657	1648.95	2788	2943.26	417	417	601	597.64
Ranga Reddy	1988	1757.27	2588	2492.78	341	319.59	296	290.15
Warangal	1914	1730.99	3900	3658.77	889	850.21	744	684.5
Grand Total	**17385**	**17190.39**	**30620**	**31191.41**	**12368**	**12084.18**	**8925**	**8665.72**

Source: Telangana State Micro Irrigation Project, Hyderabad

2.7. Progress in Participatory Irrigation Management in Telangana:

The main objectives of Participatory Irrigation Management (PIM) include participation of stake holders in operation, maintenance of irrigation systems, agriculture productivity enhancement and water management. After the reorganization of the state of Andhra Pradesh the new state of Telangana was formed on 2nd June, 2014 with 10 districts.

As per K.V. Rajus[2] article on "Participatory Irrigation Management in Andhra Pradesh, India" traditionally the Telangana region had less experience in canal irrigation. However, many surface irrigation projects are close to the completion stage (Some of the them have been on-going over the last 20-30 years) the SRSP (Sri Ram Sagar Project) which had created a large irrigation belt had induced social and economic development in this region. The project is yet to attain its full potential. Hence, the irrigated area (one-third of the designed command area) had surplus water. But the carrying capacity of the distribution system had been declining overtime owing to the lack of maintenance and repairs. Under these circumstances, funds through WUAs (Water Users Associations). DCs (Distributary Committees) became handy to carryout works of their choice. This had boosted the local farmers' confidence in WUAs.

The number of WUAs, distributary Committees and Project Committees in major, medium and minor irrigation systems to which elections are to be conducted now in Telangana state is presented in table 2.10:

Table 2.10

Number of Farmer Organizations in Different Irrigation Systems in Telangana

S.No.	Farmers Organization	Major	Medium	Minor	Total
1	WUA's	744	173	3876	4793
2	DC's	97	--	--	97
3	PC's	8	26	--	34

The last elections to WUAs were conducted in united state of Andhra Pradesh in 2008; subsequent elections to be conducted in the year January, 2010, January 2012 and January 2014 were not conducted due to several reasons. Now the entire body of WUAs became vacant by January, 2014. In view of expiry of term of all TC Territorial Constituency) members in January, 2014, elections are to be conducted to the total number of territorial constituency members. There are 4793 WUAs in the state. The district-wise number of WUAs in the state and number of TC member in each WUA are given in table 2.11.

[2] "Participatory Irrigation Management in Andhra Pradesh, India" – K.V. Raju, Senior Fellow, Centre for inter disciplinary study in Environment and Development, Institute for Social and Economic study, Bangalore.

Table 2.11

District-wise P.Cs, D.Cs & Water User Associations for Elections to be conducted

S.No	District			DC	WUAs as per Notification				TC members (Total vacancies)			
		Major	medium		Major	medium	minor	Total	Major	medium	minor	Total
1	Mahabubnagar	2	1	14	81	5	518	604	972	60	3108	4140
2	Rangareddy		1		0	5	175	180	0	60	1050	1110
3	Medak		2		0	14	544	558	0	168	3264	3432
4	Nizamabad	1	3	11	85	16	285	386	1020	192	1710	2922
5	Adilabad	1	5	6	33	38	258	329	396	456	1548	2400
6	Karimnagar	1	3	20	167	18	495	680	2004	216	2970	5190
7	Khammam		5	9	79	38	381	498	948	456	2286	3690
8	Warangal	1	4	10	87	23	645	755	1044	276	3870	5190
9	Nalgonda	2	2	27	212	16	575	803	2544	192	3450	6180
	Total	8	26	97	744	173	3876	3876	8928	2076	23256	34260

TC – Territorial Constituency, WUA-Water Users Association, DC- Distributary Committee, PC- Project Committee
Source: Government of Telangana, Office of the Commissioner, CAD, Irrigation & CAD Department

The government appointed the irrigation officers to perform the functions of manging committees till such farmers organizations are duly constituted or reconstituted.

Capacity Building of Farmer's Organization:

The state government has initiated an exhaustive capacity building programme for the office bearers of the farmer's organizations. These organizations have a training centre of their own at each circle level. These representatives are being taken to exposure visits to other states as well as for better appreciation of the management and operation of the irrigation system.

Operation and Maintenance:

The state government has provided adequate financial support to these organizations for efficient management of the system. The financial support is provided as tax re-ploughs and also the deferred maintenance works. The water users associations are permitted to take up works up to Rs. 5 lakhs by themselves while the works above this limit are tendered. The works out of tax re-plough are also administratively sanctioned by the water users associations only.

Allocation of Funds:

Entire Water Tax Collection is being ploughed back to the Farmer's Organizations (WUA/DC/PC) for taking up operation and maintenance in the area of operation. The ratio is as follows as per GO Ms. No.170 I&CAD (Gen.IV.1) dept., dated 14.10.2008.

Table 2.12

Allocation of Funds under Different Systems of Irrigation

	Allocation						
	WUAs		D.Cs		P.Cs		Gram Panchayat
	Works	Admn.	Works	Admn.	Works	Admn.	
Major	50%	10%	15%	5%	14%	1%	5%
Medium	50%	10%	-	-	30%	5%	5%
Minor	80%	10%	-	-	-	-	10%

Source: Government of Telangana, Office of the Commissioner, CAD, Irrigation & CAD Department

In view of formation of Telangana state on 2nd June, 2014, the proposals for adopting the APFMIS Act, 1997 for implementation of Participatory Irrigation Management in Telangana state is under process.

2.8. Summary:

Out of the total geographical area 40.5 per cent is net area sown, 23.9 per cent is under forests 10.5 per cent is under current fallows 7.7 per cent of area is towards non-agricultural uses and 5.4 per cent of area is barren and uncultivable land. The net cropped area is 46.54 lakh hectares. The influence of south-west monsoon is predominant. The increase in intensity of irrigation between 2010-13 and 2013-16 is 1.86 per cent. Due to inadequate water supply from different sources of irrigation the land cannot be substantially irrigated in the second season of the crop. The intensity of cropping is decreased by -2.77 per cent between 2010-13 and 2013-16. The reason may be attributed to the failure of some irrigation sources all over the state. The reason may be accelerated growth in the second sub-period, might be the result of the renovation tanks and creation of new ground water was due to lack of rainfall or inadequate rainfall. Observing across the sources, it is observed that the area under tanks, tube-wells and other sources has decreased from 2005-06 to 2010-11. The reason for the decrease in area may be attributed to the disrepair state of tanks and failure of tube-wells and other sources.

It is observed that the number of farmers used drip has increased in 2015-16 by 76.13 per cent while the number of farmers used sprinkler system has decreased by 27.84

per cent in 2015-16. The reason for the decrease in the number of sprinkler systems is the problems in maintenance of the sprinkler system. Moreover, the area under drip irrigation system has increased by 81.45 per cent while the area under sprinkler system has decreased by -28.29 per cent from 2014-15 to 2015-16. Across the districts, the area under drip irrigation has increased in all the districts from 2014-15 to 2015-16. On the other hand the area under sprinkler irrigation system has substantially decreased from 2014-15 to 2015-16 in all districts except in Mahaboobnagar and Nizamabad districts.

In view of formation of Telangana state on 2nd June, 2014 the proposals for adopting the APFMIS Act, 1997 for implementation of Participatory Irrigation Management in Telangana state is under process.

* * *

CHAPTER – III

Overview of PINS (MIS) programmes in Telangana

3.1 Introduction:

The present chapter deals with an overview of PINS (MIS) programmes in Telangana. As said earlier, since there are no government PINS projects with MIS available in the state, alternatively the projects with MIS scheme are installed connected to the irrigation source of tube-wells/bore-wells in the state. This MIS scheme was installed and implemented by twelve private agencies in the state. The list of agencies implemented the scheme is presented in appendix Table 3.1.

3.2 Overview of PINS/MIP project programmes in Telangana:

Effective utilization of every drop of water through micro-irrigation is imperative for improving crop productivity, production and to achieve sustainable improvement in living standards of small and marginal farmers of the state by improving the water use efficiency through micro-irrigation and farmers can get assured additional income.

The MIP scheme has been implemented by horticulture department under NMMI (National Mission for Micro-Irrigation) up to 2013-14 with differential subsidy pattern for different categories of farmers. From the year 2014 onwards MIP scheme (NMMI) was subsumed into National Mission for Sustainable Agriculture (NMSA) as one of the components as On Farm water Management (OFWM) and nodal department is agriculture department (HOD). The physical and financial achievements under micro-irrigation project in Telangana are as follows in Table 3.1.

Table - 3.1
Physical and financial achievements under micro-irrigation project in Telangana

Year	Physical in Ha			Financial (Rs. In lakhs)
	Drip	Sprinkler	Total	
2003-06	32331	34314	66646	8330.00
2006-07	30461	9700	40161	9276.00
2007-08	42185	12600	54785	13748.00
2008-09	39516	15650	55166	13808.00
2009-10	47316	18750	66066	30369.00
2010-11	41259	17650	58909	24386.00
2011-12	35719	115416	51135	34231.00
2012-13	47385	8	47393	40652.00
2013-14	39501	0	39501	32672.00
2014-15	36742	16993	53736	35008.90
2015-16	31191	8666	39857	32231.69
Total	423608	573355	573355	274712.60

Source: Telangana State Micro Irrigation Project, Hyderabad

3.2.1 Micro-Irrigation in Telangana:

In Telangana out of 17.12 lakh hectares of net irrigated area, irrigated with groundwater, only 5.73 lakh hectares are covered under micro-irrigation, leaving a balance potential of 11.39 lakh hectares for micro-irrigation.

Table - 3.2
District wise number of covered area in Telangana

Sl.No.	District	Net Irrigated area with bore-wells (in lakh ha)	MIP covered area (in lakh ha)	MIP to be covered (in lakh ha)
1	Mahboobnagar	2.18	1.34	0.84
2	Ranga Reddy	0.70	0.41	0.29
3	Medak	1.64	0.85	0.79
4	Nizamabad	1.76	0.40	1.36
5	Adilabad	0.68	0.42	0.26
6	Karimnagar	4.69	0.46	4.23
7	Warangal	2.60	0.56	2.08
8	Khammam	0.92	0.37	0.55
9	Nalgonda	1.95	0.96	0.99
	Total	17.12	5.73	11.39

Source: Telangana State Micro Irrigation Project, Hyderabad

3.2.2 Highlights of the action plan on micro-irrigation in 2014-15:

The highlights of the action plan are:

1. Subsidy is extended upto five acres to all categories of farmers with 100 per cent subsidy to SC/STs, 90 per cent subsidy for BCs, SF/MF farmers and 80 percent subsidy to other caste farmers (2 to 5 acres) without limitation of unit cost subsidy when compared to earlier limitation of Rs. 1 lakh subsidy per farmer.
2. At least 25 per cent of the financial target allocated to the state must be earmarked to agriculture crop sector in drip including sugarcane, sericulture etc.,
3. Provision of lateral roller to farmers on subsidy @Rs. 1,500/- per farmer.
4. Provision of ten years after sales service to all beneficiary farmers instead of five years earlier.

5. Provision of crop-wise agricultural manner printed in Telugu to all farmers and
6. Provision of service centres by MI (micro-irrigation) companies at all Revenue Divisional Head Quarters.

3.3. Coverage of PINS (MIS) in the districts of Telangana:

There are two types of MIS systems viz., drip and sprinkler. In all districts the MIP projects through MIS scheme connected to tube-wells are implemented upto 2015-16. The district-wise distributions of MIS through feeder irrigation source are presented in following Table 3.3.

Table - 3.3

Feeder Irrigation source-wise distribution of PINs in the state

District	Irrigation basin/ project	No. of MIS Installed	Total number of beneficiaries	Area covered (Ha)
		Tube wells	Tube wells	Tube wells
Adilabad	Tube well / bore well	128476	69517	128476
Karimnagar	Tube well / bore well	40238	21803	40238
Khammam	Tube well / bore well	79897	44934	79897
Mahabubnagar	Tube well / bore well	38050	26869	38050
Medak	Tube well / bore well	39783	21217	39783
Nalgonda	Tube well / bore well	43436	31052	43436
Nizamabad	Tube well / bore well	50195	34930	50195
Rangareddy	Tube well / bore well	36463	13350	36463
Warangal	Tube well / bore well	93672	32762	93672
State Total	Tube well / bore well	550212	296434	550212

Source: Telangana State Micro Irrigation Department, Hyderabad

From the above Table it can be seen that upto 2015-16, 5, 50,212 numbers of micro-irrigation systems were installed with a coverage of area of 5, 50,212. Moreover the total number of beneficiaries is 2, 96,436.

3.4. Cost pattern on PINS:

The Telangana state micro-irrigation project prescribed the initial capital cost requirement/provision on PINS-MIS in the state. The drip system of MIS is provided for different crops with a total initial fixed cost of Rs. 1, 06,120 of which Rs. 10,612 is given as subsidy for BCs small and marginal farmers and for others the subsidy is given to a maximum of Rs. 21,224. Each drip system is targeted to irrigate an area of one hectare. On the other hand the sprinkler irrigation system of MIS is provided for different crops with a total fixed cost of Rs. 17,800 of which Rs. 4,470 is given as subsidy for SC/ST, BC small/marginal farmers and for others. Each system of sprinkler is targeting to irrigate an area of one hectare. All the details can be observed from the Table 3.4.

Table - 3.4

Initial Capital Cost Requirements / Provisions on PINS - MIS in the State

Type of MIS	Total Initial fixed Cost (Rs.)		Total area irrigated (bigha/local unit)
	Actual	**Less subsidy**	
Drip	106120	SC,ST - NIL BC, SF/MF - 10612 Others - 21224	1 ha
Sprinkler	17880	SC,ST, BC,SF/MF & Others - 4470	1 ha

Source: Telangana State Micro Irrigation Department, Hyderabad

3.5. Installation of PINS-MIS in the state:

Telangana state micro-irrigation project has not at all coined PINS in the action plan since inception, but a very few of MI installations are done by taking the irrigation from canals and tanks. MI project in Telangana is mainly based on the well and tube-well irrigated areas. The mechanism of supply/purchase of MIS equipments/material installation on fields is all through the empanelled MI companies (Appendix Table - 3.1) MIP (Micro Irrigation Project) is giving the awareness on fertigation and chemigation through the drip system due to non-availability of water soluble fertilisers. Very few farmers doing fertigation through drip system. The area under fertigation is approximately 10 per cent of the sanctioned area in the state. All the details can be viewed from the Table 3.5.

Table - 3.5

Average Cost of PINS Equipments and Installations in the State

(Rs/Ha)

PINS - MIS Equipments	Equipment Cost (Rs)	Installations Cost (Rs)	Periodicity of servicing provided (Number per Year)
Drip Equipments			
Control Head	6985.34	483.00	"5 years free of cost and 5 years at the cost of farmers"
Main / Sub Main pipes	8341.90		
Laterals	89166.06		
Emitters			
Total Drip System	104493.30		
Sprinkler Equipments			
Control Head	-	-	"5 years free of cost and 5 years at the cost of farmers"
Main / Sub Main pipes	13425		
Laterals	4455		
Emitters			
Total Sprinkler System	17880		

Source: Telangana State Micro Irrigation Department, Hyderabad

3.6. District-wise coverage of MIP:

The details of district-wise number of farmers and area covered upto 2015-16 under MIP are presented in the following Table 3.6. A total of 2,96,434 farmers are benefitted through MIP covering an area of 5,50,212 hectares in the state. The number of farmers varied from 13,350 in Khammam district to 69,517 in Mahaboobnagar district. Similarly the area covered from a low of 36,463 hectares in Khammam to 1,28,476 hectares in Mahaboobnagar district.

Table - 3.6

District-wise coverage of MIP in the State

Districts	No. of farmers	Area covered (Ha)
Mahboobnagar	69517	128476
Ranga Reddy	21803	40238
Medak	44934	79897
Nizamabad	26869	38050
Adilabad	21217	39783
Karimnagar	31052	43436
Waranga	34930	50195
Khammam	13350	36463
Nalgonda	32762	93672
Total	296434	550212

Source: Telangana State Micro Irrigation Department, Hyderabad

The details of crop-wise number of beneficiaries and area covered under drip and sprinkler system in the state are presented in the following Table 3.7.

Table - 3.7

Crop wise number of beneficiaries and area covered under drip and sprinklers in the State

Crop Description	Drip		Sprinkler		Total	
	No. of Beneficiaries	Area in Ha	No. of Beneficiaries	Area in Ha	No. of Beneficiaries	Area in Ha
ACID LIME (NIMMA)	440	565.56	-	-	440	565.56
AMALA (USIRI)	7	20.52	-	-	7	20.52
BAJRA	-	-	1	1	1	1
BANANA/PLANTAIN/GREEN PLANTAIN	194	323.86	-	-	194	323.86
BATAVIA/SWEET ORANGE/CIRTUS FRUITS	271	423.15	-	-	271	423.15
BEAN	51	44.9	12	11.86	63	56.76
BEET ROOT	40	31.23	53	52.54	93	83.77
BHENDI	714	639.67	104	102.3	818	741.97
VEGITABLES	550	480.82	155	150.4	705	631.2
CABBAGE	287	260.56	196	185.3	483	445.85
CARROT	145	123.56	63	61.06	208	184.62
CAULIFLOWER	48	42.56	3	3	51	45.56
CHANDINI	1	0.8	-	-	1	0.8
CHILLIES	20	18.11	1	1	21	19.11
CHRYSANTHAMUM (CHAMANTHI)	7	6.06	-	-	7	6.06
COCCINEA (DONDA)	21	23.26	1	1	22	24.26
COCOA	5	13.86	-	-	5	13.86
COCONUT	9	17.92	-	-	9	17.92
COLACACIA(CHAMAGADDA)	1	0.76	1	1	2	1.76
CORIANDER(KOTHIMEERA)	-	-	6	6	6	6
COTTON	3652	3587.6	540	516.6	4192	4104.2
CUCUMBER	6	6.2	11	11	17	17.2
CURRY LEAF	-	-	2	1.75	2	1.75
CUSTARD APPLE	4	7.58	-	-	4	7.58
DRUM STICK	30	60.45	1	1	31	61.45
FIG(ANJURA)	6	9.36	-	-	6	9.36
GINGER	29	51.7	-	-	29	51.7
GOURDS	41	55.93	28	26.26	69	82.19
GRAPES	3	7.1	-	-	3	7.1
GREEN CHILLIES	8958	7803	157	153	9115	7956
GREEN LEAFY VEGETABLES	29	30.57	61	60.72	90	91.29

GUAVA	119	173.52	-	-	119	173.52
JASMINE (MALLI)	5	3.43	-	-	5	3.43
JOWAR (SORGHUM)	-	-	2	2	2	2
LEMON GRASS (NIMMA GADDI)	4	11.97	-	-	4	11.97
LILLY	2	0.98	-	-	2	0.98
MAIZE/BABY CORN	1462	1464.6	977	937.4	2439	2402
MANGOES	1686	2973.5	-	-	1686	2973.5
MARIGOLD (BANTHI)	3	3.23	-	-	3	3.23
MULBARY	131	164.14	1	1	132	165.14
OIL PALM	160	375.87	3	3	163	378.87
OIL SEEDS	-	-	5063	4937	5063	4936.6
ONIONS	88	82.19	78	77.55	166	159.74
PAPAYA/MUSK MELON	156	270.7	-	-	156	270.7
PEAS	9	8.41	25	23.89	34	32.3
POMEGRANATE	65	120.54	-	-	65	120.54
POTATOES	212	194.77	62	59.11	274	253.88
PULSES	7	7.79	581	563.9	588	571.66
RADISH	4	1.88	-	-	4	1.88
RED CHILLIES	65	57.19	-	-	65	57.19
ROSE	17	22.26	1	1	18	23.26
SAPOTA	2	3.77	-	-	2	3.77
SUGARCANE	2850	3231.9	1	1	2851	3232.9
SWEET POTATOES	3	2.07	3	3	6	5.07
TAPIOCA	32	28.33	11	11	43	39.33
TOMATOES	5535	4992	717	694.7	6252	5686.7
TURMERIC	2432	2337.8	4	3.93	2436	2341.7
WATER MELON	2	1.99	-	-	2	1.99
Grand Total	**30620**	**31191**	**8925**	**8666**	**39545**	**39857**

Source: Telangana State Micro Irrigation Department, Hyderabad

3.7. Crop-wise water and energy saved (per hectare) with drip irrigation:

The details of crop-wise water and energy saved per hectare with drip irrigation are presented in Table 3.8. The percentage of saving of water varied from 49 per cent in case of tomato to 54 per cent in case of Vegetables and sugarcane. On the other hand the percentage of energy saved from a low of 49 per cent in case of tomato to 54 per cent in case of Vegetables and sugarcane. Moreover the percentage increase in yield ranged between 15 to 30 per cent in case of pomegranate to 35 to 40 per cent in case of papaya and mango.

Table - 3.8

Crop-wise water and energy saved per hectare with drip irrigation in the State

Crop	Water saved in (mm) per ha per season				Energy Saved (kwh) per ha				Yield Increased (%)
	flood irrigation	Drip irrigation	Net saving	% of saving	flood irrigation	Drip irrigation	Net saving	% of saving	
Sweet orange	1136	530	606	53	1307	610	697	53	25-60
Sugarcane	1634	748	886	54	1881	861	1020	54	20-40
Pomegranate	1363	663	700	51	1569	763	806	51	15-30
Vegetables	891	408	483	54	1026	470	557	54	20-40
Papaya	2196	1060	1136	52	2528	1220	1307	52	35-45
Mango	1114	520	594	53	1283	599	684	53	35-45
Tomato	994	504	490	49	1145	580	564	49	20-40
Chilli	994	480	514	52	1145	553	592	52	20-40
Banana	2196	1087	1109	51	3033	1501	1532	51	32-50

Source: Telangana State Micro Irrigation Department, Hyderabad

3.8 Summary:

The MIS scheme was installed and implemented by twelve private agencies. From 2014 onwards the MIP scheme (NMMI) was subsumed into National Mission for Sustainable Agriculture (NMSA) as one of the components as On Farm Water Management (OFWM) and the nodal department is agriculture department (HOD).

Out of 17.12 lakh hectares of net irrigated area irrigated with ground water only 5.73 lakh hectares are covered under micro-irrigation, leaving a balance potential of 11.39 lakh hectares for micro-irrigation. In all the districts the MIP projects through MIS scheme connecting to tube-well irrigation are implemented. About 5,50,212 numbers of micro-irrigation systems were installed with a coverage of area of 5,50,212 hectares the total number of beneficiaries being 2,96,436.

The drip system of MIS is provided for cotton crop with a total initial fixed cost of Rs. 1,06,120 of which 10.612 is given subsidy for BCs small/marginal farmers and for others the subsidy is given to a maximum of Rs. 21,224. Moreover, the sprinkler irrigation system of MIS is provided for groundnut crop with a total fixed cost of Rs. 17,880 of which Rs. 4,470 is given as subsidy for SC/ST, BCs small/marginal and for others. MI project in Telangana is mainly based on well and tube-well irrigated areas. The mechanism of supply/purchase of MIS equipments/material installations on fields are all through the empanelled MI companies. The area under fertigation is approximately 10 per cent of the sanctioned area in the state. A total of 2,96,434 farmers are benefitted through MIP covering an area of

5,50,212 hectares in the state. The percentage of saving of water varied from 49 per cent in case of tomato to 54 per cent in case of Vegetables and sugarcane. On the other hand, the percentage of energy saved from a low of 49 per cent in case of tomato to 54 per cent in case of Vegetables and sugarcane.

* * *

CHAPTER – IV

ADOPTION, PERFORMANCE AND MANAGEMENT OF PINS BY FARMERS

4.1 Introduction:

As mentioned in the introductory chapter, since there are no government pressurised net irrigation network systems (PINS) connected to surface irrigation in Telangana, alternatively the farmers depend on tube-well irrigation network systems are implemented in the form of providing MIS programmes for their crops. This chapter analyses the perceptions and experiences of tube-well water user farmers in terms of the adoption, benefits and costs of accessing irrigation water from available PINS system through MIS programmes.

4.2 Socio-Economic Profile of Water Users:

The details of the socio-economic characteristics of sample households are presented in Table 4.1. On an average the age of respondents of selected beneficiary and non-beneficiary farmers is around 45 years. The average numbers of years of education of beneficiary and non-beneficiary farmers are 5.67 and 5.23 respectively. All the sample households of beneficiary and non-beneficiary households reported to have agriculture as main occupation. The average family size of beneficiaries is reported to be 4.42, while the family size of non-beneficiary is 4.23. The average number of people engaged in agriculture are reported to be 2.54 for beneficiary farmers and 2.48 for non-beneficiary farmers. On an average, the average number of years of experience in farming is reported around 24. About 45 percent of beneficiary farmers and 49 percent of non-beneficiary farmers have reported to be member of in an association. About 33 percent of beneficiary farmers and 18 percent of non-beneficiary farmers have reported from general caste category, while 50 percent of beneficiary farmers and 68 percent of non-beneficiary farmers have reported from OBC category. Moreover 12 percent of beneficiary farmers and 8 percent of non-beneficiary farmers have reported. On the other hand, only 5 percent of beneficiary and 6 percent of non-beneficiaries are from SC category. All the above details can be viewed from the following Table 4.1.

Table - 4.1 Socio-economic Characteristics of Sample Households

Particulars	Pvt. PINS (SW/GW)	
	BF	NBF
Number of sample farmer households	200	100
Average age of respondent (years)	45.89	45.15
Average years of respondent education	5.67	5.23
Agriculture as main occupation (% of respondents)	100	100
Gender (% of respondents):		
Male	86.00	97.00
Female	14.00	3.00
Average family size (No.)	4.42	4.23
Average number of people engaged in agriculture	2.54	2.48
Average years of experience in farming	24.67	23.96
% of farmers being a member of any association	45.00	49.00
Caste (% of households):		
SC	5.00	6.00
ST	12.00	8.00
OBC	50.00	68.00
General	33.00	18.00

Notes: 1. BF: Beneficiary Farmers; NBF: Non- Beneficiary Farmers;
SW: Surface water; GW: Groundwater
Source: Field survey data

4.3 Land holdings, asset holding and sources of relief:

4.3.1 Operational land holding of sample household:

On an average the per household net operated area is reported to be 2.26 hectares of which 2.24 hectares is reported as own land and .02 hectares is leased-in land. Moreover, the net irrigated area per beneficiary is reported to be 2.16 hectares per household, while 1.48 hectares per household is reported for non-beneficiary farmers. Observing between beneficiary and non-beneficiary farmers, beneficiary farmers have enjoyed more irrigational facilities than non-beneficiary farmers. All these details are presented in the following Table 4.2.

Table - 4.2 Operational Landholding of the Sample Households

(ha/household)

Particulars	BF	NBF	Overall
Owned land	2.28 (99.56)	2.15 (97.29)	2.24 (99.12)
Leased-in	0.01 (0.44)	0.06 (2.71)	0.02 (0.88)
Leased-out	0.00(0.00)	0.00(0.00)	0.00(0.00)
Net operated area (NOA)	2.29(100.00)	2.21(100.00)	2.26(100.00)
Net irrigated area	2.16 (94.32)	1.48(66.97)	1.95(86.28)
Net Unirrigated area	0.13(5.68)	0.73(33.03)	0.31(13.72)

Notes: Figures in parenthesis are the percentage to net operated area
Source: Field Survey

4.3.2 Distribution of farm assets:

All the beneficiary farmers reported to have drip system. The per household area under drip system is reported to be 1.12 hectares. Either single member of beneficiary or non-beneficiary farmers did not report any of the assets like tractor, harrow, electric motor or diesel engine for their own. The details are presented in Table 4.3.

Table - 4.3 Distribution of Farm Assets

(Number/household; Area in Ha)

Particulars	BF	NBF
Tractor, Trailer/trolley	0.14	0.09
Harrow and cultivator	0.04	0.00
Electric motor,	0.63	0.39
Diesel engine	0.08	0.50
Drip system (% of HH)	100	0.00
Drip system (ha/hh)	1.12	0.00
Sprinkler system (No/hh)	0.03	0.00
Sprinkler system (ha/hh)	0.04	0.00
Any other	0.00	0.00

Source: Field Survey

4.3.3. Agricultural Credit:

All the sample farmers borrowed loan amount from Commercial banks, co-operative societies and also from informal sources (moneylenders, traders and commission agents etc.,) for agricultural purposes. On an average the per household total amount borrowed from all sources per beneficiary farmers is reported to be Rs. 1,23,879 and the outstanding loan amount is Rs. 94,315. Observing across the sources of credit the per household loan amount borrowed ranged from Rs. 1,09,375 from co-operative credit sources to

Rs. 1,26,884 from Commercial banks. On the other hand the outstanding loan amount ranged between Rs. 82,917 from co-operative societies and 1,07,500 towards informal sources.

On an average the total per household amount borrowed from all sources by non-beneficiary farmers is reported to be Rs. 1,30,264. Across the sources the loan amount borrowed ranged between Rs. 92,452 from Commercial banks and Rs. 2 lakhs from informal sources. On the other hand the per household total outstanding loan amount for non-beneficiary Rs. 1,17,667. Across the sources the per household outstanding loan amount ranged from Rs. 87,405 from Commercial banks to Rs. 2 lakhs towards informal sources.

Moreover, the percentage of repayment of loan amount for beneficiary farmers is reported around 24 percent towards Commercial banks and Co-operative Credit societies and around 10 percent towards informal sources. On the other hand the percentages of repayment of loan amount for non-beneficiary farmers are reported as 5.46 percent towards Commercial banks and 13.64 percent towards Co-operative Credit societies. No repayment is reported towards informal sources. On the whole it is observed that there is no proper repayment of loan amount either by beneficiaries or by non-beneficiaries towards any sources of credit. The above details can be viewed from the following Table 4.4.

Table - 4.4 Outstanding Agricultural Credit of the Sample Households

(RS/hh)

Sources	Beneficiary Farmers				Non-beneficiary Farmers			
	No	Amount of loan taken (Rs)	Rate of interest (%)	Amount of loan outstanding (Rs)	No	Amount of loan taken (Rs)	Rate of interest (%)	Amount of loan outstanding (Rs)
Commercial banks	121	126884	7	96140	42	92452	7	87405
Co-operative Credit Societies	24	109375	4	82917	28	182000	4	157179
Other banks	0	0	0	0	0	0	0	0
Government programmes	0	0	0	0	0	0	0	0
Informal sources (Money lenders, Traders/Commission agents etc.,)	4	120000	24	107500	2	200000	24	200000
Total	200	123879		94315	100	130264		117667

Source: Field Survey

4.3.4 Purpose of Agricultural loan availed:

Out of the total sample of 200 beneficiary farmers, only 149 farmers have borrowed agricultural loan and out of 100 non-beneficiary sample farmers, 72 farmers have borrowed agricultural loan. Out of the total sample of 149 beneficiaries, 89.26 percent of farmers availed the loan for seasonal crop cultivation and 10.74 percent of farmers spent the loan amount towards purchase of tractor and other implements. On the other hand, out of 72 non-beneficiary farmers 83.33 percent of farmers availed the loan for seasonal crop cultivation and 16.67 percent of farmers utilised the loan amount for the purchase of tractor and other implements. All the details are presented in the following Table 4.5.

Table - 4.5 Purpose of Agricultural Loan Availed (Beneficiary HH)

(% to total farmers)

Purpose	No. of Beneficiary farmers	No. of Non-Beneficiary farmers
Seasonal crop cultivation	133(89.26)	60(83.33)
Purchase of tractor and other implements, livestock	16(10.74)	12(16.67)
Consumption expenditure, Marriage and social ceremonies etc.	0(0.00)	0(0.00)
Total Farmers	149(100.00)	72(100.00)

Source: Field Survey

4.3.5 Sources of Irrigation:

On an average the per household irrigated area is reported to be 1.95 hectares. Across the sources the per household area ranged from .01 hectares under tanks to 1.24 hectares under tube-wells.

The higher percentage of area under irrigation is reported to be under tube-wells for beneficiary and non-beneficiary farmers. The percentage of irrigated area ranged from 0.35 under tanks to 63.84 percent under tube-wells. On the other hand, the percentage of irrigated area for non-beneficiaries ranged from 0.95 percent under tanks to 62.98 percent under tube-wells. Next to the sources of tube-well, the other major sources of irrigation for both beneficiary and non-beneficiary farmers are open/dug-well and Canal respectively. The details of sources of irrigation are presented in Table 4.6.

Table - 4.6 Sources of Irrigation

(Area as a % of net irrigated area: No of farmers as a % of total farmers)

Particulars	BF		NBF		Overall	
	Area	No. of farmers	Area	No. of farmers	Area	No. of farmers
Canal	9.63 (0.21)	16.10 (32)	6.03 (0.09)	13.16 (10)	8.65 (0.17)	15.00 (42)
Open/ dug well	26.18 (0.57)	26.83 (54)	30.04 (0.44)	30.26 (23)	27.23 (0.53)	28.00 (77)
Tube- well	63.84 (1.38)	56.59 (113)	62.98 (0.93)	53.95 (41)	63.61 (1.24)	55.67 (154)
Tank	0.35 (0.01)	0.49 (1)	0.95 (0.01)	2.63 (2)	0.52 (0.01)	1.33 (3)
Others	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Total	100 (2.16)	100.00 (200)	100 (1.48)	100.00 (76.00)	100 (1.95)	100.0 (276)

Source: Field Survey

4.3.6 Distribution of farmers according to Area under PINS:

Out of total number of 200 beneficiary farmers 47.50 percent are small farmers, 23.50 percent are marginal farmers, 16 percent of the farmers are medium farmers, 13 percent of the farmers are large farmers. All the above details can be viewed from Table 4.7.

Table - 4.7 Distribution of farmers according to area under PINS

Area under PINS (Area in acre)	No of farmers	% farmers
Marginal (upto 2.50 ac)	47	23.50
Small (2.51 to 5.0 ac)	95	47.50
Medium (5.01 to 10.0)	32	16.00
Large (>10.0)	26	13.00
Total	200	100.00

Source: Field Survey

4.3.7 Average area under PINS project by farmer category:

On an average the area under PINS (MIS) is reported to be 1.11 hectares. Across the groups the area under PINS (MIS) varied from .88 hectares in case of marginal to 1.39 hectares in case of large farmers. The details are presented in Table 4.8.

Table - 4.8 Average areas under PINS Project by farmer category

(Area in ha per hh)

Farmer category	Area under PINS (MIS)
Marginal (upto 2.50 ac)	0.88
Small (2.51 to 5.0 ac)	1.14
Medium (5.01 to 10.0)	1.13
Large (>10.0)	1.39
Total	1.11

Source: Field Survey

4.3.8 Adoption of micro-irrigation systems (MIS) under PINS programme:

Two types of MIS viz., drip and sprinkler systems are adopted as micro-irrigation systems under PINS programmes. All the 200 sample farmers are provided drip system and sprinkler system is provided only for five farmers. The per household total cost of the drip system is reported to be Rs. 1 lakh with a subsidy of 90 percent, while the per household total cost of sprinkler system is reported as Rs. 17,880 with a subsidy of 25 percent. The subsidy for both of the micro-irrigation systems is given by TSMIP (Telangana State Micro Irrigation Project) under the subsidy programme of PMKSY. The details can be viewed from the Table 4.9.

Table - 4.9 Adoptions of Micro Irrigation Systems (MIS) under PINS Programs

Type of MIS used	No. of farmers used	%.of farmers used	Average area under MIS (ha/hh)	Total cost of the system (Rs/hh)	Amount paid the farmers (Rs/hh)	Subsidy (%)	Who gives the subsidy*	Name of the subsidy programme
Drip system	200	100	1.11	100000	10000	90	TSMIP	PMKSY
Sprinkler	5	2.5	0.04	17880	4470	25	TSMIP	PMKSY

Source: Field Survey

4.3.9 The distribution of farmers according to subsidy received on MIS:

On the whole the per household amount spent by farmers on MIS is reported to be Rs. 8,443. The per household amount spent by 47.50 small farmers is reported as Rs. 8,674. The per household amount spent on MIS varied from Rs. 6,660 in case of marginal farmers to Rs. 10,000 in case of large farmers. The details can be viewed from Table 4.10.

Table - 4.10 Distribution of farmers according to subsidy received on MIS

Farmer category	Amount Spent by farmers (Rs) Per HH	No of farmers	% farmers
Marginal (upto 2.50 ac)	6660	47	23.50
Small (2.51 to 5.0 ac)	8674	95	47.50
Medium (5.01 to 10.0)	9063	32	16.00
Large (>10.0)	10000	26	13.00
All farmers	8443	200	100.00

Source: Field Survey

4.4 Reasons behind adoption of PINS:

There are three main reasons behind the adoption of PINS (MIS) programme. The first reason is to get assured amount of water for irrigation, 2. To get better and stable crop yield and farm income and 3. To save more water and to cover more area under irrigation. Out of the total 200 sample beneficiary farmers 67.50 percent of farmers reported that to get assured amount of water for irrigation is the most important reason behind the adoption of PINS programme. On the other hand, 25 percent of farmers reported that the reason is important, while 7.50 percent of farmers reported the reason is as least important. Moreover 65 percent of the farmers reported that the second reason is most important behind the adoption of PINS. Nearly 30 percent of farmers reported that the second reason as important, while only 5 percent expressed the reason as least important. About 55 percent of farmers expressed the third reason as most important behind the adoption of PINS programme. Alternatively 42.50 percent of farmers reported the third reason as important, while 2.50 percent of farmers reported the reason as least important. About 97 percent of farmers reported the reason of avoidance of unnecessary conflicts with the other farmers as least important reason, while all sample farmers reported the reason of facilitating judicious or efficient distribution of water among the water users as least important. The details can be viewed from the following Table 4.11.

Table - 4.11 Reasons behind adoption of PINS-MIS

(% of farmers agreed)

Reasons	Most Important	Important	Least important	Total
To get assured amount of water for irrigation	67.50	25.00	7.50	100.00 (200)
To get better and stable crop yield and farm income	65.00	30.00	5.00	100.00 (200)
To save more water and to cover more area under irrigation thereby	55.00	42.50	2.50	100.00 (200)
To avoid unnecessary conflicts with other farmers	0.00	3.00	97.00	100.00 (200)
To facilitate judicious or efficient distribution of water among the water users	0.00	0.00	100	100.00 (200)
Any other (please specify)	0.00	0.00	0.00	0.00

Source: Field Survey

4.5 Benefits accrued by participating in TUA:

Out of the total sample of beneficiary farmers 90 percent of the farmers reported to be benefitted by 56 percent of increase in area under irrigation. About 95 percent of farmers reported that their agricultural income has increased by 45 percent prior to participating in TUA. Moreover 94 percent of farmers reported that they have derived about 40 percent of increased water saving due to judicious use of water. Nearly 60 percent of farmers reported that they are benefitted by 48 percent of increase of electricity saving by participating in TUA. All the details can be observed from the Table 4.12.

Table - 4.12 Benefits accrued by participating in TUA

Benefits accrued	% farmers benefited	Extent of benefit (% increase)
Area under irrigation has increased	90.00	56.00
Agricultural income has increased	95.00	45.00
Water saving due to judicious use of water	94.00	40.00
Electricity saving	60.00	48.00
Water arrives in time	N.A	
Timely information on release of water from canal	N.A	
More information on how to use water judiciously	N.A	
proper distribution of water among farmers	N.A	
Less conflicts around water or less water theft	N.A	
More information on crops and technologies	N.A	
Improved maintenance of the system	N.A	
Any other	N.A	

Source: Field Survey

4.6. Farmers' awareness and perceptions about functioning of TUA:

Out of 200 sample beneficiary farmers forty numbers of farmers are participating in four TUAs of which one TUA is not functioning properly. As such the information was elicited from 30 beneficiary farmers participating in three TUAs.

About 15 percent of farmers have reported that they are aware of rules and regulations of TUA. The same percentage of farmers agreed to have acquainted with the office bearers of TUAs. All these farmers reported that they are paying operation and maintenance costs of MIS project and water rates regularly every month. The details can be observed from the following Table 4.13.

Table - 4.13 Farmers' awareness and perceptions about functioning of TUA

Particulars	% farmers with positive response
Do you know rules and regulations of TUA?	15.00
Do you know who the office bearers of TUA are?	15.00
Do you see any influence of political parties in selection of office bearers of TUA?	0.00
If yes, whether influential persons in TUA take all major decisions regarding activities of TUA?	0.00
Do you pay operation and maintenance cost of PINS (MIS) project and water rates regularly?	15.00
If Yes, It is paid:	
Annually	0.00
Half-yearly	0.00
Quarterly	0.00
Monthly	15.00
As and when required	0.00

Source: Field Survey

4.7. Planning and Installation of PIN & MIS:

All the total sample beneficiary farmers reported that the representatives of authorised dealers of manufacturer have installed MIS on their fields. All the sample beneficiary farmers have informed that the supply/purchase of MIS equipment's was through dealers (distributors appointed by manufacturers).

About 25 percent of farmers have reported that the fertigation and chemigation practices are followed on an average area of .68 hectares. About 25 percent micro-irrigated area of 50 farmers was supplied with insecticides/herbicides. All the sample beneficiary farmers invariably reported that water quality testing has been carried out prior to installation of MIS to their fields. The details can be viewed from the following Table 4.14.

Table - 4.14 Planning and Installation of MIS

Particulars	No of farmers agreed	% farmers agreed
(a) Agencies installed MIS on farmer's field:		
Representatives of authorized dealers of manufacturers (jain/netafin/Godavari/finolex)	200	100
Government Agency (/Extension Agency/ Irrigation Advisory Services/University)	0.00	0.00
Private consultants	0.00	0.00
Farmers themselves	0.00	0.00
Any other (please specify)	0.00	0.00
(b) Channel for supply/purchase of MIS equipment's/material:		
Through dealers (distributors appointed by manufacturers)	200	100
Through Govt. Agency	0.00	0.00
Through local market	0.00	0.00
(c) Fertigation and chemigation practices followed: If yes,	50	25.00
Average area under fertigation (ha)	0.68	-
Proportion of micro irrigated area supplied with insecticides/ herbicides	50	25.00
(d) Used saline water in MIS, If yes,	0.00	0.00
% of micro irrigated area affected by saline area	0.00	0.00
(e) water quality testing has been carried out prior to installation of MIS	200	100

Source: Field Survey

4.8 Operation and Maintenance costs incurred by farmers and PINS (MIS):

4.8.1 Annual operating cost of cultivation (A_2+FL) with MIS (Kharif):

The details of annual operating costs of cultivation with MIS for kharif season are presented in Table 4.15. The kharif crops grown by farmers are cotton, redgram, (inter crop), turmeric, soyabean, maize, ginger and chillies. The per hectare total costs of cultivation are reported to be higher in case of cotton, turmeric ginger and chillies crops. Across the crops the per hectare cost of cultivation varied from a low of Rs. 3,768 in case of redgram to a maximum of Rs. 1,82,974 in case of ginger.

Table 4.15: Annual operating cost of cultivation (A2+FL) with PINS-MIS (Kharif season)

(Rupees per ha)

Operating cost	Cotton	Red Gram (inter crop)	Turmeric	Soya been	Maize	Ginger	Chillie
Land preparatory work	5651 (8.77)	0 (0.00)	6400 (4.41)	4479 (13.43)	3089 (13.75)	6425 (3.51)	7104 (4.14)
Seed and seed sowing	4347 (6.74)	513 (13.61)	49139 (33.83)	4170 (12.50)	1853 (8.25)	61776 (33.76)	17606 (10.26)
Fertilizers/ FYM	13272 (20.59)	394 (10.46)	26831 (18.47)	7012 (21.03)	3089 (13.75)	35583 (19.45)	24710 (14.40)
Pesticides	14474 (22.45)	441 (11.70)	13487 (9.28)	1452 (4.35)	1853 (8.25)	18780 (10.26)	47568 (27.71)
Labour cost on fertilizer/pesticide application	3914 (6.07)	0 (0.00)	5276 (3.63)	2100 (6.30)	1500 (6.68)	4053 (2.22)	12849 (7.49)
Weeding and intercultural	6795 (10.54)	0 (0.00)	6454 (4.44)	3197 (9.59)	3089 (13.75)	10378 (5.67)	13282 (7.74)
Labour charges for irrigation	2428 (3.77)	0 (0.00)	3180 (2.19)	2131 (6.39)	2595 (11.55)	2965 (1.62)	1200 (0.70)
Harvesting cost	12330 (19.13)	2120 (56.26)	32489 (22.37)	8309 (24.91)	4942 (22.00)	41514 (22.69)	46332 (26.99)
Others	1250 (1.94)	300 (7.96)	2000 (1.38)	500 (1.50)	450 (2.00)	1500 (0.82)	1000 (0.58)
Total cost	64461 (100.00)	3768 (100.00)	145256 (100.00)	33350 (100.00)	22460 (100.00)	182974 (100.00)	171651 (100.00)

Note: Figures in parentheses are the percentages of total cost
Source: Field Survey

Table - 4.16 Annual operating cost of cultivation (A2+FL) with PINS-MIS (Rabi season)

(Rupees per ha)

Operating cost	Maize	Bengal gram	Green gram	Groundnut	Cucumber	Vegetables
Land preparatory work	6966 (17.79)	4324 (22.21)	4366 (9.59)	3089 (8.68)	24711 (16.08)	6981 (11.03)
Seed and seed sowing	6225 (15.90)	2595 (13.33)	3295 (7.24)	12355 (34.73)	36360 (23.65)	16371 (25.88)
Fertilisers/ FYM	9366 (23.92)	2224 (11.43)	5750 (12.63)	3459 (9.72)	27535 (17.91)	10811 (17.09)
Pesticides	2812 (7.18)	1606 (8.25)	8237 (18.09)	1853 (5.21)	14473 (9.42)	5436 (8.59)
Labour cost on fertiliser/pesticide application	2953 (7.54)	1236 (6.35)	3295 (7.24)	2471 (6.95)	5295 (3.44)	2780 (4.39)
Weeding and inter-culture	3165 (8.08)	927 (4.76)	7413 (16.28)	3089 (8.68)	25770 (16.77)	3089 (4.88)
Labour charges for irrigation	600 (1.53)	988 (5.08)	3295 (7.24)	1350 (3.79)	4942 (3.22)	2162 (3.42)
Harvesting cost	6566 (16.77)	5066 (26.02)	9061 (19.90)	7413 (20.84)	13626 (8.86)	15135 (23.92)
Others	500 (1.28)	500 (2.57)	824 (1.81)	500 (1.41)	1000 (0.65)	500 (0.79)
Total cost	39153 (100.00)	19466 (100.00)	45536 (100.00)	35579 (100.00)	153712 (100.00)	63265 (100.00)

Note: Figures in parentheses are the percentages of total cost
Source: Field Survey

4.8.2 Annual operating costs of cultivation with MIS (Rabi season):

The crops grown by farmers in rabi season are maize, bengal gram, green gram, groundnut, cucumber and vegetables. On an average the per hectare cost of cultivation reported from a low of Rs. 19,466 in case of bengal gram to a high of Rs. 1,53,712 in case of cucumber. The details of costs of respective crops can be viewed from the following Table 4.16.

4.8.3 Annual operating costs of cultivation with MIS (Perennial crops):

The Perennial crops grown by farmers are reported as sweet orange, pomegranate and papaya crops. On an average the per hectare cost of cultivation reported to be a high of Rs. 22,10,210 in case of sweet orange, while a low of Rs. 1,17,686 in case of papaya. The details can be observed from the following Table 4.17.

Table - 4.17 Annual operating cost of cultivation (A2+FL) with PINS-MIS (perennial crops)

(Rupees per ha)

Operating cost	Sweet orange	Pomegranate	Papaya
Land preparatory work	13664 (6.18)	6523 (5.03)	24711 (21.00)
Seed and seed sowing	42210 (19.08)	19500 (15.04)	37066 (31.50)
Fertilisers/ FYM	60925 (27.54)	25680 (19.81)	7413 (6.30)
Pesticides	42881 (19.38)	51896 (40.04)	12355 (10.50)
Labour cost on fertiliser/pesticide application	13313 (6.02)	6487 (5.00)	3707 (3.15)
Weeding and inter-culture	24685 (11.16)	8785 (6.78)	12355 (10.50)
Labour charges for irrigation	2628 (1.19)	1350 (1.04)	2417 (2.05)
Harvesting cost	17940 (8.11)	8250 (6.36)	16062 (13.65)
Others	2964 (1.34)	1150 (0.89)	1600 (1.36)
Total cost	221210 (100.00)	129621 (100.00)	117686 (100.00)

Note: Figures in parentheses are the percentages of total cost
Source: Field Survey

4.9 Impact of PINS with MIS an Cropping Pattern and Production:

4.9.1. Cropping Pattern:

Table - 4.18 Impact of MIS on Cropping Pattern of the Sample Households

(Area in ha, % of GCA)

Sl. No.	Season/ crop	Beneficiary Farmers		Non-beneficiary Farmers		Overall		% change in BF over NBF
		Area (ha)	% of total	Area in ha	% of total	Area in ha	% of total	
A	**Kharif crops**							
	paddy	0.285	8.77	0.150	6.17	0.240	8.12	90.00
	Jowar	0.028	0.86	0.030	1.23	0.028	0.95	-6.67
	Maize	0.144	4.43	0.000	0.00	0.096	3.25	NA
	Red gram	0.055	1.69	0.040	1.65	0.050	1.69	37.50
	Cotton	0.922	28.37	1.550	63.79	1.131	38.27	-40.52
	Turmeric	0.326	10.03	0.250	10.29	0.301	10.19	30.40
	Soya	0.056	1.72	0.130	5.35	0.082	2.77	-56.92
	ginger	0.051	1.57	0.000	0.00	0.034	1.15	N.A
	Chilli	0.049	1.51	0.030	1.23	0.043	1.46	63.33
	Vegetables	0.059	1.82	0.000	0.00	0.039	1.32	N.A
	Total Kharif Crops	1.973	60.71	2.180	89.71	2.043	69.14	-9.50
B	**Rabi crops:**							
	paddy	0.227	6.98	0.080	3.29	0.178	6.02	183.75
	Maize	0.141	4.34	0.020	0.82	0.101	3.41	605.00
	Jowar	0.051	1.57	0.000	0.00	0.034	1.15	N.A
	Bengal Gram	0.093	2.86	0.000	0.00	0.062	2.10	N.A
	Green Gram	0.099	3.05	0.020	0.82	0.073	2.46	395.00
	Red Gram	0.115	3.54	0.040	1.65	0.090	3.05	187.50
	Ground nut	0.190	5.85	0.040	1.65	0.140	4.74	375.00
	Cucumber	0.125	3.85	0.000	0.00	0.083	2.82	N.A
	Total Vegetable	0.053	1.63	0.010	0.41	0.039	1.31	430.00
	Total Rabi Crops	1.094	33.66	0.210	8.64	0.799	27.05	420.95
C	**Perennial crops :**							
	Sweet orange	0.066	2.03	0.04	1.65	0.066	2.23	65.00
	Papaya	0.034	1.05	0	0.00	0.034	1.15	N.A
	Pomegranate	0.013	0.40	0	0.00	0.013	0.43	N.A
	Total Perennial crops	0.183	5.63	0.04	1.65	0.113	3.81	357.50
D	**Gross cropped area :**	3.250	100.00	2.430	100.00	2.955	100.00	33.74

Source: Field Survey data.

The details of the cropping pattern under MIS for beneficiaries and the cropping pattern non-beneficiary farmers are presented in Table 4.18. Among the crops the beneficiary farmers utilized MIS for maize, redgram, cotton, turmeric, soya, ginger chillies and vegetable crops in kharif season, maize bengalgram, redgram, groundnut, cucumber and vegetable crops in rabi season and perennial crops like sweet orange, papaya, pomegranate crops. The area under kharif crops for beneficiary farmers is reported to be 1.973 hectares. On the other hand the area under rabi and perennial crops are reported to be 1.094 hectares and 0.183 hectares respectively. Glancing over non-beneficiary farmers, the area under kharif crops is reported to be 2.18 hectare, 0.210 hectares in rabi and negligible percentage of area was reported for perennial crops. Observing between beneficiary and non-beneficiary farmers the percentage change is reported as -9.50 percent for kharif crops and 420.95 per cent for rabi crops.

4.9.2 Production:

Table - 4.19 Production Pattern of the Sample Households

(Quintal/ha)

S.No	Season/crop	Beneficiary Farmers	Non-Beneficiary Farmers	% of change in BF over NBF
A	**Kharif crops:**			
	Paddy	32	26.25	21.90
	Jowar	6	4	50.00
	Maize	30	0	0.00
	Red gram	8	4	100.00
	Cotton	12	7	71.43
	Turmeric	32	25	28.00
	Soya	7	4.5	55.56
	ginger	20	0	0.00
	Chilli	40	28	42.86
	Vegetables	250	160	56.25
B	**Rabi crops:**			
	paddy	39	30	30.00
	Maize	40	21	90.48
	Jowar	5	0	0.00
	Bengal Gram	7	0	0.00
	Green Gram	5	3	66.67
	Red Gram	8	4	100.00
	Ground nut	12	8	50.00
	Cucumber	36	0	0.00
	Total Vegetable	280	200	40.00
C	**Perennial crops:**			
	Sweet orange	75	25	200.00
	Papaya	75	0	0.00
	Pomegranate	25	0	0.00

Source: Field Survey data.

The details of per hectare production of various crops grown by the beneficiary and non-beneficiary farmers are presented in Table 4.19. Observing between beneficiary and non-beneficiary farmers, the beneficiary farmers could achieve more production of respective crops and respective seasons than non-beneficiaries. Glancing over beneficiary and non-beneficiaries, the percentage change varied from 21.90 per cent in case of paddy to 100 per cent in case of redgram during kharif season. On the other hand, the percentage of change in beneficiaries over non-beneficiaries in achieving production ranged from 30 per cent in case of paddy to 100 per cent in case of redgram. The percentage change in beneficiaries over non-beneficiaries in case of sweet orange crop grown as perennial crop is reported to be 200 per cent.

4.10 Impact of MIS on irrigated cropped area:

The details of irrigated area under various crops in kharif and rabi seasons grown by beneficiary farmers are presented in Table 4.20. Out of the total per household irrigated area of kharif crops, 54.03 per cent of area is under drip irrigation. On the other hand, out of a total of .939 hectares, 51.13 per cent of area is under drip irrigation during rabi season. Moreover, out of 3.088 hectares of total irrigated area, 54.66 per cent of area is under perennial crops. The per household area of perennial crops varied between 0.019 hectares in case of pomegranate to 0.063 hectares in case of water melon.

4.11 Details of water used and impact on water saving:

Observing the difference in yield between drip irrigation and irrigated other than drip, the change has varied from 33.33 per cent in case of maize to 375 per cent in case of turmeric. All the crops under drip irrigation have achieved more per hectare production than the yield achieved under the other source of irrigation other than drip. This inferences that the beneficiary farmers benefitted by achieving more per hectare production through the drip irrigation system. The details can be observed from the Table 4.21.

Table - 4.20 Impact of MIS on irrigated cropped area

(ha/hh)

Sl. No.	Crops	Area under drip	Area other than drip	Total Irrigated area
A	**Kharif crops:**			
	paddy	0.000	0.285	0.285
	Jowar	0.000	0.028	0.028
	Maize	0.094	0.050	0.144
	Red gram	0.055	0.000	0.055
	Cotton	0.492	0.430	0.922
	Turmeric	0.211	0.115	0.326
	Soya	0.056	0.000	0.056
	ginger	0.051	0.000	0.051
	Chilli	0.049	0.000	0.049
	Vegetables	0.059	0.000	0.059
	Total Kharif Crops	1.067	0.908	1.975
B	**Rabi crops:**			
	paddy	0.000	0.227	0.227
	Maize	0.094	0.047	0.141
	Jowar	0.000	0.026	0.026
	Bengal Gram	0.043	0.025	0.068
	Green Gram	0.064	0.005	0.069
	Red Gram	0.050	0.015	0.065
	Ground nut	0.150	0.040	0.190
	Cucumber	0.063	0.062	0.125
	Total Vegetable	0.028	0.025	0.053
	Total Rabi Crops	0.429	0.410	0.839
C	**Perennial crops:**			
	Sweet orange	0.059	0.020	0.079
	Papaya	0.051	0.000	0.051
	Pomegranate	0.019	0.000	0.019
	Total Perennial crops	0.191	0.083	0.274
D	**Gross cropped area**	**1.688**	**1.400**	**3.088**

Source: Field Survey data.

Table - 4.21 Production Impacts of PINS with MIS

(Quintal/ha)

Major Crops	Drip (with PINS)	Canal/Flood/other irrigation (both PINS & Non-PINS)	%change in yield under drip over flood
Paddy	-	30	0.00
Jowar	-	5	0.00
Maize	40	30	33.33
Red gram	12	5	140.00
Cotton	15	8	87.50
Turmeric	38	8	375.00
Soya	8	5	60.00
Ginger	25	-	0.00
Chilli	50	30	66.67
Vegetables	300	220	36.36
Bengal Gram	7	-	0.00
Green Gram	5	3	66.67
Ground nut	15	8	87.50
Cucumber (tonnes/ha)	40	-	0.00
Sweet orange (tonnes/ha)	35	10	250.00
Papaya (tonnes/ha)	30	-	0.00
Pomegranate (tonnes/ha)	12	-	0.00

Source: Field Survey data.

4.12 Other economic, social and environmental benefits of PINS (MIS):

All the beneficiary farmers expressed the benefits received through installation of MIS in the following way. About 64 per cent of farmers reported that they are benefitted due to less maintenance costs compared to conventional flow of irrigation. Nearly 52 per cent of farmers reported that the frequency of maintenance is less compared to conventional flow of irrigation. The benefit of reduction in over extraction of ground water is reported by 89 per cent of the farmers. Moreover nearly 78 per cent of farmers expressed that the energy consumption is saved due to sharing through common pump set (MIS). About 91 per cent of farmers reported that the pressure on pump set/tube-well is reduced due to less extraction. Less water logging is reported by 34 per cent of farmers. While 47 per cent of farmers reported the reduced use of pesticides. The reduction in fertiliser use is reported by 51 per cent of farmers, while reduction in weeding costs is reported by 44 per cent of farmers. About 83 per cent of farmers reported that there is reduction in labour use, while 95 per cent of farmers reported the benefit of effective

allocation of water among farmers. All these details can be seen from the following Table 4.22.

Table - 4.22 Other Economic, Social and Environmental Benefits of PINS with MIS

(% farmers agreed)

Particulars	No. of farmers	% of farmers agreed
Cultivated land saved due to less need to construct field channels	0.00	0.00
Less maintenance cost compared to conventional flow irrigation	128	64.00
Frequency of maintenance is less compared to conventional flow irrigation	104	52.00
Reduction in over-extraction of ground water	178	89.00
Saving of energy consumption due to sharing through common pump set/PINS	152	76.00
Reduction in pressure on pump set/tube well due to less extraction	182	91.00
Less water logging or water salinity	68	34.00
Less pest attack/Reduced use of pesticides	94	47.00
Reduction in fertilizer use	102	51.00
Reduction in weeding cost	88	44.00
Reduction in labour use	166	83.00
Effective allocation of water among farmers	190	95.00
Reduction in migration of family members due to more availability in water	0.00	0.00
Increase in social cohesion among the water users/villagers in managing the water	0.00	0.00

Source: Field Survey data.

4.13 Factors responsible for benefits accrued from PINS and MIS:

Probit Model:

The beneficiary farmers have reported that the tube-well PINS has been very useful for them on various aspects such as increasing agricultural yield and Income, Water saving, Energy saving and reduction in fertiliser and pesticide use. In this connection an attempt has been made to analyse the determinants of benefits accrued from tube-well PINS using Probit Model. Table 4.23, 4.24, 4.25, and 4.26 presents the marginal effects of accessing benefits of PINS-MIS. The estimated wald chi-square test was found to be significant in all models, it implies that the explanatory variables taken as a group are quite significant in all explaining the benefits accrued from PINS-MIS.

It can be seen from the Table 4.23. that four explanatory variables are statistically found to be significant at different probability levels. Among the four independent variables, operational area and sufficient water are found to be significant at 10 and 1 per cent significant levels. The other two variables i.e., years of schooling and area under MIS are negatively associated with increasing agricultural yield and income at 5 per cent significance level.

For instance, a 1 per cent increase in operational area leads to a change in Increase of agricultural yield and income by 4 per cent. Similarly, a 1 per cent increase in quantity of water leads to an increase of 39.2 per cent in the agricultural yield and income. It can be observed from the results of the Table 4.24.b that the explanatory variables viz., adequate quantity of water, no interruption of power supply and operational area are found to be statistically significant at 1 and 10 per cent levels of probability. The marginal effects of the explanatory variables indicate that a 1 per cent increase in required amount of water, no interruption of power supply and operational area leads to a 33.5, 28.4 and 3.6 per cent increase respectively in the water saving.

Table – 4.23 Factors influencing Adoption of PINS (Probit model)

(Dependent variable: **Increasing agricultural Yield and Income**, Yes=1, No=0)					
Predictor Variables	Coefficient	Marginal effects	Std Error	Z value	Pr (>|z|)
Intercept	0.9189502	-	0.8078736	1.14	0.255
Age of the head of the household	0.0044454	0.0012018	0.0046255	0.26	0.795
Years of schooling	-0.0505926**	-0.0136776	0.0066036	-2.06	0.040
Agricultural experience of the household	-0.0199715	-0.0053993	0.0040699	-1.32	0.188
Amount of loan taken	0.00000071	0.00000019	0.00000025	0.74	0.460
Membership other than TUA	0.1081479	0.0292376	0.0562825	0.52	0.604
Operational area	0.1479781***	0.0400056	0.0208842	1.91	0.056
Area under MIS	-0.8992583**	-0.243113	0.0977887	-2.44	0.015
Sufficient of water	1.124813*	0.391829	0.129021	3.31	0.001
No interruption of power supply	0.0247131	0.0066789	0.059886	0.11	0.911
Pseudo R^2	0.1260	No. of observations =200			
LR Chi-square	26.24	Degree of freedom= 9			

Notes: Significance codes: *(1 percent), **(5 percent) and ***(10 percent)

Source: Computed (using STATA) from field data

Table – 4.24 Factors influencing Adoption of PINS (Probit model)

(Dependent variable: **Water saving**, Yes=1, No=0)					
Predictor Variables	Coefficient	Marginal effects	Std Error	Z value	Pr (>|z|)
Intercept	-0.1769451	-	0.8427434	-0.21	0.834
Age of the head of the household	-0.0014628	-0.0003467	0.0044765	-0.08	0.938
Years of schooling	-0.0354373	-0.0084003	0.0062874	-1.34	0.181
Agricultural experience of the household	-0.022687	-0.0053779	0.0039828	-1.33	0.182
Amount of loan taken	0.0000015	0.00000036	0.00000029	1.23	0.220
Membership other than TUA	0.0947472	0.0224596	0.0551865	0.41	0.684
Operational area	0.1522424***	0.0360887	0.0194528	1.87	0.062
Area under MIS	-0.1292414	-0.0306363	0.088684	-0.35	0.730
Sufficient of water	1.038382*	0.3353435	0.1373898	2.90	0.004
No interruption of power supply	1.217606*	0.2839204	0.055203	4.57	0.000
Pseudo R^2	0.2587	No. of observations =200			
LR Chi-square	54.51	Degree of freedom= 9			

Notes: Significance codes: *(1 percent), **(5 percent) and ***(10 percent)

Source: Computed (using R) from field data

The estimated results of the Table 4.25 indicate that only two explanatory variables are found to be significant at 1 and 5 per cent probability levels respectively. The marginal effects of these two variables are found to be positively associated with energy saving. Table 4.26 reveals that the explanatory variables, operational area and years of schooling are negatively associated with reduction in fertiliser and pesticide use at 1 and 5 per cent levels of significance.

Table- 4.25 Factors influencing Adoption of PINS (Probit model)

(Dependent variable: **Energy saving**, Yes=1, No=0)					
Predictor Variables	Coefficient	Marginal effects	Std Error	Z value	Pr (>|z|)
Intercept	0.0890256	-	0.8165671	0.11	0.913
Age of the head of the household	0.020666	0.0052689	0.0041021	1.27	0.202
Years of schooling	0.0007714	0. 0001967	0.0059207	0.03	0.974
Agricultural experience of the household	-0.0090451	-0.0023061	0.0036247	-0.63	0.527
Amount of loan taken	-0.0000000437	-0.000000011	0.00000022	-0.05	0.960
Membership other than TUA	-0.2026996	-0.0516789	0.0548757	-0.94	0.346
Operational area	0.4129459*	0.1052819	0.0298656	2.92	0.003
Area under MIS	-0.38722	-0.098723	0.0875414	-1.10	0.273
Sufficient of water	-0.2975995	-0.0673451	0.0814356	-0.73	0.468
No interruption of power supply	0.4673384**	0.1182558	0.0565936	2.09	0.036
Pseudo R^2	0.1211	No. of observations =200			
LR Chi-square	25.82	Degree of freedom= 9			

Notes: Significance codes*(1 percent), **(5 percent) and ***(10 percent)

Source: Computed (using R) from field data

Table-4.26 Factors influencing Adoption of PINS (Probit model)

(Dependent variable: **reduction in fertilizer and pesticide use**, Yes=1, No=0)					
Predictor Variables	Coefficient	Marginal effects	Std Error	Z value	Pr (>|z|)
Intercept	1.893867	-	1.162297	1.63	0.103
Age of the head of the household	0.0042596	0.0009861	0.0068373	0.15	0.884
Years of schooling	-0.0718293**	-0.0166282	0.0093713	-2.08	0.038
Agricultural experience of the household	-0.0241232	-0.0055844	0.0063841	-0.96	0.335
Amount of loan taken	-0.00000027	-0.0000000064	0.00000035	-0.19	0.853
Membership other than TUA	-0.3264313	-0.0755676	0.0836196	-0.94	0.345
Operational area	-0.9178227*	-0.2124724	0.0419628	-2.66	0.008
Area under MIS	0.4954701	0.1146994	0.1296801	0.80	0.424
Sufficient of water	Omitted due to collinearity				
No interruption of power supply	Omitted due to collinearity				
Pseudo R^2	0.2608	No. of observations =200			
LR Chi-square	28.31	Degree of freedom= 7			

Notes: Significance codes*(1 percent), **(5 percent) and ***(10 percent)

Source: Computed (using R) from field data

4.14. Farmers feedback to improve working and performance of PINS:

The beneficiary farmers expressed the various problems faced after adoption of PINS (MIS) on their fields. The major problem reported by about 55 per cent of farmers is energy supply to MIS. Nearly 22.50 per cent of farmers reported the problem of operation & maintenance on the other hand, 17.50 per cent of farmers reported the problem of planning & installation of MIS. About 15 per cent of farmers reported the problem of scheduling of micro-irrigation. A smaller percentage of farmers reported other problems which can be seen from the following Table 4.27.

Table - 4.27 Farmer's feedback on the problems faced after adoption of PINS-MIS

(% farmers agreed)

Particulars	Pvt-PINS
Planning and installation	17.50
Availability of suitable pump sets and system components	10.50
Getting subsidy for the system	7.50
Quality of various components	7.50
Testing of equipments	5.00
Water availability and quality	10.00
Energy supply to PINS-MIS	55.00
Operation and maintenance	22.50
Scheduling of micro-irrigation	15.00
Fertigation and Chemigation	5.00
After sale services by manufacturers	6.00
Damage from rodents (squirrels, rats etc) and insects etc.	5.00
Extension advisory services for farmers, especially for PINS-MIS	8.00
Training of farmers	10.00

Source: Field Survey data.

4.15 Suggestions by the farmers:

All the beneficiary and non-beneficiary farmers suggested the following points for the improvement of working and performance of PINS/MIS.

About 76.50 per cent of farmers suggested that the MIS subsidy is to be extended from one hectare to three hectare, while 85.50 per cent of farmers expressed the reduction in input price. Nearly 90 per cent of farmers wanted the availability of electricity regularly in day time. Nearly 92.50 per cent of farmers suggested the provision of subsidy for digging of bore-well to a group of farmers, while 75 per cent of farmers requested that the MSP is to be increased for all crops. Only 58 per cent of farmers asked for the provision of training and guidance for MIS. All the above details can be viewed from the Table 4.28.

Table 4.28. Farmer's suggestions to improve working and performance of PINS -MIS

Major Suggestions	% farmers agreed
MIS subsidy increase to 1 ha to 3 ha	76.50
Input price should be reduce	85.50
To avail electricity regular (day time)	90.00
To get training & Guidance for MIS	58.00
MSP	75.00
To give subsidy Digging of bore well to group of farmers	92.50

Source: Field Survey data.

4.16. Summary:

The average family size of beneficiaries is reported to be 4.42, while the family size of non-beneficiaries farmers is 4.23. On an average, the average number of years of experience is reported around 24. The average per household net operated area is reported to be 2.26 hectares of which 2.24 hectares is reported as owned land and 0.02 hectares is leased-in land. Observing between beneficiary and non-beneficiary farmers, beneficiary farmers have enjoyed more irrigational fertilities than non-beneficiary farmers.

The per household area under drip system is reported to be 1.12 hectares. On an average the per household total amount borrowed from all sources per beneficiary farmer is reported to be Rs. 10,23,879 and the outstanding loan amount is Rs.94,315. Moreover the per household total outstanding loan amount per non-beneficiary farmers is Rs. 1,17,667. On the whole, it is observed than there is no proper repayment of loan amount either by beneficiaries or by non-beneficiaries towards any source of credit. Out of the total sample of 149 beneficiaries, 89.26 per cent of farmers availed the loan for seasonal crop cultivation and 10.74 per cent of farmers spent the loan amount towards purchase of tractor and other implements. On the other hand out of 72 non-beneficiary farmers 83.33 per cent of farmers availed the loan for seasonal crop cultivation and 16.67 per cent of farmers utilized the loan amount for the purchase of tractor and other implements.

The higher percentage of area under irrigation is reported to be under tube-wells for both beneficiary and non-beneficiary farmers. The percentage of irrigated area for beneficiary farmers ranged from 0.35 per cent under tanks to 63.84 per cent under tube-well. On the other hand the percentage of irrigated area for non-beneficiaries ranged from 0.95 per cent under tanks to 62.98 per cent under tube-wells.

On an average the area under PINS (MIS) is reported to be 1.11 hectares. All the 200 sample farmers are provided drip system and the sprinkler system is provided only for five farmers. On the whole, the per household amount spent on MIS is reported to be Rs. 8,443. The per household spent on MIS varied from Rs. 6,660 in case of marginal farmers to Rs. 10,000 in case of large farmers.

These are three main reasons behind the adoption of PINS (MIS) programme. They are:

1. To get assured amount of water for irrigation.
2. To get better and stable crop yield and farm income and
3. To save more water and to cover more area under irrigation. All the sample beneficiary farmers are benefitted by participating in Tube-well User Association (TUA). Out of 200 sample beneficiary farmers, forty number of farmers are participatory in four TUA of which one TUA is not functioning properly.

All the total sample beneficiary farmers reported that the representatives of authorised dealers of manufacturing have installed MIS on their fields. All the sample beneficiary farmers invariably reported that water quality testing has been carried out prior to installation of MIS to their fields. Across the crops the per hectare cost of cultivation varied from a low of Rs. 3,768 in case of redgram to a maximum of Rs. 1,82,974 in case of ginger. On an average, the per hectare cost of cultivation in rabi season reported from a low of Rs. 19,466 in case of bengalgram to a high of Rs. 1,53,712 in case of cucumber. Moreover, the average per hectare cost of cultivation of perennial crops reported to be a high of Rs. 22,10,210 in case of sweet orange, while a low of Rs. 1,17,686 in case of papaya.

Observing between beneficiary and non-beneficiary farmers the percentage change in area is reported as -9.50 per cent for kharif crops and 420.95 per cent for rabi crops. Between beneficiary and non-beneficiary farmers, the beneficiary farmers could achieve more production of respective crops in respective seasons than the non-beneficiaries. Moreover the percentage of change in beneficiaries over non-beneficiaries in achieving production ranged from 30 per cent in case of paddy to 100 per cent in case of Redgram.

All the crops under drip irrigation have achieved more per hectare production than the yield achieved under the other sources of irrigation other than drip.

All the beneficiary farmers expressed that they are benefitted through installation of MIS:

1. by getting adequate water to their fields.
2. Reduction in over extraction of ground water

3. Saved energy consumption
4. Less water logging and
5. Less maintenance costs etc.,

The probit model analysis explains that among the explanatory variables the marginal effect of operated area is positively associated with increase in agricultural yield, income, water and energy saving but negatively associated with fertilizer and pesticide use. The positive association implies that due to the marginal effect of operated area, the yield, income, water and energies are saved to a significant level. On the other hand, the negative association inferences that the fertilizers and pesticides are being used more than the required doses. Hence the model finally explains that the positive change in required amount of water will be resulted in an increase in agricultural yield, income and energy saving to a significant level.

Majority of the beneficiaries expressed the problem of power supply to MIS and a few farmers reported the problem of operation and maintenance. Minimum percentage of farmers reported the problem of scheduling of micro-irrigation.

Majority of the farmers suggested that the MIS subsidy is to be extended from 1 hectare to 3 hectares and reduction in input price also. Almost all farmers suggested intermittent power supply.

* * *

CHAPTER – V

ADOPTION, PERFORMANCE AND MANAGEMENT OF PINS BY TUBEWELL USERS ASSOCIATIONS (TUAS):

5.1 Introduction:

Participatory Irrigation Management (PIM) refers to the involvement of irrigation users in all aspects and at all levels of irrigation management. In this system all irrigation users form into an association, discuss and design a proper plan for equal distribution of irrigation water to all levels of farmers. Since there are no government pressurised irrigation network systems connected to surface irrigation in Telangana, alternatively the farmers depend on tube-wells through which the pressurised irrigation network systems are implemented in the form of providing MIS programmes for their crops. The present chapter deals with the adoption, performance and management of PINS by tube-well user associations (TUAs).

5.2 Details of Associated PINS Project:

The average life span of PINS (associated with tube-well users associations) is about 7-8 years (if it is properly maintained the life spam of PINS may be upto 15 years. So the life span of PINS extended subject to the maintenance). All the sample farmers have reported to be under tube-wells as feeder source of irrigation. The total number of beneficiaries reported to be associated under minor irrigation project are 50 and the total area covered under PINS project by tube-well user associations are 137 acres. Out of total 50 members covered under four tube-well user Associations, only 40 beneficiaries, 10 each from each association are taken as sample for the analysis. About 65 percent of the tube-well users reported that their land in command area of the PINS project is moderately fertile, while 35 percent of the users reported to have less fertile land. All the sample farmers reported to have practiced crop rotation in their land. The crops grown during kharif (2015) are paddy, maize and turmeric while paddy, pulses and groundnut are grown during rabi season. All the above details can be viewed from the following Table 5.1.

Table - 5.1 Details of Associated PINS Project

Particulars	Pvt. PINS (SW/GW)
Average Life Span of the PINS (Years)	7-8
Feeder irrigation source (% distribution):	
Canal	-
Tube well	100
Tank	-
River	-
Any other	-
Type of the irrigation project (% distribution):	
Major	-
Medium	-
Minor	100
Total Area covered under the PINS Project TUA (acre)	137
Total number of beneficiaries of the Project/TUA	40
Nature of the land in the command area of PINS Project (% distribution):	
Very fertile	
Moderately fertile	65
Less fertile due to salinity	35
Less fertile due to water logging	
Less fertile since exposed to erosion/or for any other reason	
Type of cultivation practice:	
Plots periodically left fallow	
Zero or minimum tillage practiced on it	
Crop rotation practiced on it	100
Crops grown during Kharif (2015):	
Kharif crop1	Paddy
Kharif crop1	Maize
Kharif crop1	Turmeric
Crops grown during Rabi (2015-16)	
Rabi crop1	Paddy
Rabi crop1	Pulses
Rabicrop1	Groundnut

Source: Field Survey

5.3 Capital cost of PINS Equipments and Installations:

The details regarding the capital cost of PINS equipments and installations per TUA are presented in the following Table 5.2. Out of the total cost of Rs. 5,50,000 of the PINS system per TUA, 44.45 percent was invested on pumpsets and Power units, while 54.55 percent of the amount expended towards system layouts (main/sub-main PINS Pipes/PVC

Pipes). Moreover the per TUA installation cost is reported to be Rs. 60,000 of which 83.33 percent is expended towards installation of pumpsets and power units while 16.67 percent is towards system layouts. The service provided for pumpsets and power units is reported as one or two times per year, while the service for system layout is provided only once in a year. The above details can be observed from the following Table 5.2.

Table - 5.2

Initial capital cost on PINS equipments and installations (Rs) at TUA level

Category3: Pvt-PINS (SW/GW) **(Cost Per TUA)**

Sr. No.	PINS-MIS Equipments	Equipment Cost (Rs)	Installation Cost (Rs)	Periodicity of servicing received (Number per Year)
1	Water Supply System			
2	Pump Sets and power unit	2,50,000	50,000	1-2
3	Control Head/ control box	-	-	-
4	Storage Facility/ Wells	-	-	-
5	Filters/Filtration	-	-	-
6	**Water Supply System Subtotal**	2,50,000	50,000	1-2
7	System Layouts			
8	Main/Sub-main PINS pipes/PVC Pipes	3,00,000	10,000	1
9	Valves, Flush valves, Fittings and Bushings	-	-	-
10	**System Layouts Subtotal**	3,00,000	10,000	1
11	Automated Water control System, if any			
12	Monitoring Storage	-	-	-
13	Float device and float switch	-	-	-
14	Automation equipment	-	-	-
15	**Automated Water control System Subtotal**	**-**	**-**	**-**
16	**Total PINS System (Excluding MIS) (6+10+15)**	**5,50,000**	**60,000**	

Source: Field Survey

5.4. Annual operation and Maintenance cost of PINS:

Usually the operation and maintenance cost of PINS are electricity charges, repairing and maintenance of tube-wells. On an average, the total annual operation and maintenance cost of PINS per TUA accounts for Rs. 8,000/- of which 87.50 per cent towards repairing and maintenance of tube-wells and 12.50 per cent towards electrical charges. Generally the

maintenance works will be undertaken once in a year. The details can be seen from the following Table 5.3.

Table - 5.3
Annual Operation and Maintenance Cost on PINS

Category3: Pvt-PINS (SW/GW)

Heads of expenses	Expenses (Rs)
Electricity Charges	2000
Repairing/Maintenance of tube well/canal PINS	14000
Other Expenses	-
Total annual Operation and Maintenance Cost on PINS (Rs):	16000
Frequency of maintenance works undertaken (Number/Year):	1

Source: Field Survey

5.5. Details of PINS Tube-well Users Association:

The PINS programmes under TUA are all organised by non-governmental organisation (NGO). All the members of four TUAs unanimously reported that the facilitator for formation of TUAs is NGO. While enquiring the members of TUAs about their satisfaction towards the facilitator, 55 percent have reported that they have good satisfaction about the facilitator, 30 percent of the members reported average satisfaction and 20 percent of the members reported poor satisfaction. The total number of user members in four TUAs together reported to be 50. The details can be viewed from the following Table 5.4.

Table - 5.4
Details of PINS- Tube-well Users Association (TUA) (N=4)

(TUA agreed (%))

Particulars	Pvt. PINS (SW/GW)
(a) Who acted as facilitator/catalyst for formation of TUA/TUA	
Government Department Official	
NGO	100
Community Organiser	
Any Other	
(b)Satisfaction over the facilitator:	
Good	50
Average	30
Poor	20
(c) Number of members of TUA/TUA (No/TUA)	50
(d) Number of farmers having land in the PINS Command area but did not become the member of TUA (No/TUA):	-
(e)Reasons of their not joining the TUA/TUA:	-
Don't want to pay anything for PINS Project	-
PINS Project implementation was defective	-
Getting water from other sources	-
Not satisfied with office bearers of TUA/TUA	-
Belongs to opposite political parties	-
Don't want to carry out any agricultural operations on their plots	-
Don't see agriculture remunerative	-
Any other	-
(f) Number of non-members of TUA/TUA who avails the facilities of PINS Project	-

Source: Field Survey

5.6. Functioning and Activities of TUA:

A) Functioning: Twelve general body meetings were conducted during 2015-16 per TUA. Six decisions were taken in the meeting during 2015-16 of which five decisions were implemented. All the water users expressed the need of assistance from NGO. These details can be observed from the Table 5.5.

Table - 5.5
Some aspects of functioning of PINS TUA

(Responses by TUA office bearers)

Particulars	Pvt. PINS (SW/GW)
(a) No. of General Body meetings conducted during 2015-16 (No/TUA)	12
(b) No. of decisions taken in the meetings during 2015-16	6
(c) No. of decisions implemented during 2015-16	5
Is there any influence of political parties in selection of office bearers of TUA (% agreed)	No
If yes, whether influential persons in TUA take all major decisions regarding activities of TUA? (% agreed)	No
Was there any rehabilitation problems generated by Installation of PINS Project (% agreed)	No
If yes, who did the rehabilitation or construction? :	No
Contractor	No
WU A	
(c) Does TUA need any assistance for its Management? (% agreed)	100
If Yes, from whom:	
Government	
NGO	NGO
CBOs	
Others	
Does the TUA get any annual matching grant from Government for operation and maintenance of PINS project? If Yes,	No
mention the amount (Rs/TUA :	-

Source: Field Survey

b) Activities: All the water users under TUAs, expressed their preferences in the following way. The first preference is given to the decision of timely water release, while the second preference is judicious water distribution, operation and maintenance of PINS project is given third preference and collection of per capita operation and maintenance cost as fourth preference. Ultimately the final preference is towards collection of water rates. The details can be observed from the following Table 5.6.

Table - 5.6
Major activities of PINS TUA

(Ranks)

Major activities	Pvt. PINS (SW/GW)
Operation & Maintenance of PINS Project	3
Deciding the timing of water release	1
Judicious water distribution	2
Collection of water rates	5
Collection of per capita operation and maintenance cost	4
Dispute settlements	-
Seed or Fertiliser distribution	-
Produce collection	-
Money lending to members	-
Any other	-

Source: Field Survey

5.7. Details of income and expenditure of TUA:

The details of income and expenditure of four TUAs for three years viz., 2013-14, 2014-15, and 2015-16 are presented in Table 5.7. During 2013-14 and 2014-15 there was only one TUA functioning. During 2015-16 two more TUAs were formed. Therefore the income and expenditure were furnished for one TUA in 2013-14 and 2014-15 and during 2015-16 the amounts were given for three TUAs together. The inflow of income is due to collection of annual maintenance fees while the outflow of income is through expenditure on electricity bill and repairing expenses. The surplus income amounts will be utilised for the unexpected future maintenance costs. The details can be viewed form the Table 5.7.

Table - 5.7
Details of income and expenditure of TUAs
Category3: Pvt-PINS (SW/GW): (Amount in rupees)

Particulars	2013-14	2014-15	2015-16
Inflow to the account (Income)			
Water rate collection	-	-	-
Annual maintenance fees collected	12000	12000	36000
Annual electricity/diesel fees collected	-	-	-
Earnings from business activities of the TUA, if any (e.g., sale of fertilizers)	-	-	-
Interest income	-	-	-
Loans from banks or individuals	-	-	-
Any other	-	-	-
Total Income	12000	12000	36000
Outflow from the account (Expenses)			
Charges to Irrigation Department	-	-	-
Expenditure on electricity bill	1000	1000	3000
Repairing expenses	5000	7500	23500
Salary expenses	-	-	-
Travel and Conveyance expenditure	-	-	-
Audit expenses	-	-	-
Loan repayment/interests paid	-	-	-
Office rent	-	-	-
Miscellaneous expenses	-	-	-
Any other	-	-	-
Total Expenditure	6000	8500	26500

Source: Field Survey

5.8. Relationship of TUA with related organizations:

While collecting the information regarding the relationship of TUA with related organisations the TUA office bearers responded in the following way. The office bearers of TUA expressed their relationship with Public Works Department (PWD) as follows. 21 percent of office bearers reported good relationship, while 52 percent of office bearers reported average relationship with public works department. Only 27 percent of office bears reported poor relationship with PWD. About 58 percent of the office bearers reported good relationship with irrigation department, while 42 percent of the office bearers reported average relationship. Moreover, 45 percent of the office bearers reported good relationship with department of agriculture, while 40 per cent of the office bearers reported average relationship. Only 15 percent of the office bearers reported poor relationship with the agriculture department. The details can be observed in the following Table 5.8.

Table - 5.8
Relationship with the Government Departments and Other Organizations

(% TUA office bearer agreed)

Particulars	Good	Average	Poor
Public Works Department	21.00	52.00	27.00
Irrigation Department	58.00	42.00	0.00
Department of Agriculture	45.00	40.00	15.00

Source: Field Survey

5.9 Water Resource Management by TUA:

The office bearers of TUAs expressed that about 66.67 percent of management is transferred to TUAs and remaining 33.33 percent of management is under the control of individual farmers. All 66.67 percent of office bearers reported that the water rates and operation and maintenance cost of PINS project are being collected by TUA and all the TUA members are paying operation and maintenance cost of PINS project and water rates regularly. The operation and maintenance costs of PINS project are being collected monthly. On the whole it inferences that those members that are involved in TUAs only are being regular in maintaining or paying water rates regularly, while those farmers who are under the control of management of individual farmers are not regular. All the above details are furnished in the following Table 5.9.

Table - 5.9
Water Resource Management by TUA

(% TUA office bearer agreed)

Particulars	Pvt. PINS (SW/GW)
Is the Irrigation Management Transferred to TUA?	66.67
Who does the water distribution? :	
TUA	66.67
Individual farmers	33.33
Is the water rates and the operation and maintenance cost of PINS project are being collected by TUA?	66.67
Whether the operation and maintenance cost of PINS project and water rates are paid by its member regularly?	66.67
If Yes, periodicity of its collection the operation and maintenance cost of PINS project:	
Annually	-
half-yearly	-
Quarterly	-
monthly (As and when required)	66.67

Source: Field Survey

Out of four TUAs, one TUA consisting of 10 members is not functioning properly. As a result, the PINS Project was not implemented properly. This TUA may be referred to that which was under the management of individual farmers. The reasons for non-payment operation and maintenance cost of PINS are presented in the following Table 5.10.

Table - 5.10
Reasons for non-payment of operation and maintenance costs of PINS (N =10)

(% TUA office bearer agreed)

Reasons	Pvt. PINS (SW/GW)
Did not get enough water	-
MIS system did not work	-
PINS Project implementation was defective and did not work (one TUA)	100.00
Not satisfied with maintenance of the system (one TUA)	100.00
Crop failure due to natural calamities	-
Crop failure due to pest attack	-
Crop output was not sold in time	-
Good price of crop output was not realized	-
Heavy household consumption	-
Any other (please mention)	-

Source: Field Survey

5.10 Benefits provided by TUA to its members:

About 66.67 percent of office bearers (of three TUAs) reported that due to the farmers formation into TUAs the following benefits could receive by the farmers. They are:

1. Timely release of water to their fields and judicious use of water.

2. Improved maintenance of the system.

3. More information on crops and technologies and thereby improved quality of ground water due to less extraction compared to pre - TUA periods. The details can be viewed from the following Table 5.11.

Table - 5.11
Benefits accrued by the members of TUA

(% TUA office bearer agreed)

Benefits accrued	Pvt. PINS (SW/GW)
Water arrives in time	66.67
Timely information on release of water from canal	-
More information on how to use water judiciously	66.67
proper distribution of water among farmers	66.67
Less conflicts around water or less water theft	-
More information on crops and technologies	66.67
Improved maintenance of the system	66.67
Environmental problems such as water logging and salinity resolved compared to pre-TUA period	-
Quality of groundwater improved due to less extraction compared to pre-TUA period	66.67
Enhanced financial situation	
Any other	-

Source: Field Survey

5.11 Constraints in operation and maintenance of PINS at TUA level:

5.11.1 Sufficiency of Irrigation Water per TUA members:

About 66.67 percent of TUA members reported to have received sufficient water throughout the year. However, some of the users of water reported that they have suffered due to inadequacy water during three months on an average in a year.

Table - 5.12
Sufficiency of irrigation water for the TUA members

Particulars	Pvt. PINS (SW/GW)
Do **TUA members** get sufficient water throughout the year (% TUA members agreed)	66.67
If No, Average no. of months of insufficient water	3

Source: Field Survey

5.11.2 Reasons for inadequate supply of water to the farm plots:

The members of four TUAs have reported some reasons for inadequate supply of water to their farm plots. About 66.67 percent of water users reported that the availability of water in tube-well is inadequate. Nearly 33.33 percent of water users reported that the PINS system is not functioning properly and also due to improper management of PINS system, they received inadequate water to their farm plots. Non-payment of water rates and maintenance charges by the members is also another reason for getting inadequate supply of water to their fields. Moreover all the water users unanimously agreed that due to poor rainfall they could not get sufficient water to their fields. All these details can be observed by the following Table 5.13.

Table 5.13
Reasons for inadequate supply of water to the farm plot (N = 40)
(% TUA office bearer agreed)

Reasons	Pvt. PINS (SW/GW)
Water availability is inadequate in canal/tube well	66.67
PINS system is not functioning properly.	33.33
PINS system was not managed properly.	33.33
Non-payment of water rate and maintenance charges by the member	33.33
Unresolved conflicts among TUA members	-
Poor rainfall	100
Any other (please mention)	-

Source: Field Survey

5.11.3 Causes of conflicts among water users:

No conflicts or causes of conflicts among water users are reported.

5.12. Major problems faced by the TUAs:

There are several problems faced by the TUAs in implementing the PINS programmes. Among the problems, 32 percent of the problems arose out of fund constraints. Nearly 40 percent of the problems are due to water availability. About 18 percent of the problems are due to maintenance and repair of PINS and only 10 percent of the problems arose due to poor participation of TUAs' members.

Table 5.14

Major problems faced by the TUA

(% TUA office bearer agreed)

Constraints	Pvt. PINS (SW/GW)
Fund constraints	32.00
Water availability	40.00
Maintenance and repair of PINS	18.00
Support from Govt.	--
Poor participation of TUA members	10.00
Non-participation of farmers in the command area	--
Unsolved conflicts	--
Political interference	--
Any other(please mention)	--

Source: Field Survey

5.13. Trends in Constraints faced by TUA:

5.13.1 Constraints before TUA formation:

Nearly 70 percent of the users reported that there was less water logging problems, while 30 percent of the users reported no water logging problem. Almost all water users agreed that there was no salinity in water, no dug well pollution, no groundwater pollution and no problem in crop yields. About 20 percent of the users reported more labour problems, while 30 percent of the users reported less labour problems. 50 percent of the users reported that there were no labour problems. About 50 percent of the water users reported that there were no problems in crop yields, while 40 percent of the users reported that there are less problems in crop yields.

5.13.2 Constraints after TUA formation:

All the Water Users reported that there are no constraints of water logging, salinity, inter and intra village conflicts and crop yields after formation into TUAs. However only 15 percent of users reported labour problems. These inferences that the water users of TUAs received better results after formation into TUAs.

Table - 5.15

Trends in constraints faced by the TUA

Category3: Pvt-PINS (SW/GW): (% TUA office bearer agreed)

Constraints	More	Less	No
Before TUA formation:			
Water logging	0.00	70.00	30.00
Salinity	0.00	0.00	100.00
Tank /dug well pollution	0.00	0.00	100.00
Groundwater pollution	0.00	0.00	100.00
Labour problems	20.00	30.00	50.00
Inter and Intra village conflicts	0.00	0.00	100.00
Crop yields	10.00	40.00	50.00
Irrigated area (Ha)	295.00		
Value of Agricultural production (Rs/Ha)	12655		
After TUA formation:			
Water logging	0.00	0.00	100.00
Salinity	0.00	0.00	100.00
Tank /dug well pollution	0.00	0.00	100.00
Groundwater pollution	0.00	0.00	100.00
Labour problems	0.00	15.00	85.00
Inter and Intra village conflicts	0.00	0.00	100.00
Crop yields	0.00	0.00	100.00
Irrigated area (Ha)	432.00		
Value of Agricultural production (Rs/Ha)	52698		

Source: Field Survey

5.14 Summary and Conclusions:

The average life span of PINS is about 7-8 years (if it is properly maintained the life spam of PINS may be up to 15 years. So the life span of PINS extended subject to the maintenance). About 65 per cent of tube-well users reported that their land in command area of the PINS project is moderately fertile, while 35 per cent of the users reported to have less fertile land. All sample farmers followed crop rotation.

Out of the total cost of Rs. 5,50,000 of the PINS system per TUAs, 44.45 per cent was invested on pumpsets and power units, while 54.55 per cent of the amount expended towards system layouts. Moreover the per TUA installation cost is reported to be Rs. 60,000 of which 83.33 per cent is expended towards installation of pumpsets and power units, while 16.67 per cent is towards system layouts.

On an average, the total annual operation and maintenance cost of PINS per TUA accounts for Rs. 8,000 of which 87.50 per cent towards repairing and maintenance of tube-wells and 12.50 per cent towards electrical charges.

While enquiring the members of TUAs about their satisfaction towards the facilitator (NGO), 55 per cent have reported that they have good satisfaction about the facilitator, 30 per cent of the members reported average satisfaction and 20 per cent of the members reported poor satisfaction.

Six decisions were taken in twelve general body meetings conducted during 2015-16 of which five decisions were implemented. All the water users expressed the need of assistance from NGO.

The inflow of income is due to collection of annual maintenance fees, while the outflow of income is through expenditure on electricity bill and repairing expenses.

About 58 per cent of the office bearers reported good relationship with irrigation department, while 42 per cent of the bearers reported average relationship. Moreover, 45 per cent of the office bearers reported good relationship with department of agriculture, while 40 per cent of the office bearers reported average relationship.

The office bearers of TUAs expressed that about 66.67 per cent of management is transferred to TUAs and remaining 33.33 per cent of management is under the control of individual farmers. Those farmers that are involved in TUAs only are being regular in maintaining or paying water rates regularly, while those farmers who are under the control of management of individual farmers are not regular. Out of four TUAs, one TUA consisting of ten members is not functioning properly. As a result, the PINS project was not implemented properly.

Due to formation into TUAs the farmers could receive three benefits viz., 1. Timely release of water to their fields and Judicious use of water, 2. Improved maintenance of the system, 3. More information on crops and technologies and thereby improved quality of ground water due to less extraction compared to pre-TUA periods.

About 66.67 per cent of TUA members reported to have received sufficient water throughout the year. Nearly 33.33 per cent of water users reported that the PINS system is not functioning properly and also due to improper management of PINS system, they received inadequate water to their farm plots. Non-payment of water rates and maintenance charges by the members is also another reason for getting inadequate supply of water to their fields.

Among the problems faced by the TUAs, 32 per cent of the problems arose out of the fund constraints. Nearly 40 per cent of the problems are due to water availability. About 18 per cent of the problems are due to maintenance and repair of PINS and only 10 per cent of the problems arose due to poor participation of TUAs' members.

Nearly 70 per cent of the users reported that there is less water logging problem prior to formation into TUA. Almost all water users agreed that there was no salinity in water, dug well pollution, ground water pollution and crop yields. 50 per cent of the users reported that there were no labour problems and no problems in crop yields.

All the water users reported that there are no constraints of water logging, salinity, inter and intra village conflicts and crop yields after formation into TUAs. All the water users of TUAs received better results after formation into TUAs than pre-TUA period.

* * *

CHAPTER – VI

SUMMARY AND CONCLUSIONS

6.1. Introduction:

A pressurized irrigation system is a network installation consisting of pipes, fittings and other devices properly designed and installed to supply water under pressure from the source of the water to the irrigable area. In this system of irrigation water is pressurized, supplied to farm field that uses MIS (Micro-Irrigation System) such as drip and sprinkler and thus precisely applied to the plants under pressure through a system of pipes. Pressurized irrigation systems as opposed to the surface irrigation systems, are more effective in water saving and in increasing area under irrigation. These systems provide improved farm distribution, improved control over timing and reduced wastage of land in laying field distribution network, reduced demand for labour and better use of limited water resources.

6.1.1. The objectives of the presented study are:

a. To analyse various private PINS programmes implemented in the selected districts of Telangana;
b. To assess the extent of adoption and performance of PINs in different scenarios;
c. To analyse the arrangements for management, operation and maintenance of private PINs;
d. To identify the major constraints in adoption management, operation and maintenance of PINs and
e. To recommend suitable policy measures to enhance the effectiveness and techno-economic performance of private PINs.

6.1.2. Limitation of the study:

Since there are no other public PINs programmes available in Telangana state, alternatively the sample size was taken from private PINs with MIS (Micro Irrigation Systems) with a condition of sharing each system by two or three farmers. In this connection the available beneficiary and non-beneficiary households in each district were taken as sample.

The present study is analysed through both secondary and primary data. The primary data is collected from beneficiary and non-beneficiary households in four selected districts viz., Vikarabad, Adilabad, Nirmal and Nalgonda. As said earlier the available beneficiary and non-beneficiary households, in each district are canvased to account to a total sample of 200 beneficiaries and 100 non-beneficiaries for the study in the state of Telangana.

The present study is divided into six chapters. The first being the introductory chapter, the second chapter deals with irrigation development and management in Telangana. Overview of PINs programmes in Telangana is presented in chapter three, while adoption, performance and management of PINs by farmers are presented in chapter four. The fifth chapter deals with the adoption, performance and management of PINs by Water Users' Associations (WUAs) and finally chapter six provides conclusions and Policy implications.

6.2. Summary and Findings:

6.2.1. Irrigation Development and Management in Telangana:

Out of the total geographical area 40.5 per cent is net area sown, 23.9 per cent is under forests 10.5 per cent is under current fallows 7.7 per cent of area is towards non-agricultural uses and 5.4 per cent of area is barren and uncultivable land. The net cropped area is 46.54 lakh hectares. The influence of south-west monsoon is predominant. The increase in intensity of irrigation between 2010-13 and 2013-16 is 1.86 per cent. Due to inadequate water supply from different sources of irrigation the land cannot be substantially irrigated in the second season of the crop. The intensity of cropping is decreased by -2.77 per cent between 2010-13 and 2013-16. The reason may be attributed to the failure of some irrigation sources all over the state. The reason may be accelerated growth in the second sub-period, might be the result of the renovation tanks and creation of new ground water was due to lack of rainfall or inadequate rainfall. Observing across the sources, it is observed that the area under tanks, tube-wells and other sources has decreased from 2005-06 to 2010-11. The reason for the decrease in area may be attributed to the disrepair state of tanks and failure of tube-wells and other sources.

It is observed that the number of farmers used drip has increased in 2015-16 by 76.13 per cent while the number of farmers used sprinkler system has decreased by 27.84

per cent in 2015-16. The reason for the decrease in the number of sprinkler systems is the problems in maintenance of the sprinkler system. Moreover, the area under drip irrigation system has increased by 81.45 per cent while the area under sprinkler system has decreased by -28.29 per cent from 2014-15 to 2015-16. Across the districts, the area under drip irrigation has increased in all the districts from 2014-15 to 2015-16. On the other hand the area under sprinkler irrigation system has substantially decreased from 2014-15 to 2015-16 in all districts a except in Mahaboobnagar and Nizamabad districts.

In view of formation of Telangana state on 2nd June, 2014 the proposals for adopting the APFMIS Act, 1997 for implementation of Participatory Irrigation Management in Telangana state is under process.

6.2.2. Overview of PINS Programmes in Telangana:

The MIS scheme was installed and implemented by twelve private agencies. From 2014 onwards the MIP scheme (NMMI) was subsumed into National Mission for Sustainable Agriculture (NMSA) as one of the component as on Farm Water Management (OFWM) and the modal department is agriculture department (HOD).

Out of 17.12 lakh hectares of net irrigated area irrigated with ground water only 5.73 lakh hectares are covered under micro-irrigation, leaving a balance potential of 11.39 lakh hectares for micro-irrigation. In all the districts the MIP projects through MIS scheme connecting to tube-well irrigation are implemented. About 5,50,212 numbers of micro-irrigation systems were installed with a coverage of area of 5,50,212 hectares the total number of beneficiaries being 2,96,436.

The drip system of MIS is provided for cotton crop with a total initial fixed cost of Rs. 1,06,120 of which 10.612 is given subsidy for BCs small/marginal farmers and for others the subsidy is given to a maximum of Rs. 21,224. Moreover, the sprinkler irrigation system of MIS is provided for groundnut crop with a total fixed cost of Rs. 17,880 of which Rs. 4,470 is given as subsidy for SC/ST, BCs small/marginal and for others. MI project in Telangana is mainly based on well and tube-well irrigated areas. The mechanism of supply/purchase of MIS equipments/material installations on fields are all through the empanelled MI companies. The area under fertigation is approximately 10 per cent of the sanctioned area in the state. A total of 2,96,434 farmers are benefitted through MIP covering an area of 5,50,212 hectares in the state. The percentage of saving of water varied from 49 per cent

in case of tomato to 54 per cent in case of Vegetables and sugarcane. On the other hand, the percentage of energy saved from a low of 49 per cent in case of tomato to 54 per cent in case of Vegetables and sugarcane.

6.2.3. Adoption, Performance and Management of PINS (MIS) by Farmers:

The average family size of beneficiaries is reported to be 4.42, while the family size of non-beneficiaries farmers is 4.23. On an average, the average number of years of experience is reported around 24. The average per household net operated area is reported to be 2.26 hectares of which 2.24 hectares is reported as owned land and 0.02 hectares is leased-in land. Observing between beneficiary and non-beneficiary farmers, beneficiary farmers have enjoyed more irrigational facilities than non-beneficiary farmers.

The per household area under drip system is reported to be 1.12 hectares. On an average the per household total amount borrowed from all sources per beneficiary farmer is reported to be Rs. 10,23,879 and the outstanding loan amount is Rs.94,315. Moreover the per household total outstanding loan amount per non-beneficiary farmers is Rs. 1,17,667. On the whole, it is observed than there is no proper repayment of loan amount either by beneficiaries or by non-beneficiaries towards any source of credit. Out of the total sample of 149 beneficiaries, 89.26 per cent of farmers availed the loan for seasonal crop cultivation and 10.74 per cent of farmers spent the loan amount towards purchase of tractor and other implements. On the other hand out of 72 non-beneficiary farmers 83.33 per cent of farmers availed the loan for seasonal crop cultivation and 16.67 per cent of farmers utilized the loan amount for the purchase of tractor and other implements.

The higher percentage of area under irrigation is reported to be under tube-wells for both beneficiary and non-beneficiary farmers. The percentage of irrigated area for beneficiary farmers ranged from 0.35 per cent under tanks to 63.84 per cent under tube-well. On the other hand the percentage of irrigated area for non-beneficiaries ranged from 0.95 per cent under tanks to 62.98 per cent under tube-wells.

On an average the area under PINS(MIS) is reported to be 1.11 hectares. All the 200 sample farmers are provided drip system and the sprinkler system is provided only for five farmers. On the whole, the per household amount spent on MIS is reported to be Rs. 8,443. The per household spent on MIS varied from Rs. 6,660 in case of marginal farmers to Rs. 10,000 in case of large farmers.

There are three main reasons behind the adoption of PINS (MIS) programme. They are:

1. To get assured amount of water for irrigation.
2. To get better and stable crop yield and farm income and
3. To save more water and to cover more area under irrigation. All the sample beneficiary farmers are benefitted by participating in Tube-well User Association (TUA). Out of 200 sample beneficiary farmers, forty number of farmers are participatory in four TUA of which one TUA is not functioning properly.

All the total sample beneficiary farmers reported that the representatives of authorised dealers of manufacturing have installed MIS on their fields. All the sample beneficiary farmers invariably reported that water quality testing has been carried out prior to installation of MIS to their fields. Across the crops the per hectare cost of cultivation varied from a low of Rs. 3,768 in case of redgram to a maximum of Rs. 1,82,974 in case of ginger. On an average, the per hectare cost of cultivation in rabi season reported from a low of Rs. 19,466 in case of bengalgram to a high of Rs. 1,53,712 in case of cucumber. Moreover, the average per hectare cost of cultivation of perennial crops reported to be a high of Rs. 22,10,210 in case of sweet orange, while a low of Rs. 1,17,686 in case of papaya.

Observing between beneficiary and non-beneficiary farmers the percentage change in area is reported as -9.50 per cent for kharif crops and 420.95 per cent for rabi crops. Between beneficiary and non-beneficiary farmers, the beneficiary farmers could achieve more production of respective crops in respective seasons than the non-beneficiaries. Moreover the percentage of change in beneficiaries over non-beneficiaries in achieving production ranged from 30 per cent in case of paddy to 100 per cent in case of Redgram.

All the crops under drip irrigation have achieved more per hectare production than the yield achieved under the other sources of irrigation other than drip.

All the beneficiary farmers expressed that they are benefitted through installation of MIS:

1. by getting adequate water to their fields.
2. Reduction in over extraction of ground water
3. Saved energy consumption
4. Less water logging and
5. Less maintenance costs etc.,

The probit model analysis explains that among the explanatory variables the marginal effect of operated area is positively associated with increase in agricultural yield, income, water and energy saving but negatively associated with fertilizer and pesticide use. The positive association implies that due to the marginal effect of operated area, the yield, income, water and energies are saved to a significant level. On the other hand, the negative association inferences that the fertilizers and pesticides are being used more than the required doses. Hence the model finally explains that the positive change in required amount of water will be resulted in an increase in agricultural yield, income and energy saving to a significant level.

Majority of the beneficiaries expressed the problem of power supply to MIS and a few farmers reported the problem of operation and maintenance. Minimum percentage of farmers reported the problem of scheduling of micro-irrigation.

Majority of the farmers suggested that the MIS subsidy is to be extended from 1 hectare to 3 hectares and reduction in input price also. Almost all farmers suggested intermittent power supply.

6.2.4. Adoption, Performance and Management of PINS (MIS) By Tube-well Users Associations (TUAs):

The average life span of PINS is about 7-8 years (if it is properly maintained the life spam of PINS may be up to 15 years. So the life span of PINS extended subject to the maintenance). About 65 per cent of tube-well users reported that their land in command area of the PINS project is moderately fertile, while 35 per cent of the users reported to have less fertile land. All sample farmers followed crop rotation.

Out of the total cost of Rs. 5,50,000 of the PINS system per TUAs, 44.45 per cent was invested on pump sets and power units, while 54.55 per cent of the amount expended towards system layouts. Moreover the per TUA installation cost is reported to be Rs. 60,000 of which 83.33 per cent is expended towards installation of pump sets and power units, while 16.67 per cent is towards system layouts.

On an average, the total annual operation and maintenance cost of PINS per TUA accounts for Rs. 8,000 of which 87.50 per cent towards repairing and maintenance of tube-wells and 12.50 per cent towards electrical charges.

While enquiring the members of TUAs about their satisfaction towards the facilitator (NGO), 55 per cent have reported that they have good satisfaction about the facilitator, 30 per cent of the members reported average satisfaction and 20 per cent of the members reported poor satisfaction.

Six decisions were taken in twelve general body meetings conducted during 2015-16 of which five decisions were implemented. All the water users expressed the need of assistance from NGO.

The inflow of income is due to collection of annual maintenance fees, while the outflow of income is through expenditure on electricity bill and repairing expenses.

About 58 per cent of the office bearers reported good relationship with irrigation department, while 42 per cent of the bearers reported average relationship. Moreover, 45 per cent of the office bearers reported good relationship with department of agriculture, while 40 per cent of the office bearers reported average relationship.

The office bearers of TUAs expressed that about 66.67 per cent of management is transferred to TUAs and remaining 33.33 per cent of management is under the control of individual farmers. Those farmers that are involved in TUAs only are being regular in maintaining or paying water rates regularly, while those farmers who are under the control of management of individual farmers are not regular. Out of four TUAs, one TUA consisting of ten members is not functioning properly. As a result, the PINS project was not implemented properly.

Due to formation into TUAs the farmers could receive three benefits viz., 1. Timely release of water to their fields and judicious use of water, 2. Improved maintenance of the system 3. More information on crops and technologies and thereby improved quality of ground water due to less extraction compared to pre-TUA periods.

About 66.67 per cent of TUA members reported to have received sufficient water throughout the year. Nearly 33.33 per cent of water users reported that the PINS system is

not functioning properly and also due to improper management of PINS system, they received inadequate water to their farm plots. Non-payment of water rates and maintenance charges by the members is also another reason for getting inadequate supply of water to their fields.

Among the problems faced by the TUAs, 32 per cent of the problems arose out of the fund constraints. Nearly 40 per cent of the problems are due to water availability. About 18 per cent of the problems are due to maintenance and repair of PINS and only 10 per cent of the problems arose due to poor participation of TUAs' members.

Nearly 70 per cent of the users reported that there is less water logging problem prior to formation into TUA. Almost all water users agreed that there was no salinity in water, dug well pollution, ground water pollution and crop yields. 50 per cent of the users reported that there were no labour problems and no problems in crop yields.

All the water users reported that there are no constraints of water logging, salinity, inter and intra village conflicts and crop yields after formation into TUAs. All the water users of TUAs received better results after formation into TUAs than pre-TUA period.

6.3. Policy Implications:

1. Though the MIS scheme is being implemented by private agencies, the subsidy is being released by the Telangana state micro-irrigation project. Due to delay in release of funds from Central government the release of subsidy to farmers is accordingly delayed. As a result the farmer could not receive the benefit in time and could not proceed further.
2. In recent years, the tanks in Telangana are being renovated through the programme of Mission Kakatiya. This renovation should be extended to all other tanks which in turn be useful to irrigate more land in various parts of Telangana. Thus, the MIS scheme could be initiated through this source of irrigation.
3. The amount of subsidy for all inputs and also to the machinery should be enhanced.
4. Awareness about the MIS must be created by conducting more training programmes i.e., once in a month in every mandal head-quarters.

5. Training programes to farmers to create awareness about fertigation and chemigation must be conducted.
6. The department officials (TS-MIP) must thoroughly check the operations of drip and sprinkler systems at frequent intervals.
7. After sales service should be done by the companies efficiently they should visit the farmers field frequently to give acid treatment & explain the farmers about the advantages of this treatment so that farmer should use this drip system efficiently.

* * *

Appendix -3.1 Numbers of the PINS Project implemented and List of Agencies implementing the PINS-MIS Scheme in the State

Districts covered	Name of the implementing Agency/Company	Head Quarters and Address of implementing Agency/Company	Contact Numbers of implementing Agency/Company:	E-mail ids of implementing Agency/Company
All Districts	Premier Irrigation Equipment		9440621705	hyd@pial.in
All Districts	Jain Irrigation Systems		9440797890	jaihyderabad@jains.com pratapa.venkat@jains.com tallurari.udaybhaskar@jains.com
All Districts	Netafim Irrigation India (p) Ltd.,		8142244701	bhushan.kumar@netafim.com mahamulkar@netafim.com mangal.pawar@netafim.com
All Districts	Parixit Industries Ltd.,		9959899639	prnagar@parixit.com rereddy@parixit.com
All Districts	FinoloxPlassion Industries (India) Ltd.,		9848020622	finolexplassion.ap@fpil.in
All Districts	Nagarjuna Palma India Ltd.,		9989578882	ajayb@nagarjunagroup.com hkraghuram@nagarjunagroup.com
All Districts	Godavari Polymers		9849999728	homail.@godavaripipe.com srinivasd@godavaripipe.com
All Districts	Rungta Irrigation		9985395925	rungtahyd@gmail.com
All Districts	Nandi Plasticisers & Pipes Industries		9866664934	nandidriphyd@yahoo.co.in
All Districts	Nandi Irrigation		9848125284	nandidriphyd@yahoo.co.in
All Districts	Sudhakar Plastics Ltd.,		9848882206	Sudhakar_drip@yahoo.com
All Districts	Kumar Enterprises		9848050656	Kumardrip2003@gmail.com

Source: TSMIP, Hyderabad.

Annexure - II

Comments on draft report and Action Taken

"**Working of Pressurized Irrigation Network Systems (PINS) in Telengana**"

1.	Title of report	**"Working of Pressurized Irrigation Network Systems (PINS) in Telengana"**
2.	Date of receipt of the draft report	September 25, 2017
3.	Date of dispatch of the comments	October 21, 2017
4.	Comments on the objectives of the study	The objectives of the study have been addressed properly.
5.	Comments on the methodology	The sampling and methodology used is accepted.

6. Comments on analysis, organization, presentation etc.

The analysis, organization and presentation of the work have been done properly. Some relevant policy measures have also been suggested to strengthen the PINS programme in the state. However, few errors and omissions were observed at some places in the draft report, which have been pointed out below:

(a) Pages 22, 23 and 24: Please provide Table Nos and titles to three tables (after Table 2.9).

Suggestion incorporated.

(b) Page 26: There is no title to chapter three. It should be "**Overview of PINS Programmes in Telangana".** Section 3.1 should be **"Introduction".**

Suggestion carried out.

(c) Page 28, Table 3.3: Since the source of irrigation is tubewell in all cases, other blank columns may be deleted**.**

Suggestion incorporated.

(d) While referring to Tables within text, please mention the table no, instead of writing 'above table' or 'below table' (Pl see page 29).Also sources to tables should be clearly mentioned.

Suggestion incorporated.

(e) Page 30, Table 3.5: Please mention the cost unit as Rs/ha.

Suggestion carried out.

(f) Page 30, Table 3.6: The title of the table should be '**District-wise coverage of MIP in the State'.** The title of Table 3.5 has been wrongly copied here.

Suggestion incorporated.

(g) Pages 50, 51 and 53, Tables 4.18, 4.19 & 4.20: Please put cucumber as Kharif vegetables or Rabi vegetables, as the case may be in Telengana, but not under perennial crops.

Suggestion incorporated.

(h) Page 55, Table 4.22: Please mention the response in last two rows. If there is no response, please state it as zero. In last row of the table, please replace 'waste' with 'water'.

Suggestion carried out.

(i) Pages 56- 60, Tables 23.1 to 23.4: Please rectify table numbers in both text and tables. It should be 4.23 onwards.

Suggestion carried out

(j) Page 61, Table 4.24: Please provide spaces between words.

Suggestion incorporated.

(k) Page 66, Table 5.1: The Average Life Span of the PINS is stated as 7-8 years, which seems to be very less. Please clarify. Also please rectify kharif and rabi crop numbers.

Suggestion incorporated.

(l) Page 72, Table 5.7: It is found that the income of the WUA is more than expenditure. Please explain how the TUA utilizes the excess funds.

Suggestion carried out.

(m) Page 74, Table 5.10: The sum total percentages is less than 100.

Suggestion incorporated.

(n) Page 77, Table 5.14: Sine there is no cases of conflicts reported, please delete this table and number the remaining tables accordingly.

Suggestion incorporated.

(o) Page 78, Table 5.16: Please mention the value of agricultural production (Rs/Ha) and irrigated area (ha) in both before and after TUA formation.

Suggestion carried out.

(p) Typographical errors in some places may be corrected.

Suggestion incorporated.

7. References: All important references have been used in the study.

8. General remarks: The report is acceptable after taking into consideration the comments.

9. Overall view on acceptability of report. The report is acceptable after revision based on comments.

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