PERFORMANCE EVALUATION OF MINOR LIFT IRRIGATION SCHEMES IN NORTHERN KARNATAKA

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I. INTRODUCTION

Globally, 68 per cent of the cultivated area is rain fed and only 32 per cent is irrigated. World Bank in its report warns of serious water crisis in all major countries in the days ahead. It is not land scarcity but water scarcity that would decide the fate of our agriculture. The global water resources are estimated at 1.37×10^8 million-hectare meter of which about, 97.2 per cent is salt water, mainly in oceans and the remaining 2.8 per cent is available as fresh water on the earth. This 2.8 per cent constitutes about 2.2 per cent as surface water and 0.6 per cent as ground water. Even out of this 2.2 per cent of surface water 2.15 per cent is fresh water in glaciers and icecaps and only of 0.03 per cent (1.36×10^4 mhm) is available in lakes and reservoirs. Only about 0.3 per cent (41.2×10^4 mhm) can be economically extracted with the present driving technology (Raghunath, 1990).

Agriculture occupies central position in the Indian economy because of its contribution to overall economic development through supply of food, raw materials and exports. Nearly 70 per cent of Indian population depends upon agriculture for its livelihood. Agriculture contributes 21 per cent to the national income by using 48 mha-irrigated area.

To carry out agricultural operations efficiently throughout the year, controlled, assured and continuous water supply through irrigation is very essential. The importance of irrigation has been realized long ago. Realizing the importance of irrigation system, Mahatma Gandhi observed, “Nothing can be more important than the provision of agricultural growth. In the absence of irrigation facilities, agriculture is nothing more than a gamble”. Similarly, Thomas Fuller observed that “we never know the worth of water till the well is dry”. In order to adopt intensive method of cultivation along with a cropping pattern, irrigation system is considered very imperative. Success in enlarging the area under irrigation is crucial in raising agriculture production.

India's food grain production increased from 52 million tonnes in 1951-52 to around 212 million tonnes in 2004-05. This quantum jump in food production is attributed to the introduction of high – tech inputs, through “green revolution”. It is undisputed fact that the effectiveness of these inputs was possible with one of the most important and primary input i.e., irrigation, which is responsible for the increased production. According to the planning commission’s estimate, the contribution of irrigation water alone in increasing productivity was 27 per cent, while 13 per cent by improved seeds and 60 per cent by all other factors.

India receives 117 cm of rain annually, which produces 400 mhm of fresh water. But, the distribution in time and space is erratic, which leads to floods and droughts each year in some part of the country or the other. As such in India, agriculture is gambling with the monsoon.

The entire rainfall in the country occurs within the narrow space of a few days, in fact within about 300 hours. Apart from such a marked seasonality, even total annual precipitation in many regions is grossly inadequate for crop growth. Due to its wide departure from normal, about 30 per cent of the net sown area lies in the low rainfall regions, with annual precipitation of less than 750 mm. Another 43 per cent of the net cultivated area receives precipitation in the range of 750 to 1150 mm. Only the remaining 28 per cent of the net sown area enjoys the benefits of high rainfall.

In India, main sources of irrigation comprised wells, tanks, small, medium and large reservoirs, gravity canals by diversion of water through inundation, canals, rivers, etc. Major, medium and minor irrigation systems have been tried in India. But in view of the growing disadvantages of large projects, the emphasis is slowly shifting towards the minor irrigation.

Out of the total geographical area of 329 million hectares, the net cultivable area in the country is only 186 million hectares and the net sown area is about 142 million hectares. The ultimate irrigation potential of the country from all sources of water has been estimated at 113.5 million hectares, comprising 58.5 million hectares under major and medium irrigation projects and 55 million hectare under minor irrigation projects. This implies the possibility of

raising the output of food crops in the country by about 25 per cent, by fully realising the ultimate irrigation potential.

Planned efforts in the development of irrigation facilities in post-independent India witnessed a great spurt both in surface and ground water exploitation. Irrigation potential in the beginning of first five year plan was only 22.6 million hectares, which increased to 93.95 million hectares by the end of the Ninth plan (1997-2002). The comfortable position of food grain production and stocks during the last four decades has been largely associated with increased area under irrigation.

Minor irrigation schemes like ground water and surface water help explore the options for cost effective expansion of irrigated area. Irrigation acts as key input for optimizing agricultural production. Creation of irrigation facilities has increased the use of other inputs like fertilizers, better seeds, better management practices, etc., resulting in increased output.

Minor irrigation schemes include ground water and surface water projects. The ground water schemes include dug wells, shallow tube wells and pump sets and surface water schemes include diversion of water from tanks and reservoirs to farms. Lift irrigation from rivers and streams, sprinkler irrigation, drip irrigation etc. also come under minor irrigation.

In the eighth five-year plan, special emphasis was laid on creation of minor irrigation potential in the country. At the beginning of the tenth plan in 2002, there were 162 major, 221 medium and 95 Extension, Renovation and Modernization (ERM) projects were carried forward from the past.

In 1997 Finance Minister of India introduced an Accelerated Irrigation Benefit Programme (AIBP) in the annual plan. An outlay of Rs. 800 crores was provided for large irrigation projects under Blue Ribbon Commission Scheme (BRCS) with terms of reference to prefer an integrated water plan for development of water resources for drinking, irrigation, industrial, flood control and other purposes. Under the special food grains production programme has envisaged the creation of additional irrigation potential of 8.6 million hectares through minor irrigation schemes.

In Karnataka, bore wells are the main sources of minor irrigation, providing water for 32.47 per cent of the net irrigated area. Amongst minor irrigation facilities, wells contribute to 16.41 per cent, whereas tanks and other minor irrigation sources provide irrigation to 19.92 per cent of the net irrigated area.

Karnataka, the eighth largest state in India in terms of geographical area (19.05 million hectares) has about 55 per cent of its area under cultivation. Total cropped area is 10.80 million hectares, of which only 21.50 per cent is irrigated while the remaining 78.5 per cent of agriculture is under rain fed condition. The ultimate irrigation potential in the state as estimated by the government of India was 5.5 million hectares, out of which the net area irrigated during 2003-04 was 2.32 million hectares, accounting for 22 per cent of the net cultivated area.

Ground water and surface water are the two major sources of irrigation in the state. Considerable efforts have been made to expand ground and surface water potential available through canals, tanks, wells, bore wells, and lift irrigation sources which accounts for 31.18 per cent 6.16 per cent, 16.41 per cent, 32.47 per cent, 4.89 per cent and 8.87 per cent, respectively of the net irrigated area.

Krishna river traverses in Maharashtra, Karnataka and Andhra Pradesh states and the total length of the river is 1,400 km. The river and its tributaries in Bagalkot provide abundant scope for use of surface water. Government has identified lift irrigation system as the thrust area for exploitation of available surface water source for agricultural production.

There are many studies on different irrigation systems like drip, sprinkles and canal irrigation systems. But, studies on government lift irrigation system are few. Particularly in

Karnataka no studies have been taken up. Therefore, this study was purposively taken up to study the performance of minor irrigation schemes across Krishna River in Bagalkot district of Karnataka.

SPECIFIC OBJECTIVES OF THE INVESTIGATION

1. To estimate the growth of Minor Lift Irrigation Scheme (MLIS) in Karnataka
2. To analyse investments in selected MLIS
3. To evaluate the performance of selected MLIS
4. Identification of constraints in working MLIS

PRESENTATION OF THE STUDY

This study is presented in six chapters. The first chapter deals with a general introduction to the subject of irrigation and its importance. It includes with the mention of specific objectives of the study. The second chapter presents a brief review of research work carried out in the field of present study.

The third chapter describes the study area, the Adihudi-Todalabagi projects, sampling design, nature and sources of data, and the analytical techniques used in the study.

The fourth chapter includes the main findings of the study, while the fifth chapter interprets and explains the results obtained in the study. The sixth chapter summarizes the important findings of the study drawing some conclusions. Lastly, relevant policy implications are presented that can be used for future planning and policy making.

LIMITATION OF THE STUDY

The interview method of data collecting requires the respondents to recall from their memories the operations carried out many years back. In the absence of written records of investment pattern. Hence, the findings are subject to errors in memories of respondents.

II REVIEW OF LITERATURE

This chapter presents a review of the research work carried out so for relating to the objectives stated in the previous chapter. For the sake of clarity, the reviews are presented under the following heads:

2.1 Growth rate of Minor Lift Irrigation schemes (MLIS) in Karnataka

2.2 Investment in selected MLIS

2.3 Performance of selected MLIS

2.4 Identification of constraints in working MLIS

2.1 GROWTH OF MLIS (MINOR LIFT IRRIGATION SCHEMES) IN KARNATAKA

Pathak (1983) estimated that out of the identified Indian irrigation Potential of 113 million hectares about 65 percent (73 m.ha) is from surface water and remaining 35 percent (40 m.ha) is from ground water. The contribution of ground water to irrigated agriculture increased from 6.5 m.ha in 1951 to 25.58 million hectares by March 1983.

Reddy (1985) Studied the cropping pattern and changes in it from the beginning of this century in Guntur district of Andra Pradesh. The study revealed that there were spectacular increases in both area and production of rice, during the century due to increase in irrigated area. However, the percentage of area under sorghum was stagnant during 1920-21 to 1969-70 due to stagnancy in yield during the period. The increased irrigation facilities resulted in decline of sorghum area without any perceptible decrease in the yield in last two decades. Substantial changes have occurred in the cropping pattern of commercial crops over time – a favourable shift towards cotton in the seventies was seen due to its relative higher profitability.

Sethu *et al.* (1989) reported that at the commencement of the first plan, there were only five reservoirs in Tamil Nadu, by 1984, the number of reservoirs constructed in the state increased to 37, accounting for about 90 percent of the total live capacity. With the limited scope for additional projects, the available tank resources, supplemented by irrigation wells, are the only alternatives. Irrigation wells have progressively increased by over three and half times from 2.89 thousand in the first place to 7.9 thousand by the end of the fifth plan and accounted for 4.0 per cent of the irrigation area.

Reddy and Mohammad (1992) delineated the irrigation potential of canals, tanks and tube wells in Andhra Pradesh and Telangana.Regional analyses of irrigated area indicated that coastal Andra Pradesh recorded an increase in all sources of irrigation, But, Royalseema recorded a marginal fall in irrigated area. An index value was derived to show the concentration of irrigation types in the region. This showed that canal and well based irrigation increased and there has been a marked shrinkage in the extent of tank –based irrigation for the period 1972-1983.

Sisodia (1992) evaluated the performance of ‘‘Warabandi’’ (fixation of turns) system of irrigation management in Chambal command area of Madhya Pradesh. As a result of the introduction of Warabandi programme, irrigation ratio increased from 40.19 percent 1981-82(before Warabandi) to 87.39 per cent in 1986-87. A steady increase in the irrigated area was observed during the implementation period of six years. The judicious use of water by the cultivator thus resulted in the larger coverage of the irrigated area. Farmers in the head and middle reaches showed stronger inclination to grow double crop than the tail–enders. The

study further indicated that after the introduction of Warabandi the cropping pattern titled towards non-food grains, which were remunerative to the farmers.

Mark and Mark (1993) studied the pattern of growth of irrigated area in Asia from 1960-88. The annual average growth rates over the full period, 1960-88 ranges from 2.7 per cent South East Asia to 1.1 per cent East Asia with South Asia growing at a rate of 1.9 per cent. In terms of shares, however, the region of strongest growth-South East Asia, contributes only 13 per cent of the regions net irrigated area, while, South Asia provides about 15 per cent. Further, the average annual growth in Asia a whole and in each sub-region there has been sharp decline in the rate of growth in irrigated areas. In South Asia the growth rate in irrigated area dropped from 2.8 per cent during 1975-80 to 1.8 in irrigated area was over 2 per cent annually through the mid 70's but was virtually stagnant in the mid 1980;s but declined sharply from 4.1 per cent in 1980-85 to 1.5 percent in 1985-88.

Murty and Takeuchi (1996) observed that nearly 30 per cent of the irrigated area in the Asia-Pacific region is under lift irrigation. The water lifting devices used can be broadly classified as human powered devices, animal-powered devices, mechanical devices, and devices powered by renewable energy sources. The use of mechanical water lifting devices is discussed with reference to standardization and testing, availability of energy resources, credit facilities, and extension services. Water lifts that use non-conventional energy sources such as solar energy, wind energy, biomass conversion and hydropower are being developed.

Dhindsa and Sharma (1997) studied the impact of irrigation in Punjab for the period 1966-67 to 1991-92. The increased gross irrigated area in various regions of the state resulted in a heavy fall in the area under chickpea and other pulses. The adverse impact of irrigation in the case of chickpea has been felt in the state with short run acreage irrigation elasticities of -1.479. They opined that irrigation has a backlash effect on cultivation of pulse crops in the state.

Vikas-Rawal (2001) identified the basic structure of irrigation in West Bengal, and the extent of growth of irrigation in the post-land reform period. They presented a detailed evaluation of secondary data available on irrigation in West Bengal. The author used the data from the mid-1970s-mid-1990s to identify certain features of irrigation development in the state. After presenting an overview of the pattern of irrigation in the state, the author analyses the growth of irrigation from groundwater and canals and the changes in irrigation from ponds and river lift-irrigation schemes. Finally, inter-district variations in the growth of irrigated area are discussed.

2.2 PERFORMANCE EVALUATION OF MLIS

Saikia and Bora (1975) studied the economics of 25 small farms in Nahotia village within the area of Nahotia Electric Lift Irrigation Project, Jorhat. Economics was worked out in terms of impact of the irrigation project on the cropping pattern, cropping intensity, yield levels and household incomes. The results showed that the area under high-yielding variety of paddy increased from two per cent to 32 per cent between 1972 and 1974. After the adoption of new methods of cultivation, the paddy yields per ha. and the annual average income per household increased by 23 percent and 46 per cent, respectively. The scope for transforming the small farms into potentially viable units through the application of modern agricultural technology was found to be large.

Sinha (1978) examined the impact of irrigation on cropping pattern and crop yields after the advent of lift irrigation schemes. Based on a survey of 197 households selected from a cross-section of three lift irrigation villages and three non-lift irrigation villages in Bhiwani district of Haryana, The general cropping pattern of the selected villages as indicated by the crop registry in 1975-76 (the year of the survey) was compared with those obtained in 1967 for analyzing the impact of irrigation on the entire village area.

Tripathy (1982), using different indicators studied the impact of irrigation with a highly labour intensive indigenous manual lift system in Ganjam (Orissa). He found that well irrigation had brought about marked changes in cropping pattern and cropping productivity. Social benefit cost ratios were much higher than B:C ratio found in the commercial profitability analysis, the intra and inter regional distribution effects of the scheme were found to be substantial.

Sarada and Narender (1990) reported the impact of the lift irrigation project on farm activities of randomly selected farmers. The scheme substantially raised the fixed as well as working capital investment per hectare and resulted in increased cropping intensity. About 66 per cent of the designed command area was developed and the rest under- developed due to improper management, irresponsibility in implementation, financial problems etc.

Setty *et al.* (1990) conducted an experiment on cropping system at Agricultural Research Station, Siraguppa during 1987-88 to find out suitable cropping sequences for Tungabhadra irrigation project. Among the various crop sequences tried, maize –chickpea produced highest net return of Rs. 6,370 per hectare and benefit-cost ratio of 2.50. This was followed by maize –wheat sequence with a net return of Rs. 3,693 per hectare and benefit-cost ratio of 1.60.

Bos and Wolters (1990) studied irrigation efficiencies with characteristics of charges and irrigation systems, based on data collected by the International Commission on Irrigation and Drainage during the early 1970s and 1984 using a questionnaire on irrigation water use, distributed to 159 projects throughout the world. It discusses, for instance, the relation of field data with the generally endorsed presumption that water charges only influence irrigation efficiency if they are levied by volume. The conclusions indicated that there was no statistically significant influence of the structure of the charges on the three investigated efficiencies, namely field application efficiency, tertiary unit efficiency and project or overall efficiency. The efficiencies were not measurably higher when the charges were levied by volume, probably because the charges were too low to have an effect. In projects where the water supply to the fields had to be lifted, the field application efficiency was significantly influenced by the built-in, proportional charge. Such systems were only found in regions with an indication of water shortage. The three effects: water shortage lifting of water to fields and higher efficiency seem to be interrelated. In more than 60 per cent of the projects, charges are levied on the basis of area (either total or cropped). In less than 15 per cent of the projects the basis of the charge was combination of area and volume. In about 25 per cent of the projects, the charging is by volume.

Thapa and Banskotu (1991) in their study on performance evaluation of selected farmer –managed irrigation systems in Nepal, reported that, cropping intensity increased by 35 per cent in the Hills and 41 per cent in the Terai, on an average, following irrigation development. Besides, significant changes were observed in cropping pattern. The important change was the introduction of high value crops like vegetables. Irrigation development also led to significant gains in yields of major crops. Average rice yields increased by about 56 per cent, in Hill schemes and 37 per cent in Terai schemes. Similarly average wheat yield also increased.

Singh and Sikka (1992) studied the management system of different types of minor irrigation projects in Himachal Pradesh. Various aspects examined were: water management and water security traditional and conventional approaches to irrigation management, effectiveness of irrigation management appropriateness of management techniques, people's participation and government intervention in the management of systems, problems of irrigation water management and suggestions for improvement. Two irrigation schemes were chosen from each of two districts: lift irrigation scheme Panesh (Panesh Kanda) and flow irrigation scheme Dwarcha (Dwarcha Bathara) in Shimla district and lift irrigation scheme Sunhani and flow irrigation scheme Makri in Bilaspur district. A sample of 211 beneficiaries (52 beneficiaries in Panesh, 62 in Dwarcha, 47 in Makri and 50 in Sunhani) were selected and classified into three categories according to their land holdings. Makri and Dwarcha Bathara were running on a sound footing because of their small command area and active

participation of beneficiaries. The lift irrigation schemes were not optimally utilizing their capacity. Of all the schemes, Makri had the best management from the user's point of view.

Sharma, Singh and Sikka (1992) undertook a study to assess the social structure of sample farmers, the impact of irrigation on income, employment, and education, introduction of modern technology, cropping intensity and production patterns and to examine the pattern of inequality in the distribution of agricultural income after the introduction of irrigation. Study was based on data collected in Shimla and Bilaspur districts of Himachal Pradesh. Two schemes selected were the Kanda-Panesh lift irrigation scheme in Shimla district and the Gallian flow irrigation scheme in Bilaspur district. A sample of 50 beneficiaries and 50 non-beneficiaries from each scheme was selected and categorized on the basis of ownership of cultivated land. The socioeconomic structure of beneficiary and non-beneficiary families indicated that the lift irrigation scheme in Kanda-Panesh proved successful. Lack of inputs like fertilizers, insecticides/pesticides and HYV seed was reported by the farmers. Lack of transportation and packing material was the main problem reported by the farmers in marketing their produce.

Bhattacharya (1992) studying the impact of tube well irrigation on farmers income in Uttar Pradesh showed that cash crops dominated under tube well and food crops under dug well irrigation . The cropping intensities under tube well and dug well were estimated to be 123.4 per cent and 117 per cent, respectively.

Phuke *et al.* (1994) studied the investment pattern on Marathwada farms in Parbhani district of Maharashtra. The average intensity of cropping was found to be 164.19 per cent in the command area (irrigated) and the double cropped and gross cropped areas were higher on the same than outside the command area. The overall picture of cropping patternin the command area indicated that nearly 40 per cent of the total cropped area was under kharif crops, 25 per cent under crops, two per cent under perennial crops and the remaining 14 per cent area was under summer crops.

Singh Nasib *et al.* (1996) conducted study in Bhiwani district, Haryana to investigate the influence of socio economic factors on the area under mixed cropping. The sample included 25 farmers from each of four villages (selected from 62 villages receiving water from the Jui canal lift irrigation system). A significant positive correlation was found between age, land holding, socio economic status and area under mixed cropping. Family education and respondent's education showed a significant negative correlation with mixed cropping.

Saleth (1996) studied the institutional dimensions of water resource management, focusing on economic, legal and policy aspects. He examined critical gaps in the water economy, their causes and consequences. The five major gaps in the Indian irrigation economy were irrigation gap, utilization gap, incentive gap, financial gap and policy/institutional gap.

Norman and Walter (1997) evaluated eight irrigation systems typical of the Sahel representing the major types of irrigation activities in Niger ranging from large government-administered perimeters to small, privately owned manual lift microsystems. Most of the field data used in the study were obtained from studies initiated under the USAID-funded Niger Applied Agricultural Research Project during 1991/92. The total cost to the farmer for water, the various components of that cost and systems performance were evaluated and found to vary significantly among systems. Irrigation systems in which farmers incurred the highest volumetric costs for water and which allowed for greater direct farmer control over system water management tended to exhibit the highest performance characteristics

Chhikara *et al.*(1998) studied land utilization and water resources and their impact on sustainable agricultural development in Haryana, India. The adoption of new technology resulted in an increase in cropping intensity, irrigation intensity, agricultural production and over-exploitation of land and water resources. On an average, the state exploited about 70 per cent of groundwater potential and about 50 per cent of surface water potential. Approximately 55 per cent of the area has problems with underground water. It was observed that the area under forest had gone up from 91 thousand hectares in 1966-67 to 170

thousand hectares in 1991-92. Lift commands were developed in South-Western Haryana. In the case of lift canals only 5 to 20 per cent of the area was under irrigation, which highlighted the gap between potential created and the actual utilization of irrigation water. It also showed that about 7.5 per cent of the total area was affected by sodicity or alkalinity.

2.3 FINANCIAL FEASIBILITY OF MLIS

Patel and Singh (1976) studied the investment pattern and cost of water lifted by electric tube-well, electrified dug-cum-bore-well, and dieselized dug-cum-bore-well in Mehsana district of Gujarat. The study covered pump sets selected from six villages of the district. The data were collected by survey method for the year 1973-74. The investment cost for lifting water per horsepower was Rs. 863 in electric tube-well, Rs. 564 in electrified dug-cum-bore-well and Rs. 653 in dieselized dug-cum-bore-well. The total cost (fixed and variable) for lifting one hectare-centimeter of water was Rs. 27.15 for electric tube-well, Rs. 20.31 for electrified dug-cum-bore-well and Rs. 23.09 for dieselized dug-cum -bore-well, which showed that water for irrigation lifted from the dug-cum -bore-well was cheaper than the electric tube-well. Among dug-cum-bore -wells, the electrified dug-cum-bore-well was cheaper than dieselized dug -cum-bore-well. It was therefore, suggested that before investing a large amount in electric tube-wells in the area, the other feasible alternatives needed to be carefully examined and unplanned investment should be checked.

Mitra and Muranjan (1978) evaluated the viability of electrification of wells in a compact rural region in Poona district, Maharashtra, India. The study dealt with the financial analysis from the point of view of the state electricity board, which undertook this scheme during 1971/72. The study also dealt with the economic viability of the project from the point of view of society. Taking a life period of 25 years a field investigation was undertaken to assess progress and to estimate the future load development and its phasing. The stream of cost and returns was estimated over the life of the project. Discounted cash flow technique was used to compute net present worth at a discount rate of 6 per cent. The project was not financially profitable for the state electricity board. Total social benefits and social costs of the project were assessed considering opportunity of cost of alternative sources of energy. The social benefit-cost ratio of above unity indicated that the project was economically viable from the point of view of society.

Islam (1979) estimated the efficiency of low lift pump irrigation under than irrigation programme and analyzed relevant socio-economic and institutional factors. These included the farmer's return from irrigation, credit, role of group managers and members and repair and maintenance.

Anonymous (1982) evaluated a cooperative enterprise implemented by the Panchaganga Sahakari Pani Purvatha Mandali, Ltd., (PSPPM) in Wadange and Nigwe villages of Karveer taluka in Kolhapur district of Maharashtra. The results provided estimates of costs, benefits and increases in farm employment with reference to the scheme. The scheme had implicitly assumed that its beneficiaries would continue bullock farming even after commissioning of the RLIU. However, the present evaluation, some 11 years after the scheme completion, showed that about 80 percent of the beneficiary households used tractors, either owned or hired.

Anonymous (1982) studied costs, benefits and increment on farm employment of two river-life irrigation schemes in Pune district of Maharashtra, the study also evaluated implementation efficiency in 12 other schemes in the district. The primary motivation for the schemes was the development of sugarcane area and output and in many cases the primary promotional work was done by cooperative sugar factories. Although the two evaluated schemes led chiefly to the substitution of more assured irrigation for uncertain tail-end canal irrigation, the financial rate of return on investment, at 24 percent, was satisfactory. It might have been higher had the schemes led to the transformation of rain fed farms into irrigated farms. Water management was found to be equitable in that all beneficiary members who wanted to grow sugarcane could obtain irrigation for the crop in accordance with the rules in force. The pricing of irrigation water by the lift irrigation societies favored sugarcane however discriminated against food crops.

Erhabor (1983) hypothesized that promotion and improvement of the small scale lift irrigation methods of applying water (shadoof and pump) might contribute to more efficient agricultural production in Nigeria. He also estimated the economic returns to small-scale shadoof and pumps irrigation systems and indicated implications of these returns for research, extension and government policy. A major problem of using the LP model chosen was that the farmers intercropped, making it difficult to assign inputs used to a specific crop. Regression analysis was therefore used in the specification of small-scale irrigation linear programming activities. The production Possibility-Convex Approximation Model (PP-CAM) used in this study was a new and potentially useful technique for analyzing resource use under intercropping. The data necessary to estimate the coefficients or parameters of the model were obtained from 14 irrigation farmers (104 shadoof and 10 pump) in Ringim LGA, Kano, Nigeria during the 1978/79 irrigation seasons. The returns to irrigation farming with the shadoof and pump irrigation technology were found to be quite high; small-scale lift devices are therefore worth promoting. A major barrier to expansion of irrigated land area was unavailability of water.

Anonymous (1988) study on water management at Parbhani found that the incomes obtained from tomato were Rs. 64,407, Rs. 58,989 and Rs. 33,684 per ha under drip (micro tube), drip (nozzle) and ridge and furrow method of irrigation, respectively. With respect to total costs at Rs. 15,191, Rs. 24,210 and Rs. 8,500 the net benefits were Rs. 49,216, Rs. 35,779 and Rs. 25,184. The additional benefits over ridges and furrow method were Rs. 24,032 under drip (micro tube) and Rs. 10.595 under drip (nozzle).

Anonymous (1989) studied the minor irrigation scheme for installation of private shallow tube wells (STW) and lift points (LP) implemented by the Assam State Minor Irrigation Development Corporation (ASMIDC). Commercial banks, the Pragjyotish Gaoulia Bank and Assam Central Co-operative Land Mortgage Bank financed the Scheme. Field investigations were carried out in Bhabanipur and Bajali blocks of Barpeta district and Kathiatali and Mayang blocks of Nagaon district during 1986-87. A sample of 72 STWS and 28 LPS were selected and 40 farmers cultivating under rain fed conditions were selected for the purpose of estimating the incremental benefits from investments. Assured irrigation from STWS and LPS enabled the farmers to grow multiple as well as new crops. There was a shift from local varieties to high yielding varieties and the use of fertilizers and pesticides increased. Net income per hectare of cultivated area under STW and LP was 124 percent and 130 percent higher, respectively, than that of the rainfed area. Despite higher incomes, the repayment performance of the beneficiaries was unsatisfactory.

Govindasami and Balasubramanian (1990) analyzed five tanks in north Arkot district and estimated their financial feasibility out of which four tanks yielded a BC ratio of more than one in all sensitivity combinations. The results implied that modernization would yield significant benefits over costs. The findings of the study also showed that tank performance could be improved significantly by periodical investment in a repair works such as repairing sluice structure, weirs, desilting tanks to increase the storage capacity and cleaning supply channels.

Neelakantiah (1991) estimated that the total average investment made on the wells per farm was Rs 46,953 in Doddaballapur taluk. The payback period was around three years, discounted benefit –cost ratio was 1.22 and IRR was 31 per cent, which indicated that investment on ground water irrigation was economically feasible and financially sound. This was one of the important reasons for extensive investment in well irrigation.

Kolavalli et.al (1993) in their study on ground water utilization in East Utter Pradesh revealed that the capital cost on tube well ranged from Rs. 15,000 to Rs 21,000. The cost of irrigation for tube well owners was considerably higher as compared with public irrigation system. The average cost per hectare ranged from about Rs. 950 to Rs. 2,200. Studying the impact of subsidies on ground water investment, it was referred that impacts of subsidies were the most effective in influencing ground water investment. IRR was estimated at different levels of subsidy. The stimulation of IRR for wells showed that a 30 per cent subsidy on the investment could increase the return from 8 to 16 per cent on a one-hectare farm.

Anonymous (1995) investigated the technical, financial and organizational problems encountered in implementing lift irrigation schemes in Maharashtra, India and assessed the economic impact of lift irrigation schemes. A total of seven schemes (five from Krishna basin and one each from Godavari and Tapi basins) were selected. The agricultural year 1992/93 was taken as the reference year of the study. Implementation of the lift irrigation schemes was beset with many operational problems. In the process of designing the lift irrigation systems, the water distribution system was practically lost sight of which resulted in reduced coverage of irrigable area and wasteful use of scarce irrigation water. Nevertheless, the beneficiaries were observed to have realised substantial increase in income from each investment through favourable changes in the cropping pattern, increase in crop intensity and crop yields.

Inamdar *et al.* (1996) studied investment costs, operating costs and returns of lift irrigation and biwall Drip irrigation. Data were collected from 98 sugarcane growing farmers in the command area of the lift irrigation scheme in Ankalkop village, Sangli District, Maharastra, India, both before {1987/88} and after {1989/90} installation of the biwall drip irrigation unit. The benefit cost ratio of biwall drip irrigation was found to be 1.43 in the command area.

Narayanamurthy *et al.* (1997) focused their study on agricultural production under lift irrigation schemes along the White Nile in the Sudan. A comparison was drawn between the theoretical forecast and actual practical experience regarding the feasibility of transferring management from government-run parastatal organizations to private farmer organizations. Although the theoretical model indicated that farmers should be able to cover the cost of managing the river lift irrigation systems, field data showed, however, that farmers growing wheat were barely able to break even. Even assuming a doubling of the present wheat yields, the cash surplus earned would only suffice for fuel to operate the pumps. Under these circumstances, it was not surprising that, contrary to government expectations, the private sector had been unenthusiastic about taking over management of White Nile river lift schemes. The lessons that emerged from the study indicated that unplanned and rapid withdrawal of state management could lead to negative results. The transfer of management responsibility for the river pumps does not appear to influence economic performance considerably, which depends on the wider context of the country's economic, political and institutional environment, within which the agricultural sector functions.

2.4 CONSTRAINTS FACED BY THE BENEFICIARIES

Anonymous (1988) studied the shri Ram Cooperative Lift Irrigation Scheme and five similar irrigation projects in Maharasthra, India. The study focused on: (1) problems relating to irrigation project formulation and implementation and (2) their financial and social returns. The study showed that project beneficiaries were satisfied with the present open channel system of water distribution. Recovery of current water charges was nearly 90 percent. Area under cash crops (sugarcane, lucern and vegetables) increased substantially following the installation of lift irrigation schemes. On-farm employment in the study area also increased

Nagare (1989), observed that the major problems faced by drip owners in Ahmad Nagar district of Maharastra were lack of knowledge of relationship between rate of application, pressure and water discharge, lack of technical and timely advise, clogging of emitters, breaking or cracking of laterals, delay in availability of loan and higher cost of irrigation.

Desai (1991) studied a number of Lift Irrigation Schemes (LIS), which were in operation in Karnataka and identified the constraints to optimizing the LIS drawing on data from 162 beneficiariesin the year 1986/87. The organizational structure of the irrigation department and its management procedures were reviewed. A number of human, technical, and socioeconomic constraints were found to be impeding agricultural development. Poor remuneration was a disincentive to the manpower of the department while the per acre costs of each LIS were quite high. There also appeared to be a lack of communication between irrigation officials and water users. These findings call for more financial support for the agricultural sector, better management and integration with participating farmers on the part

of officials and more research on appropriate, cost-effective technology for irrigation development.

Kimmage (1991) studied the problem of equity and sustainability of water use because of the repeated under-performance of large-scale irrigation over the last 20-30 years. It is now widely perceived as having failed to reduce food deficits or significantly increase agricultural productivity in Africa. Many aid donors and state agencies, particularly in Nigeria, have become increasingly involved in informal small-scale irrigation and there has thus been rapid technical change in the methods used to lift groundwater. Using data from recent research undertaken in northern Nigeria, the question was posed as to whether the assumptions about the sustainability of technically improved small-scale irrigation have any basis in fact. It was shown that technical sustainability problems have already arisen in northern Nigeria and that there could be serious ecological and pedological problems in the future. It was also argued that because of its inherent inequity, small-scale irrigation was not suitable for effecting broad-based agricultural and/or rural development. With new small-scale irrigation technology being introduced and promoted by forces acting upon, but outside, the traditional agricultural sector, it should not be presumed that the growth so induced will be either organic or sustainable in the longer term.

Diawara (1993) dealt with the organizational and management problems of irrigation system in Mali and concluded that an irrigation scheme should not be seen as simple solution, but as one component in a genuine integrated development strategy and local people will have to become increasingly involved both as controllers and monitors.

Rana and Raman(1999) studied the irrigation arrangements in the Indian NW region of Gujarat. Approximately. 2.5 million ha of the 10.9 million ha cultivated area was irrigated. Arrangements differed in the eight agro-climatic zones. North Gujarat and the Saurashtra Peninsula were generally irrigated with groundwater, while South and Central Gujarat areas were predominantly irrigated by canal water. In the canal-irrigated areas, the major constraints were water logging, secondary salinisation, higher incidence of pest and diseases and tail end problems. These were mainly due to: (i) poor drainage, especially in heavy textured soils with low outfall conditions; (ii) unscientific water management practices; (iii) preference for high water-consuming crops; (iv) aquatic weeds; (v) high conveyance losses; (vi) overuse by head-reach farmers; and (vii) slow uptake of conjunctive use. In the lift-irrigated command, fast receding water tables combined with poor quality waters were the major constraints.

III. METHODOLOGY

This chapter deals with the details of background information about the study area, sampling procedure, nature and source of data, selection of respondents, the analytical tools and techniques employed and definitions of terms and concepts presented under the following heads.

3.1 Description of the study area

3.2 Sampling technique

3.3 Nature, sources and method of data collection

3.4 Analytical tools/techniques employed

3.1 DESCRIPTION OF THE STUDY AREA

The present study was undertaken in Bagalkot district of Karnataka during the agricultural year 2004-05. Agro climatic features of Bagalkot district are presented under the following heads.

3.1.1 Adihudi -Thodalabagi Minor Lift Irrigation System

The Government minor lift irrigation schemes in the study area have been lifting Krishna river water directly to reservoir with the help of pipelines by installing huge motors on the bank of rivers through reservoir releasing water by four channels to farmer's field for irrigation. There is only one Government scheme in the area which is a functioning and located at Adihudi village in Jamakhandi taluk of Bagalkot district. The Adihudi-Thodalabagi Minor Lift Irrigation scheme was purposively selected to make a case study.

Adihudi-Todalbagi Minor Lift Irrigation Scheme

Background

Farmers coming under the Adihudi-Todalabagi Minor Lift Irrigation Scheme (Fig. 2 and Plate 7 and 8) are small farmers. They were facing perennial drought, poverty and labour migration before this scheme. In general, the very dignity of human life was at stake, as happens in any drought prone area for want of basic needs.

This apathy of the state towards problems of the farmers and the need of the farmers brought them together under the leadership of a local farmers cum social worker Sri.Vittal Chouri the farmers group represented to the Government of Karnataka to take up construction of Adihudi-Todalabagi Minor Lift Irrigation Scheme across Krishna near Hirepadasalgi village in Jhamkhandi taluk. The Government estimated for construction of a Minor Lift Irrigation Scheme at a cost of eight crore in 1991.

Technical details of the project

The Adihudi- Todalabagi Minor Lift Irrigation Schemes is situated on the left bank of Krishna river near Hirepadasalgi village in Bagalkot district of Karnataka., with a longitude of 70^0,23'.30" and latitude of 16^0.35'.00". The scheme was proposed to irrigate 1,450 ha belonging to Hirepadasalgi, Todalbagi and Adihudi villages.

The project irrigates about 1,450 ha of land in kharif and rabi crops. Water permission is accorded by the Government for lifting water. Single main suction and delivery chamber have been provided with a jack well and pump house.

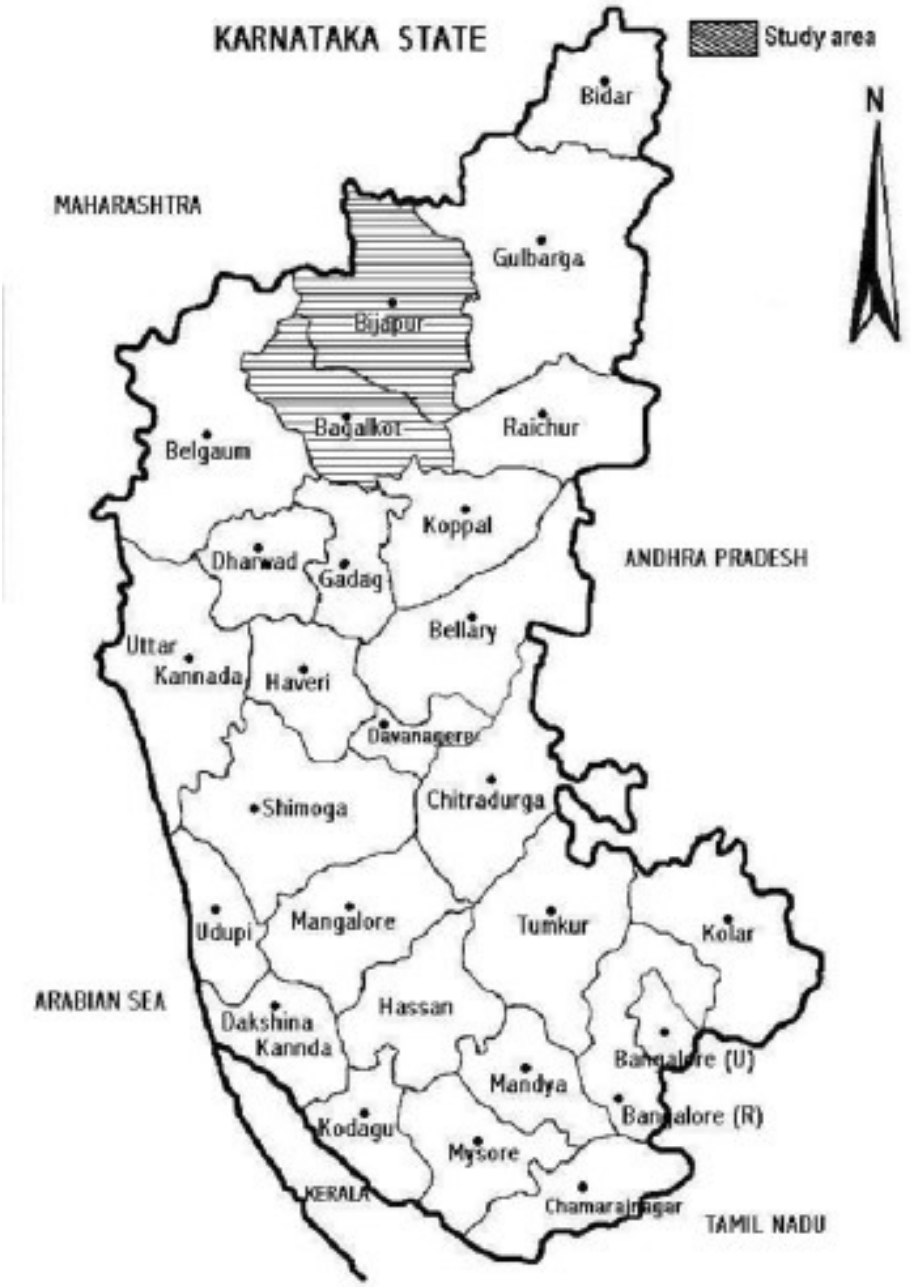

Fig. 1. Map of Karnataka depicting study districts

Fig. 2. Map showing Adihusi MLI project site in Bagalkot district

Plate 7. Water is lifted from the intake well in the river (power house in the background

Plate 8. A close up of intake well

Plate 1. Reservoir to store water from intake well

Plate 2. The reservoir with the researcher

Plate 3. Water supply from intake well to reservoir

Plate 4. A view of field channels running from the reservoir

The estimates for the project were prepared as per NABARD guidelines. It is proposed to lift the water from jack well by three pumps and electrical motors of 640 H.P. each. The lifted, water leads to delivery chamber through rising main of length 4,290 m by using 1.2m diameter psc pipes. The rising main runs underground through the length.

Distribution system

The distribution system has been made through three canals namely, the North canal irrigating an area of 856 ha, South canal irrigating an area of 296 ha and the West canal irrigating an area of 280ha. Thus, in total the project provides irrigation to 1,450 ha of land which was previously a dry land.

The project has a place of pride in the area as it has uplifted the lives of many small and marginal farmers in its command. Here, its economic evaluations assumes importance.

3.1.2 Location and General Description

Bagalkot district is 12^{th} largest district of Karnataka and consists of six taluks. It is located in three agro-climatic zones, namely hilly zones, northern transitional zone and northern dry zone of Karnataka. The district lies between $15^0.49^1$ and $16^0.58^1$ N latitude and between $74^0.59^1$ and $76^0.20^1$ longitude with a geographical area of 6.69 lakh hectares. Bijapur, Belgaum, Gadag, Koppal and Raichur districts surround the district. According to the 2001 census, the population of the district was 16.52 lakhs with literary rate of 57.81 per cent and population density of 251 per sq. km.

3.1.3 Climate and soils

The climatic condition of the district is characterized by general dryness, except during the monsoon season. The average annual rainfall of the district was 562 mm, temperature ranging from 25^0 to 41^0C. The Southwest monsoon sets in the first week of June and continues for four months.

Bagalkot district is endowed with the deep black soils, which are the major soils and only are moderately rich in plant nutrients.

3.1.4 Land use pattern

The land use pattern in Bagalkot district for the year 2004-05 is presented in Table 3.1

3.1.5 Crops and cropping pattern

The major crops grown in the district are Jowar, sugarcane, maize, oilseeds, wheat etc. The area under major crops in the district for the year 2004-05 is presented in Table 3.2 which indicates that, the district has about 4, 34,749 ha of net sown area. Crops grown in kharif season are bajra, groundnut and pulse. In Rabi, *wheat, jowar* and *bengalgram* are grown extensively. Jowar crop occupies an area of about 1,62,812 ha, which accounts as much as 37.44 per cent of the net sown area in the district, while 24.99 per cent was occupied by oilseed crops. Sugarcane and cotton are major commercial crops accounting of 13.50 per cent and 0.80 per cent of the net sown area, respectively.

3.1.6 Sources of irrigation

The net area under irrigation in the district was around 1,77,842 hectares (Table 3.3). 38.32 per cent of area irrigated through other source of irrigation in Bagalkot district while the share of the canal irrigation was around 14.48 per cent. 0.95 Per cent of area covered under Lift irrigation system.

Table 3.1: Land use pattern in Bagalkot district (2004-05)

Sl. No.	Land use, category	Area (ha)	Percentage to total geographical area	Percentage of net sown area
1	Geographical area	6,58,877	100.00	-
2	Forest area	8,11,26	12.31	-
3	Land not available for cultivation	5,3,642	8.14	-
	a) Barren and uncultivable land	24,820	3.76	-
	b) Land used for other purposes	28,832	4.37	-
4	Other uncultivated land	5,676	0.86	-
	a) Cultivable fallow	2,035	0.30	-
	b) Permanent pastures	3,429	0.52	-
	c) Trees and grooves	212	0.032	-
5	Cultivable fallow	83684	12.70	-
	a) Current fallows	73718	11.18	-
	b) Other fallows	9966	1.51	-
6	Net sown area	434749	65.98	100.00
7	Area sown more than once	43007	-	9.9
8	Total cropped area	477756	-	109.8
9	Net irrigated area	177842	26.99	40.90

Source: District Statistical Office, Bagalkot 2005-06

Table 3.2: Area under major crops in Bagalkot district (2004-05)

Sl. No.	Crops	Area (ha)	Proportion of net area sown
1	Paddy	127	0.03
2	Jowar	1,62,812	37.44
3	Wheat	23,327	.36
4	Maize	30,453	7.00
5	Sugarcane	58,694	13.50
6	Cotton	3,511	0.80
7	Pulses	54,767	12.5
8	Oilseeds	1,08,677	24.99
9	Fruits	3,409	0.78
10	Vegetables	4507	1.03
	Total	**4,50,284**	**100.00**

Source: District Statistical Office Bagalkot (2005-2006)

Plate 5. Luxuriant crop in the command of Adihudi MLI

Plate 6. Power house indicating huge electricity requirements of MLIS

3.2 SAMPLING PROCEDURE

3.2.1 Selection of the district

In view of the dispute over sharing of Krishna water among Karnataka, Maharashtra and Andhra Pradesh, a critical analysis of each source of water has assumed importance. Bagalkot district is endowed with diverse sources of irrigation. No studies were undertaken on government minor lift irrigation scheme in the Krishna river belt of Bagalkot district earlier. Hence, Bagalkot district was purposively selected for the present study.

3.2.2 Selection of MLI

Krishna River, originates at Mahabaleswar near Pune enters Karnataka state at Athani taluk of Belgaum district, and later enters Bagalkot district. Only one functioning government Minor Lift Irrigation Scheme (MLIS) is situated in Jamakhandi taluk along the Krishna river.

3.2.3 Selection of sample villages

A list of villages in which lift irrigation scheme has been working was prepared through preliminary survey. Two villages were selected randomly on Krishna river belt of Jhamakhandi to elicit information for the study.

3.2.4 Selection of sample farmers

Primary data were collected from 15 farmers under the MLIS command beneficiary and 15 farmers outside the command non-beneficiary were selected randomly from each selected village. Thus total sample size for the study was 60.

3.3 NATURE, SOURCES AND METHOD OF DATA COLLECTION

Primary and secondary data were collected in order to evaluate the various objectives of the study.

3.3.1 Primary data

For meeting the requirement of the specific objectives of the study, necessary data for the year 2004-05 were elicited from the sample farmers through personal interview method with the help of pre-tested and structured schedules. Care was taken to include those variables, which were adjudged as the most relevant for the study

Data were collected on aspects such as the total number of irrigation per season, crops grown, cropping pattern, land use pattern, etc. Opinion survey method was adopted to know the operational problems and constraints faced by the farmers in getting benefits from lift irrigation system.

3.3.2 Secondary data

Secondary data on land use pattern, crops and cropping pattern, sources of irrigation, agro-climatic features of the district, cost of lift irrigation scheme, maintenance and repair cost performance etc. were obtained from the office of the District Statistical Office, Bagalkot (2004-05) and Minor Irrigation Department, Bijapur.

Table 3.3: Sources of irrigation in Bagalkot district (2004-05)

Sl. No.	Sources of irrigation	Net irrigated area (ha)	Percentage of net irrigated area
1	Canals	25,756	14.48
2	Tanks	1,056	0.59
3	Wells	29,808	16.76
4	Tube wells	51,353	28.87
5	Lift irrigation	1,706	0.95
6	Other sources	68,163	38.32
	Total	**1,77,842**	**100.00**

Source: District Statistical Office, Bagalkot, (2005-2006)

3.4 ANALYTICAL TOOLS/ TECHNIQUES EMPLOYED

Primary data collected were processed using analytical tool like financial feasibility analysis. The brief descriptions of the presentation of data and analytical tools used for the study are presented below.

3.4.1 Tabular analysis

Tabular approach was followed for analysing the general characteristics of the sample farmers, their resource utilisation, and labour utilisation, price of inputs, returns and profits per hectare for comparison. The data were compared and contrasted with the aid of simple statistical measurable averages and percentages to achieve meaningful presentation of results.

3.4.2 Financial feasibility analysis

Financial appraisal techniques were used to evaluate the feasibility of investment on lift irrigation system. The discounted cash flow technique, which has an advantage of reducing cash flows to a single point of time, was used to facilitate the tests of feasibility.

The discounting procedure estimates the present value of an amount earlier received or paid out in the future. The discount factor permits the determination of the present value and has found application in evaluation of projects.

Four conventionally used project evaluation techniques were used in the study to evaluate the feasibility of investments on lift irrigation systems.

The techniques used for the financial analysis were:

1) Net Present Value [NPV]

2) Benefit-Cost Ratio [BCR]

3) Pay Back Period [PBP] and

4) Internal Rate of Return [IRR]

3.4.2.1 Net Present Value [NPV}

The net present value represents the discounted value of the net cash inflows to the project. This is simply the present worth of the incremental net benefit or incremental cash flow stream. Net present value may be interpreted as the present worth of the income stream generated by an investment. For a project to be economically viable, the NPV should be positive and as high as possible. The net present value was estimated using the following formula.

$$NPV = \sum_{n=1}^{a} Y_i (1_r)^{-n} - I$$

Where,

Y_i = Net cash flows in the i^{th} year (I=1,2,…..n)

r = Discount rate (at 12 per cent)

I = Initial investment on the project

3.4.2.2 Benefit Cost Ratio [BCR)

It is the ratio between the discounted cash inflows and discounted cash outflows. The ratio must be unity or more for an investment to be considered worthwhile. The Benefit Cost Ratio [BCR] was worked out by using the following formula.

$$BCR = \frac{\text{Discounted cash inflows}}{\text{Discounted cash outflows}}$$

The formula for selection criterion for the BCR measure of project worth is to accept all independent investments with a benefit cost ratio of 1 or greater than one. Since, the discount rate closely represents the opportunity cost of capital the benefit cost ratio was obtained as indicated below.

$$BCR = \frac{\sum_{t=1}^{n} R_t (1+r)^{-n}}{I + \sum_{t=1}^{n} C_t (1+r)^{-n}}$$

Where,

R_t = Returns in each year in rupees

Ct = Initial investment in rupees

r = Discount rate

I = Initial investment in the project

t = Number of years of economic life of the investment

4.2.3 Pay Back Period [PBP]

The pay back period is the length of time in years taken to liquidate the investment.

The pay back period was estimated by summing up all the undiscounted net benefits over the years to make up the initial investment incurred for establishment. The pay back period is a common, rough means of choosing among investments especially when projects entail a high degree of risk. The pay back period is worked out as below.

$$P = \frac{I}{Y}$$

Where,

P = Pay back period in pre-defined time units. (In present study it is "Years").

I = Capital investment on the project in rupees.

Y = Net income realised after meeting production expenditure.

3.4.2.4 Internal Rate of Return [IRR]

The rate at which the net present value of the project is equal to zero is the Internal Rate of Return [IRR]. The net cash inflows were discounted to determine the present worth following the interpolation technique.

3.4.2.5 Cost and returns

The benefit of the project have been estimated as the product of per hectare additional net returns (ANR) due to irrigation obtained on the average farm in the irrigation command over those outside the command and the total irrigated area in the scheme command and expenditure per year by irrigation department was taken as cost.

IV. RESULTS

The results of the investigation carried out for fulfilling the objectives of the study are presented under the following four sections.

4.1 General characteristics of the sample farmer

4.2 Growth rate of Minor Lift Irrigation schemes (MLIS) in Karnataka

4.3 Investment in selected MLIS

4.4 Performance of selected MLIS

4.5 Identification of constraints in working MLIS

4.1 GENERAL CHARACTERISTICS OF THE SAMPLE FARMER

In any scientific investigation the necessity of basic information is indispensable since, it provides deeper insights into the basic aspects of the study area. The general characteristics of the respondents in the study area are presented in Table 4.1.

4.1.1 Age

The average age of a farmers acts as an important variable in decision-making ability of the respondents. Nearly 43 per cent of the farmers were young, while 50 per cent were middle aged and about 7 per cent were old aged in under the Lift Irrigation System, while it was 36.66, 60.0 and 3.33 per cent for young, middle and old aged in non-beneficiary category of respondents.

4.1.2 Education level

The education level of farmers was categorized into five groups. The per centage of illiterates was about 23.33 and 33.33 per cent in the beneficiary and non-beneficiary categories, respectively.

Majority of respondents up to primary level education were found in both categories, indicating there by that educationally the study area was backward.

4.1.3 Occupation

The occupation of the farmers was studied classifying into two main categories as agriculture and agriculture + others (others enterprises, service and business). Among the beneficiaries 73.33 per cent of respondents had Agriculture as their main occupation, 26.66 per cent of respondents had Agriculture + others. In the case of non-beneficiary the per centage of farmers purely dependent on agriculture was less than that in beneficiary group at 56 per cent. In either case majority were dependent on farming.

4.1.4 Family size

Middle size families comprising 5-8 members were predominant in the study area.

4.1.5 Land holding

In both beneficiary and non-beneficiary category, the small farmers dominated in numbers. 70 per cent of farmers in both the categories were small. Medium farmers were the

Table 4.1: General characteristics of sample farmers

Categories	Beneficiaries of lift irrigation		Non- beneficiaries of lift irrigation	
	Frequency	Percentage	Frequency	Percentage
AGE (Years)				
Young (<35)	13	43.33	11	36.66
Middle (36-50)	15	50.00	18	60.00
Old (>50)	2	6.66	01	3.33
EDUCATION (Class)				
Illiterate	7	23.33	10	33.33
Primary (1-7)	11	36.66	16	53.33
Secondary school (8-10)	10	33.33	4	13.94
Higher secondary school (11-12)	00	00.00	0	00.00
College (>12)	02	6.66	0	00.00
OCCUPATION				
Agriculture	22	73.33	17	56.66
Agriculture + Others	8	26.66	13	43.33
FAMILY SIZE (Nos.)				
Small family (<5)	4	13.33	6	20.00
Middle family (5-8)	24	80.00	20	66.66
Large family (>8)	2	6.66	4	13.33
LAND Holding (ha)				
Small farmer (<2)	21	70.00	21	70.00
Medium farmer (2-4)	08	26.66	06	20.00
Large farmer (>4)	01	3.33	03	10.00

next important component in both the categories. While beneficiary category had about 27 per cent medium farmers, non-beneficiary had 20 per cent of them. Large farmers were minimum in both the categories.

4.1.6 Pattern of land utilization by the respondents

Land utilization pattern of sample farmers is represented in Table 4.2 and Fig. 3 and 4. Among the beneficiary farmers 70 per cent were small, followed by medium (27%) and large (3%). Beneficiary farmers were blessed with 100 per cent irrigation on their farms.

The average land holding of non-beneficiary farmers was slightly more than that of beneficiaries at 4.46 hector. Here, also size distribution of sample beneficiaries was same as that of beneficiaries. But, the non-beneficiary farmers locked irrigation facility.

4.1.7 Asset position of the respondents

The asset position of the sample respondents is presented in Table 4.3. No significant difference was noticed in the value of assets in beneficiary and non- beneficiary categories of farmers. While the total value of asset in the beneficiary category was Rs.2, 35,127, it was Rs. 2, 30,940 in the latter category.

Among both the total assets of beneficiary and non-beneficiary farmer's tractor contributed to nearly half of the total value of assets. The second important item of assets was dwelling house contributing to about 30 per cent of the total assets in the beneficiary category and about 25 per cent in the non-beneficiary category. Motorcycle was another important asset of both categories of farmers, contributing to about 9 per cent of total value of assets. Remaining were all farm implements etc.

4.2 GROWTH RATE OF MINOR LIFT IRRIGATION SCHEMES

The growth rate of minor lift irrigation schemes under public sector in terms of number and irrigated area was analysed using annual compound growth rate formula.

4.2.1 Growth in number

For a better understanding of the trend in growth of MLI schemes, compound growth rates were calculated. The time period considered for the analysis was from 1990-2005. Government MLI schemes were considered for the study. The results of the estimated growth rates of Minor Lift Irrigation Schemes are presented in Table 4.4.

In Karnataka the number of Minor Lift Irrigation Schemes grew by 1.402 per cent between the periods from 1990 to 2005.

4.2.2 Growth rate of irrigated area under MLI schemes

Growth rate of irrigated area under MLI schemes was calculated for better understanding irrigation spread of area under of MLIS. The two concepts used were gross irrigated area and net irrigated area. Results of analyses are presented in Table 4.5.

4.2.3 Working and non-working Minor Lift Irrigation Projects

There were 33 lift irrigation schemes established in the pre-bifurcation Bijapur district (1996-97) (Table 4.6 and Fig. 5). After bifurcation of the district 15 have gone to Bagalkot district and 20 have remained with Bijapur district. Of the total number of schemes in the two districts, about 61 per cent were non-working and the remaining (39.00%) were working. The performance of schemes on the banks of rivers in Bijapur district was not encouraging. All the units (100 %) have become non-functional. But, the performance of units in Bagalkot district

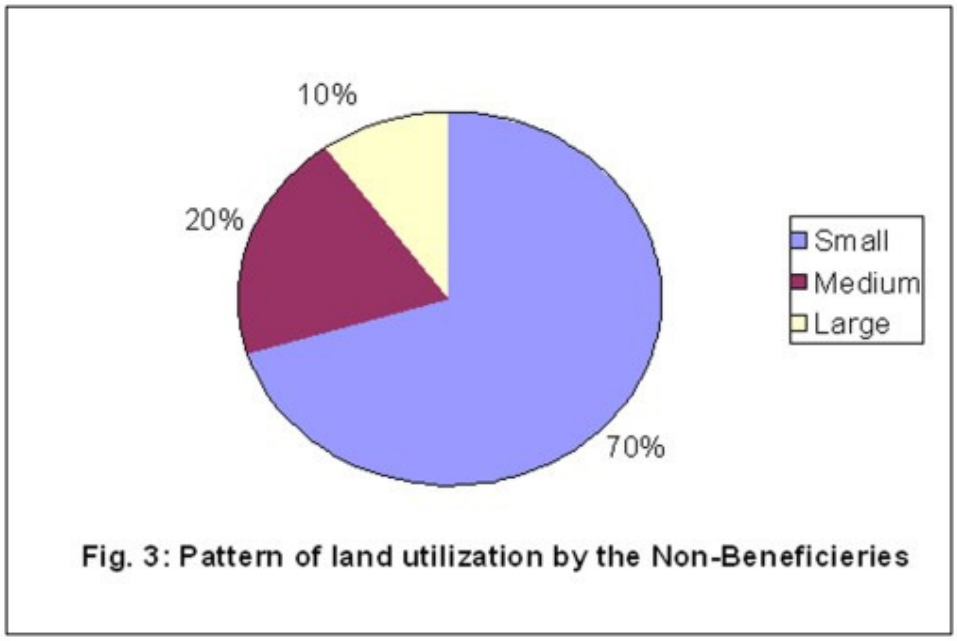

Fig. 3. Pattern of land utilization by the beneficiaries

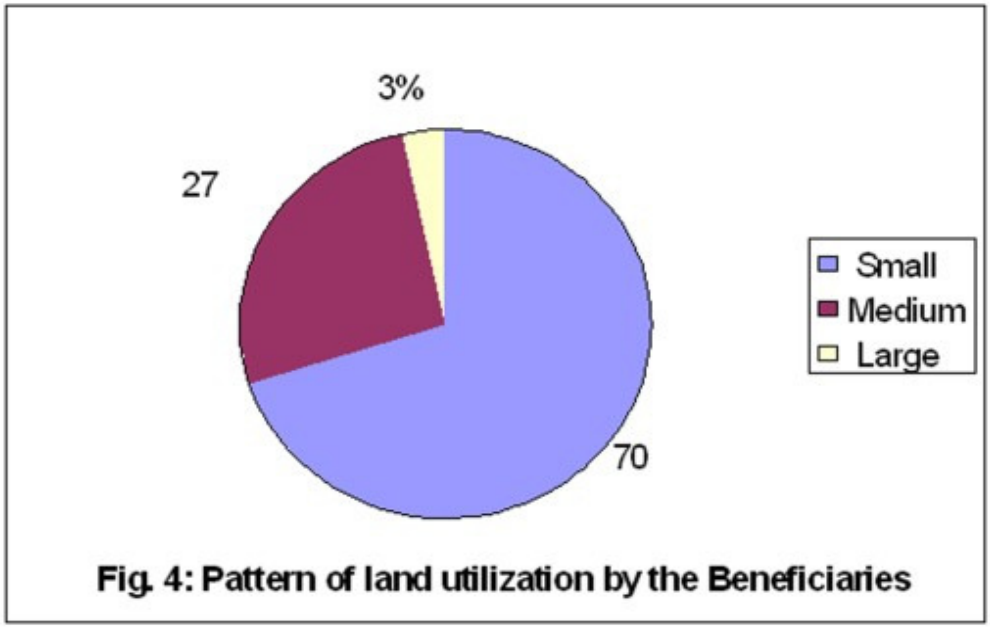

Fig. 4. Pattern of land utilization by the non-beneficiaries

Table 4.2: Pattern of land utilization by the beneficiary and non-beneficiary

(Area in ha)

Sl.No.	Size group	Total area	Average size of holding	Net cultivated area	Irrigated area (a)	Number of farmer (b)
Beneficiary						
(1)	Small	53.50	2.54	53.50	53.50 (100.00)[a]	21 (70.00)[b]
(2)	Medium	44.00	5.50	44.00	44.00 (100.00)[a]	08 (26.66)[b]
(3)	Large	10.00	10.00	10.00	10.00 (100.00)[a]	01 (3.33)[b]
(4)	Overall	107.50	3.58	107.50	107.50 (100.00)[a]	30 (100.00)[b]
Non- beneficiary						
(1)	Small	59	3.25	59	-	21 (70.00)
(2)	Medium	37	5.75	37	-	06 (20.00)
(3)	Large	38	11.00	38	-	03 (10.00)
(4)	Overall	134	4.46	134	-	30 (100.00)

Note: (a) Figures in parentheses indicates percentage to net cultivated area of respective size groups

(b) Figures in parentheses indicate percentage to total sample categories.

Table 4.3: Asset positions of respondents

Particulars	Beneficiaries		Non - beneficiaries	
	Average (Rs.)	Percentage	Average (Rs.)	Percentage
Dwelling House	72,600	30.88	56,833	24.61
Tractor	1,11,666	47.49	1,25,000	54.13
Bullock cart	5,525	2.35	5,200	2.25
Cattle shed	15,714	6.68	12,500	5.41
Motor cycle	19,600	8.34	21,250	9.20
Bicycle	859	0.37	845	0.37
Iron plough	2,100	0.89	2,350	1.02
Wooden plough	375	0.16	375	0.16
Blade harrow	475	0.20	462	0.20
Seed drill	431	0.18	416	0.18
Spade	100	0.04	87	0.04
Pickaxe	135	0.06	120	0.05
Seed cum fertilizer drill	5,545	2.36	5,500	2.38
Total	2,35,127	100	2,30,940	100

Table 4.4: Growth rates of Minor Lift Irrigation Schemes in Karnataka (1990-2005)

Description	Intercept	Slope	R square	t value	Growth rate
Government	5.870	0.0139(0.0029)	0.639	4.797	1.402

Note: Figures in parenthesis indicate the standard error

Table 4.5: Growth rate of irrigated area under Minor Lift Irrigation Schemes in Karnataka (1990-2005)

Description	Intercept	Slope	R square	t value	Growth rate
Gross	11.953	-0.018 (0.0087)	0.263	-2.154	-1.867
Net	11.645	0.012 (0.021)	0.026	0.599	1.268

Note : Figures in parenthesis indicate the standard error.

was much better. About 72 per cent of the schemes in Bagalkot were functioning and the remaining 28 per cent were non functional.

4.2.4 Potential and actual irrigation

The taluk wise potential (Table 4.7) and actual irrigation area shows that there was a large gap between the expected level and actual irrigation. On an average, there was about 70 per cent gap between the expected area and actual area achieved. Among the various taluks, Sindagi had highest gap at 90 per cent. Lowest gap was noticed in Jamakhandi taluk. These large gaps are matter of concern to irrigation experts.

4.3 FEASIBILITY ANALYSIS

4.3.1a Investment made in MLI Schemes

The information in Table 4.8 depicts the initial investments of Rs. 8,50,00,000 was made in establishing the Minor Lift Irrigation Scheme. There were no expenditures for the next two years period and at the same time no land was brought under irrigation.

However, from fourth year onwards maintenance expenditure was incurred annually. And the irrigated area increased from 1000 ha in 2002-03 to 1450 ha in 2005-06.

4.3.1b Benefits from the project

The benefits (net returns) from the project (Table 4.8), which being, negative the initial years, started rising slowly. They increased from Rs. 5,4 2,70,000 in 2002-03 to Rs. 7,94,31,500 in 2005-06.

4.3.2 Net present value

The annual net cash inflows were discounted at a discount rate of 12 per cent to obtain the present value of net benefits of lift irrigation scheme. 12 per cent discount rate was selected because the farmers availed loans from financial institutions at this rate. The net present value of the investment observed was Rs. 10, 94,18,283. This positive and high NPV indicated that the investment on Lift Irrigation scheme was financially feasible.

4.3.3 Benefit cost ratio

This criterion indicates the returns per rupee invested in lift irrigation scheme. The magnitude of the ratio also indicates the priority to be assigned for each of the alternative investment options. B-C Ratio for the present scheme was 1.57 indicating feasibility of the investment made in the irrigation system.

4.3.4 Pay back period

The time required to recover the initial investment made is indicated by the pay back period in a project. The pay back period for the irrigation scheme was 3.5 years. Hence, the investment made could be recovered in a relatively short span of time.

4.3.5 Internal rate of returns

This criterion measures the rate that can be earned by investing in the irrigation scheme. The internal rate of return was 70.50 per cent for lift irrigation scheme under study. Internal rate of return was higher than the opportunity cost of capital, which was 12 per cent. Here again the investments in the MLI scheme could be considered feasible.

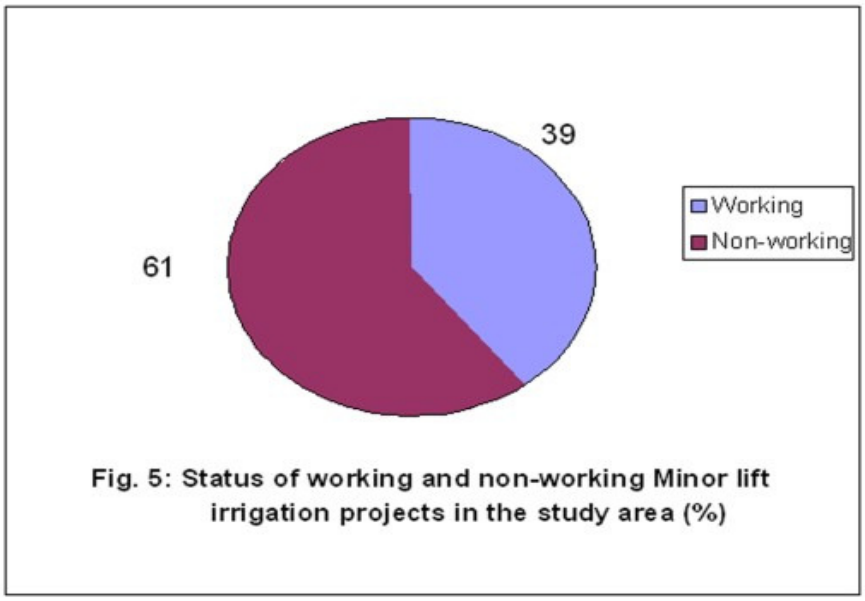

Fig. 5: Status of working and non-working Minor lift irrigation projects in the study area (%)

Fig. 5. Status of working and non-working minor lift irrigation projects in the study area

Table 4.6: Status of working and non-working Minor Lift Irrigation Projects in Bijapur and Bagalkot Districts (2005-06)

	Bijapur			Bagalkot			Total		Total
	Working	Non-working	Total	Working	Non-working	Total	Working	Non-working	W+NW
No. of MLIP	0	15	15	13	05	18	13	20	33
Percentage	0	-	100	72.22	27.78	100	39.39	60.61	100

Table 4.7: Taluk wise Potential and Actual Irrigation area in the study region in hectare

Taluk	Expected irrigation	Actual irrigation	Percentage Gap
1. Bijapur	6130	1935	68.44
2. B Bagewadi	1867	527	71.78
3. Bagalkot	1285	606	52.85
4. Badami	1162	398	65.75
5. Hungund	2872	730	74.59
6. Indi	1068	404	62.18
7. Jhamkandi	682	520	23.76
8. Sindagi	1544	139	91.00
Total	**16610**	**5259**	**68.35**

Table 4.8: Streams of cash inflows and cash outflows from the Adihudi MLI

Duration	Investment	Maintenance charge per year (Rs)	Area irrigated (ha)	Return(Rs)	Net return(Rs)
1999-2000	8,50,00,000	00	00	-8,50,00,000	00
2000-01		00	00	00	00
2001-02		00	00	00	00
2002-03		12,00,000	1,000	5,54,70,000	5,42,70,000
2003-04		14,00,000	1,200	6,65,64,000	6,51,64,000
2004-05		12,00,000	1,300	7,21,11,000	7,09,11,000
2005-06		10,00,000	1,450	8,04,31,500	7,94,31,500

Table 4.9 Feasibility analysis of investment in lift irrigation scheme

Sl.No	Financial Test criteria	Result
1	NPV	Rs. 10,94,18,283
2	B C Ratio	1.57
3	PBP	3.5 year
4	IRR	70.5 %

4.4 PERFORMANCE OF LIFT IRRIGATION SCHEME

4.4.1 Cropping pattern of the respondents in the study area

Table 4.10 shows major crops grown by beneficiary during *kharif* season were maize and turmeric. Maize shared about 87 per cent of area in the *kharif* season (Fig. 6 and 7). No crops were grown by non-beneficiary during *kharif* season due to lack of irrigation facilities and unassured rainfall in the study area. Crops taken up during *rabi* seasons by the *beneficiaries* were *Triticum dicocum*, *wheat, sorghum* and *turmeric* (biseasonal). Among these *Triticum dicocum* occupied major area (59%) followed by wheat (24%). The area under jowar was maximum at around 76 per cent followed by wheat at 16 per cent and sunflower at 8 per cent in the case of non- beneficiary during *rabi* season. The net sown area in the case of beneficiary category (107.5 ha) was less than non-beneficiary (134 ha). The gross cropped area was actually more in beneficiary category because of lift irrigation facility. No crops were taken up in summer season by both beneficiary and non-beneficiary categories because of the provision of irrigation facility in minor lift irrigation scheme was only eight months and there was no other source of irrigation facility.

4.4.2 Cropping intensities of farms of respondents

Cropping intensities on the farms of the sample beneficiaries and non beneficiaries of lift irrigation are presented in Table 4.11.

The cropping intensity on beneficiary farmers was 202.79 per cent, which was more than double the cropping intensity on non- beneficiary farmers (100%).

4.4.3 Cost and returns structure of crops grown by sample farmers

An attempt was made to work out cost and returns structure of select crops grown in the study area and the results are given in Table 4.12.

Major crops cultivated by the beneficiary were maize, *Triticum dicocum*, turmeric and wheat. Wheat, *rabi* jawar and sunflower were the crops grown by the non-beneficiary. Turmeric was the most profitable crop with the net returns of Rs. 45,017/ha which was followed by *Triticum dicocum* (Rs. 29,882/ha), maize (Rs. 18,447/ha) and wheat (Rs. 17,592/ha). Among the crops grown by the farmers outside the MLIS command area sunflower was the most profitable crop enterprise with net returns of Rs. 6,750/ha, followed by wheat (Rs. 5,142/ha) and jowar (Rs.4,705/ha). On an average the crops cultivated by the beneficiaries were more profitable than those of non-beneficiary farmers.

4.5 CONSTRAINTS FACED BY BENEFICIARY

The various constraints faced by the sample farmers as opined by the respondents are presented in Table 4.13.

Major constraints, identified in general, which affected the beneficiary farmers were – scarcity of water for irrigation, cooperation of the staff of irrigation department, water charges, electricity, condition of irrigation structures, crop and land suitabilities, cooperation among the farmers, soil degradation, availability of farm inputs and farm consultancy. The extent of problems was identified as sever, medium or no problem.

Availability of water for irrigation was identified as severe problem by about 83 per cent of the respondents. About 63 per cent of beneficiaries complained of non–cooperation of the staff of irrigation department as a medium problem. About 67 per cent of the farmers expressed high rate of water charges as a severe difficulty. Shortage of electricity was identified as a sever constraint by about 80 per cent of the respondents. About 53 per cent of the respondents felt that condition of irrigation structure was not a problem.

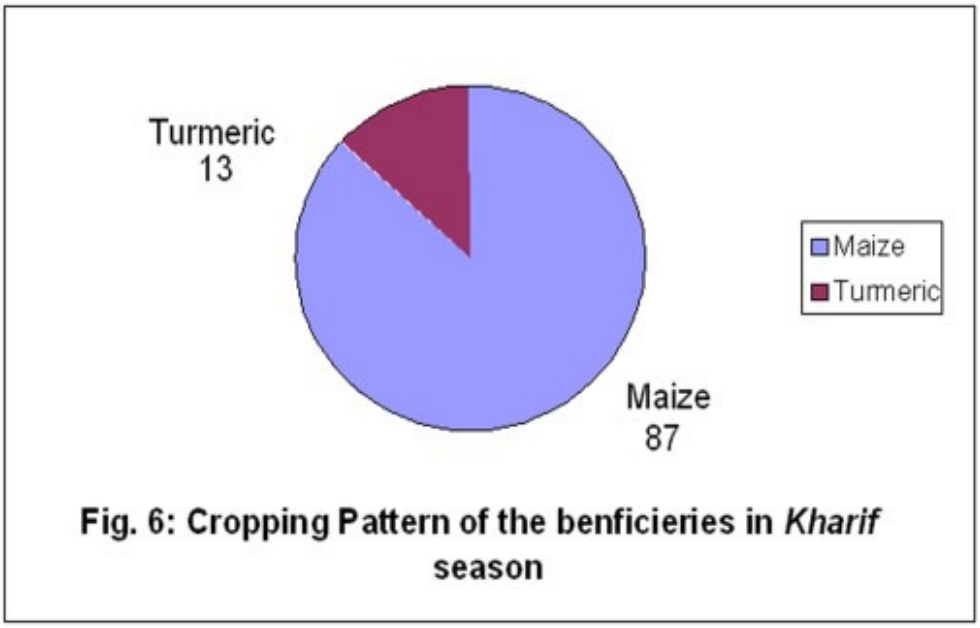

Fig. 6. Cropping Pattern of the beneficiaries in Kharif season

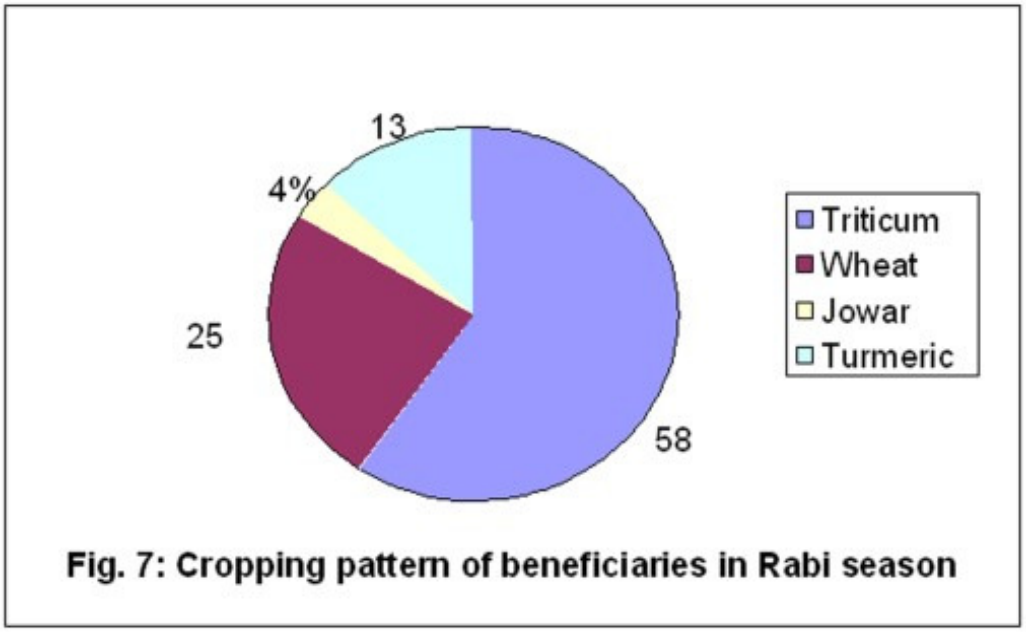

Fig. 7. Cropping Pattern of the beneficiaries in rabi season

Table 4.10 Cropping pattern of the respondents in the study area

Sl. No	Crops	Beneficiaries		Non- beneficiaries	
		Area (ha)	Percentage	Area (ha)	Percentage
Kharif					
2	Maize	94	87.03	-	-
	Turmeric	14	12.96	-	-
	Sub total	108	100.00		
Rabi					
1.	Triticum wheat	65	59.09	-	-
2.	Wheat	27	24.54	21	15.67
3.	Jowar	4	3.63	102	76.11
4.	Turmeric	14	12.72	-	-
5.	Sunflower	-	-	11	8.20
	Sub total	110	100.00	134	100.00
Net sown area		107.5	-	134	
Gross cropped area		218	-	134	-

Table 4.11: Cropping intensity on farms of beneficiaries and non-beneficiaries of lift irrigation system

Sl. No.	Category	Cropping intensity (%)
1.	Beneficiary	202.79
2.	Non-beneficiary	100.00

Table 4.12: Cost and returns structure of crops grown by the sample farmers

(Rs. /ha)

Crops	Beneficiary				Non - beneficiary			
	Gross Return	Cost of Cultivation	Net Returns	Returns/ rupee of expenditure	Gross Return	Cost of Cultivation	Net Returns	Returns/ rupee of expenditure
Maize	26,962	8,542	18,447	2.16	-	-	-	-
Triticum wheat	41,460	11,037	29,882	3.76	-	-	-	-
Turmeric	81,087	36,070	45,017	2.25	-	-	-	-
Wheat	25,277	7,685	17,592	3.29	8,950	3,450	5,142	1.49
Jowar	-	-	-	-	8,577	3,870	4,705	1.22
Sunflower	-	-	-	-	13,500	6,750	6,750	1.00

Table 4.13: Constraints faced by the beneficiary-farmers

Sl. No	Particulars	Severe		Medium		No problem	
		No	%	No	%	No	%
1	Availability of water for irrigation	25	83.33	05	16.66	00	00
2	Co-operation of MID-staff	09	30.00	19	63.33	02	6.66
3	Water charges	20	66.66	09	30.00	01	3.33
4	Electricity Problems	24	80.00	05	16.66	01	3.33
5	Water shortage in River	12	40.00	10	33.33	08	26.6
6	Condition of irrigation structures	06	20.00	08	26.66	16	53.33
7	Suitability of land	05	16.66	18	60.00	07	23.33
8	Suitability of Crops	07	23.33	19	63.33	04	13.33
9	Co-operation among the farmers of the command	11	36.66	16	53.33	03	10.00
10	Soil Degradation (area)	09	30.00	19	63.33	02	6.66
11	Availability of farm inputs	20	66.66	08	26.66	02	6.66
12	Agriculture Consultancy	19	63.33	09	30.0	02	6.66

Majority of the farmers (60%) opined that non- suitability of land for irrigation was problem of medium severity. Same was the case with non-suitability of crops for irrigation under the MLI. Cooperation among the farmers for sharing water or attending to repairs etc was also a sever constraint as expressed by about 37 per cent of the respondents.

Soil degradation was another major problem faced by the farmers in the command area.30 per cent of the respondents considered it as sever problem, followed by 66 per cent of farmers treating it as medium problem. Only few (7%) opined that it was not a problem. Non-availability of timely credit seems to be severe constraints as expressed by majority of the farmers (67%). Similarly non-availability of the suitable farm consultancy is a major problem in the way of efficient irrigated farming as expressed by about 63 per cent of the respondents.

These constraints need to be viewed seriously by the irrigation and agriculture policy makers to find suitable solutions.

V. DISCUSSION

Discussion chapter throws light on the possible causes for the results of the study and their likely impact on the policies to be adopted by the farmers and policy makers with regard to lift irrigation scheme. The discussions are presented under the following heads.

5.1 General characteristics of sample farmer

5.2 Growth rate of Minor Lift Irrigation Schemes (MLIS) in Karnataka

5.3 Investments in selected MLIS

5.4 Performance of selected MLIS

5.5 Identification of constraints in working MLIS

5.1 GENERAL CHARACTERISTICS OF SAMPLE FARMER

5.1.1 Age

The average age of the respondents was observed as an important variable to measure the decision-making ability of the respondent. In the case of beneficiaries category 43 per cent of respondents belongs to young category 50 per cent to middle aged and remaining seven per cent to old category. Where as in case of non-beneficiaries 37 per cent belonged to young category, 60 per cent to middle category and three per cent old category. It can be observed that majority of farmers in both the categories belonged to middle age category, which is very important stage of life in decision making.

5.1.2 Education level

Majority of respondents studied only up to primary level in both the category of farmers. This reflects upon poor adoption capacity of the farmers and general backwardness of the region. The percentage of highly educated farmers was negligible.

5.1.3 Occupation

It can be inferred from the results that majority of the respondents in the study area were agriculture based. The percentage of farmers taking up agriculture was more under the command than outside the command. This was possible because of provision of irrigation facility. The farmers outside the command tried to make up the family income by non-agricultural enterprises like petty business etc.

5.1.4 Family size

Most of the farm families in the study area belonged to middle size category. However, they were observed more in beneficiary category compared with non-beneficiary category. Small size families were more in non-beneficiary category (about 20%) than beneficiary's category (13%).

5.1.5 Land holding

It was interesting to notice that majority of the farmers (70%) in the study area were small farmers followed by medium and larger farmers. It is a welcome sign that scheme has benefitted mostly the small farmers in the region.

5.1.6 Pattern of land utilization by the respondents

Among the beneficiary farmers 70 per cent were small, followed by medium (27%) and large (3%). Beneficiary farmers were blessed with 100 per cent irrigation on their farms.

The average land holding of non-beneficiary farmers was slightly more than that of beneficiaries at 4.46 hectare. But the non-beneficiary farmers lacked irrigation facility.

5.1.8 Asset position of the respondents

No significant difference was noticed in the value of assets across beneficiary and non- beneficiary categories of farmers. While the total value of asset in the beneficiary category was Rs. 2,35,127, it was Rs. 2, 30,940 in the latter category.

Among both beneficiary and non-beneficiary farmer's tractor contributed to nearly half of the total value of assets. The second important item of assets was dwelling house contributing to about 30 per cent of the total assets in the beneficiary category and about 25 per cent in the non-beneficiary category. Motorcycle was another important asset of both categories of farmer, contributing to about 9 percent of total value of assets.

5.2 GROWTH RATE OF MINOR LIFT IRRIGATION SCHEMES

Rate of growth of minor lift irrigation in Karnataka was assessed in terms of growth of government sponsored minor lift irrigation units and the spread of area under irrigation from minor lift irrigation scheme.

5.2.1 Growth in number

During the period 1990 -2005. The number of Government owned minor lift irrigation schemes grew by 1.402 per cent per annum. This is a positive but small change. This probably reflects upon the dilemma of Government regarding minor lift irrigation schemes. On the one hand, Government is encouraging starting of new projects, on the other hand, there are schemes which are closing down. The bigger canal irrigation projects engulf the small minor lift irrigation schemes and the Government intends to extend this benefit to other dry farming areas.

5.2.2 Growth in irrigated area

Growth in irrigated area under minor lift irrigation was analysed using gross and net irrigated area concepts. While the gross irrigated area under minor lift irrigation decreased. The negative compound growth rate (-1.867) indicated the trend. Net irrigated area, on the other hand, has shown positive growth (1.208).

5.2.3 Working and non-working Minor Lift Irrigation Projects

In all there were 33 lift irrigation schemes established in the pre bifurcation of Bijapur district (1996-97). After bifurcation of the district 15 have gone to Bagalkot district and 20 have remained with Bijapur district. Of the total number of schemes in the two districts, about 61 per cent were non-working and the remaining were (40% working. The performance of schemes on the banks of rivers in Bijapur district was bad. All the units (100 %) have become non-functional. But, the performance of units in Bagalakot district was much better. About 72 per cent of the schemes in Bagalkot were functioning and the remaining 28 per cent were non functional.

The major reason for non-functioning of schemes was the non-availability of water in rivers through out the year. Secondly, there is an argument by the Department that some of these schemes have been overlapped with the command areas of major river projects like

upper Krishna or Ghatprabha or Malaprabha projects and as such there is no demand from the farmers. But, as the availability of water to these command areas is uncertain during dry season these projects need to be continued and water users associations can be formed and the projects handed over to them for maintenance. Preference may be given to small farmers as their situation is precarious in absence of water. The situation of schemes on the banks of river Bhima is very critical as the upper riparian state of Maharasthara is impounding water in its reservoirs over and above the recommendations of Bachawat water Tribunal without the approval of the Central Water Commission. The farmers in the region were forced to approach Supreme Court to request Maharashtra state to release water. The river bed of the Bhima was dry for almost for four years. This was additionally complicated by the droughts. Therefore, it can be inferred that the proper functioning of some of these schemes impinges upon resolution of inter state water disputes. One more factor contributing for non-functioning of these schemes is lack of adequate electrical power supply required to make the heavy pumpsets to work. These problems need to be addressed by the State Government to make best use of the lift irrigation schemes. Small and sustainable village barrages can be constructed by the State Government to store water to be lifted up by these MLIS.

5.2.4 Potential and actual irrigation area

With respect to the performance of MLI in terms of expected and actual irrigation, there was lot of gap, which should be a matter of concern for irrigation experts. An analysis of this performance revealed that only 31.65 per cent of the expected area was under irrigation, which reflected upon severe inefficiency there in. A taluk wise analysis revealed that only the lift irrigation in Jhamkandi (76.25%) and Bagalakot (47.15%) in the present Bagalakot district and only Indi (37.82%) in Bijapur district performed better. Once again the severe electricity shortage, overlapping of command areas, could be the factors responsible for large gap in potential and utilization. But, one fact is clear that huge amount of tax payers money is sunk in these projects. Therefore, the government has to proper stand visa versa minor lift irrigation schemes in the state.

5.3 FEASIBILITY ANALYSIS

5.3.1a Investment in the MLIS

The initial investment of Rs 8,50,000,00 invested on the Adihudi-Todalabagi MLI scheme was compounded to compare these investments with benefits spread over a period of time. Maintenance cost was also taken into consideration while making feasibility analysis.

5.3.1b Benefits from the project

Benefits are the net returns from the project after deducting project investments and investments by the beneficiary farmers. They increased from Rs. 5,42,70,000 in 2002-03 to Rs. 7,94,31,500 in 2005-06.

5.3.2 Net present value

Annual net cash inflows were discounted at 12 per cent rate of interest to obtaine the NPV. The 12 per cent rate of discount was chosen because farmers availed loan from the financial institutions at this rate. The NPV was positive and very large there by suggesting the feasibility of investments in this project. The present value of the net cash flows out was Rs 10, 94,18,283 of scheme (Table 4.7) reveals that the investment on lift irrigation unit was financially feasible.

5.3.3 Benefit cost ratio

The benefit cost ratio of the lift irrigation scheme was 1.57.Since the ratio was greater than unity; the investment on lift irrigation scheme was financially sound and economically

feasible. Similar findings were reported by Sivanappan and Kottiswaran (1985), Atre *et al.* (1987) and Inamdar *et al.* (1996).

Commiserate with the investment requirement (giving additional net benefit of Rs. 5,54,70,000 for first year return it was increase over the coming per year over non beneficiary of lift irrigation) hence, the investment was found to be financially feasible.

The pay back period to recover the initial investment made on lift irrigation scheme was 3.5 years. This indicated that the time required to repay the initial investment made on lift irrigation scheme was quit short. The time being short the risks involved in recovery of initial investment were also low. Hence, the farmers could easily repay the loans taken in a short period of time because of greater profitability of crops like turmeric.

The internal rate of return on investment was 70.5per cent. It was higher than the discount rate (12 per cent) considered in the analysis. This reveals that investment on lift irrigation scheme for the crops grown in the area is economically viable. The findings were in line with the findings of Rao (1989), Neelakartaiah(1991) and Kolavalli et al(1993).

Various feasibility test criteria indicated that the investments in the Aduhudi MLI were feasible. But, there is a general apathy about such MLIS without any scientific consideration. The findings of the present study attempt to clear some of the doubts. Howere, with removal of constraints being faced by the beneficiaries the efficiency of these projects can be improved.

5.4 PERFORMANCE OF LIFT IRRIGATION SCHEMES

5.4.1 Cropping pattern of the respondents in the study area

Major crops grown by beneficiary during *kharif* season were maize and turmeric. Maize shared about 87 per cent of area in the *kharif* season. No crops were grown by non-beneficiary during *kharif* season due to lack of irrigation facilities and unassured rainfall in the study area. Crops taken up during *rabi* seasons by the *beneficiaries* were *Triticum dicocum*, *wheat, sorghum* and *turmeric* (biseasonal). Among these, *Triticum dicocum* occupied major area (59%) followed by wheat (24%). The area under jowar was maximum at around 76 per cent followed by wheat at 16 per cent and sunflower at 8 per cent in the case of non-beneficiary during *rabi* season. The net sown area in the case of beneficiary category (107.5 ha) was less than non-beneficiary (134 ha). The gross cropped area was actually more in beneficiary category because of lift irrigation facility. No crops were taken up in summer season by both beneficiary and non-beneficiary categories because of the provision of irrigation facility through minor lift irrigation scheme was only eight months and there was no other source of irrigation facility.

These results are in accordance with NABARD (2000) study which reported that under irrigated condition-cropping pattern was dominated by commercial crops (74%) followed by food grain crops (26%). It was clear that introduction of lift irrigation pattern is favors of commercial crops like turmeric, maize and *Triticum dicocum*.

5.4.2 Cropping intensities

The cropping intensities on the farms of the respondents reveal that it was more (203 %) in the case of beneficiary than non-beneficiary (100%). This higher cropping intensity reflected more number of crops grown in the same area due to irrigation facility created by lift irrigation scheme. The cropping intensity of the entire area including both beneficiary and non-beneficiary of was 145.75 per cent. This study thus confirms the fact that irrigation facility provided through the lift irrigation enhances the cropping intensity. Thus, to enhance cropping intensity, crop productivity and overall production, lift irrigations need to be considered seriously in developing water resources in the state.

5.4.3 Cost and return structure of crops grown by the sample farmers

Maize, turmeric and *Triticum dicocum* were major crops grown by the cultivators in the command with a returns of 2.16, 3.76, 2.25 and 3.29, respectively per rupee of expenditure. Wheat was cultivated by both beneficiaries and non-beneficiaries but the returns were more on the farms of beneficiaries than non- beneficiaries. *Rabi* sorghum and sunflower were found to have higher returns. Thus, the return for most of the crops cultivated under the command of lift irrigation were higher than those crops grown by the non- beneficiaries. This profitability could be attributed to provision of irrigation facility by the MLIS. Similar finding was reported by Anonymous (1995).

5.5 CONSTRAINS FACED BY THE SAMPLE BENEFICIARIES

The constraints being faced by the beneficiaries were ranked as severe, medium and not severe. According to the grouping, scarcity of water, electricity and input supply and water charges fall in the severe category. The Government should ensure minimum amount of water in the river by constructing small sustainable barrages across rivers to solve water scarcity problem. Special emphasis needs to be placed upon electricity problem. Doubts have often been expressed about efficiency of lift irrigation schemes because of the severe electricity shortage in rural areas. Therefore, it is worthwhile to invest in such projects for overall agricultural development, the Government need to arrange for regular uninterrupted supply of power to these projects.

Regarding water charges a study in Maharashtra (Anonymous, 1988) reported a very high (90%) of collection of water charges. Similarly efforts can be made here by transferring complete responsibility of operation, maintenance and resource management by organizing effective Water User Association (WUA) in the command of the lift irrigation. Cooperation of the staff of minor irrigation department at the ground level was a problem of medium order. The policy makers need to focus on the observation and ensure that ground level staff cooperate with and guide the farmers. Suitability of land for particular crops was also a problem, which some times led to soil degradation problems. The agricultural extension machinery needs to be geared up to face these challenges. Cooperation among the farmers in the command area is also one of the important problems mentioned by the farmers. Lack of cooperation often leads to happen in this command. Initially these things occur due to lack of proper knowledge of sharing resources. Therefore, Water Users Association (WUA) need to be organized in the command for improving overall efficiency of water resources management.

VI. SUMMARY AND POLICY IMPLICATIONS

Water has a pre-eminent position among the natural resources. Though fixed and limited in quantum, it is fortunately a renewable resource. Water is the elixir of life. Water, through its various modes creates, sustains and promotes life on earth. Sharing of water has become a bone of contention in the social and political arena within and across the states and countries of the world. Globally 68 per cent of the cultivated area is rain fed and only 32 per cent is irrigated. World Bank in its report warns of "a serious water crisis in all major countries of the world". It is not land scarcity but water scarcity which is going to play a serious role on the global scene in the coming decades.

Agriculture occupies a predominant position in the Indian economy because of its contribution to overall economic development through supply of food, raw materials and exports. Indian agriculture gambles with monsoon. To carry out agricultural operations efficiently throughout the year, controlled, assured and continuous water supply is essential. The country receives 117 cm of rain annually, which produces 400 m ha. of fresh water. This is more than the global average of 100 cm, but its distribution in time and space is erratic. The variability results, into floods and droughts each year in some parts of the country or the others.

Karnataka, the eighth largest state in India in terms of geographical area has about 55 per cent of its area under cultivation. The ultimate irrigation potential in the state has been estimated by the Government of India at 5.50 million hectares, out of which the net area irrigated during 2004-05 was 2.32 million has which formed only 22 per cent of the net cultivated area.

There are many studies on different irrigation systems like drip, sprinkles and canal irrigation systems. But, studies on government lift irrigation system are few. Particularly in Karnataka no studies have been taken up. Therefore, this study was purposively taken up to study the performance of minor irrigation schemes across Krishna River in Bagalkot district of Karnataka.

SPECIFIC OBJECTIVES OF THE INVESTIGATION

1. To estimate the growth of Minor Lift Irrigation Scheme in Karnataka
2. To analyse investments in selected MLIS
3. To evaluate the performance of selected MLIS
4. Identification of constraints in working MLIS

6.2 METHODOLOGY

6.2.1 Sampling

To achieve the objectives of the study, multistage random sampling was adapted. In the first stage, all the Minor Lift Irrigation Schemes across Krishna river in Bagalkot district were listed. The Aduhudi-Thodalbagi Lift Irrigation Scheme (MLIS) was selected. In third stage, two villages were selected in Jhamkandhi taluk. In the final stage, from each selected village 15 beneficiary and 15 non- beneficiary farmer respondents were selected. In all 60 sample respondents were selected from two selected villages of Bagalkot district. Various source of irrigation are serving the irrigated farming in Karnataka. Important sources are bore wells, dugwells, lakes rivers, canals etc. another important source is lift irrigation scheme, where water is lifted through a jack well to uplands for off distances for irrigation a size area of command has been develop[ed under these schemes. There are many Minor Lift Irrigation (MLI) schemes on the banks of rivers like Bheema, Krishna, Malaprabha and Ghataprabha in northern Karnataka.

One such scheme Adihudi-Thodalbagi Minor Lift Irrigation Scheme was purposively selected to make case study of a typical MLIS

6.2.2 Source of data

For meeting the requirement of the specific objectives of the study, the data were collected from the pre-tested schedule by survey method from the sample farmers by the researcher for the agriculture year 2004-05. Secondary data were collected from the sources like District at a Glance (from district statistical office Bagalkot), State at a Glance, District Minor Irrigation Department, State Minor Irrigation Department Bangalore and Directorates of Economics and Statistical Office, Bangalore.

6.2.3 Analytical tools/techniques employed

Simple statistical tools such a percentage and average were used to analyse the data of cropping pattern of the respondents, Cost and returns of crops grown were worked out. To know the growth of MLIs schemes, compound growth rate technique was used. Financial feasibility tests were employed to analyses the feasibility of the functioning Adihudi-Todalbagi project.

6.3 RESULTS AND DISCUSSION

6.3.1 General characteristics of sample farmers

1. Most of the farmer respondents belonged to either young (43%) or middle age group (50%). The general educational level of the farmer respondents in the study area was low reflecting upon the slow cultural progress. It was observed that majority of the respondent were agriculture based in the project command. A small percentage of farmers outside the project area took to petty businesses also apart from agriculture. Most of the families in the command area belonged to middle size category.

Majority of the farmer's beneficiaries in the command area were small farmers. This is really a welcome sign that the government MLI scheme is helping the small holders to improve their economic status.

2. It was seen that with respect to growth of MLIS in Karnataka. The growth rate of Government MLI scheme increased between 1990-2005 at a compound rate of 1.402 per cent indicating continued relevance of these schemes in the irrigated farming of Karnataka.

3. The growth of gross irrigated area during the period under study decrease at compound rate of -1.867 per cent.

4. The growth rate of net irrigated area under Minor Lift Irrigation Scheme increased significantly over the period at compound rate of 1.268 per cent.

5. In all there were 33 lift irrigation schemes established in the pre bifurcation of Bijapur district (1996-97). After bifurcation of the district 15 have gone to Bagalkot district and 20 have remained with Bijapur district. Of the total number of schemes in the two districts, about 61 per cent were non-working and the remaining (40%) working.

6. With respect to the performance of MLI in terms of expected and actual irrigation, there was lot of gap. An analysis of this performance revealed that only 31.65 per cent of the expected area was under irrigation, which reflected upon severe inefficiency there in. A taluk wise analysis revealed that only the Lift Irrigation in Jhamkandi (76.25%) and Bagalakot (47.15%) in the present Bagalakot district and Indi (37.82%) in Bijapur district performed better.

7. The value of asset of farmers in the study area was not very high with no significant difference between the beneficiary and non- beneficiary groups.

8. Command area crops like maize (87%) and turmeric (13%) dominated in *kharif* season in the case of beneficiaries. Whereas in the case of non-beneficiary, jowar, wheat, sunflower accounted for 76 per cent, 16 per cent and 3 per cent of lands, respectively in *rabi* season. In *rabi* season wheat and *rabi* jowar were important food crops in both the categories of farmers. In general introduction of irrigation through lift irrigation favoured cultivation of profitable commercial crops in the command area.

9. The farms under command area had higher cropping intensities as compared to those on non-command farms. Thus, the study confirmed the fact that irrigation through MLI scheme enhances cropping intensities.

10. Maize, turmeric and triticum wheat were major crops grown by the cultivators in the command with higher returns. Wheat was cultivated by both beneficiaries and non-beneficiaries but the returns was more on the farms of beneficiaries than non-beneficiaries. *Rabi* sorghum and sunflower were found to have higher returns. Thus, returns for most of the crops cultivated under the command of lift irrigation were higher than those crops grown by the non- beneficiaries. This profitability could be attributed to provision of irrigation facility by the MLIS.

11. The financial appraisal of the projects revealed that the pay back period of the investment in the scheme was three and half years for the life period schemes. This short period reflected upon the high degree of financial efficiency and short gestation period of the scheme. At 12 per cent rate of discount, the net present value of the scheme was Rs. 10,94,18,283, Benefit Cost ratio of the scheme were 1.57, the internal rate of return of the investment in the scheme was 70.5 per cent. Based on the short pay back period, positive BCR, high NVP and IRR value it could safely be concluded that the investments made in the minor lift irrigation scheme was worthwhile and economically feasible.

12. The constraints being faced by the beneficiaries have been ranked as severe, medium and no problem. Accordingly scarcity of water, electricity and input supply and water charges fall in the severe category. Government should ensure minimum amount of water in the river by constructing small sustainable barrages across rivers to solve water scarcity problem. Special emphasis needs to be placed upon electricity problem.

Regarding water charges a model of Maharashtra can be adopted and a similarly efforts can be made by transferring the complete responsibility of operation, maintenance and resource management by organizing effective Water User Association (WUA) in the command of the lift irrigation. Cooperation of the staff of minor irrigation department at the ground level was a problem of medium order. The policy makers need to focus on the observation and ensure that ground level staff cooperate with and guide the farmers. Suitability of land for particular crops was also a problem, which some times led to soil degradation problems. The agricultural extension machinery needs to be geared up to face these challenges. Cooperation among the farmers in the command area is also one of the important problems mentioned by the farmers. Therefore, Water Users Association (WUA) need to be organized in the command for improving overall efficiency of national water resources.

POLICY IMPLICATIONS

1. Minor lift irrigation schemes were launched with lot of enthusiasm in the state of Karnataka as a means to mitigate the harms of drought in drought affected earst while district of Bijapur (now Bijapur and Bagalkot) but, many of them have not been functioning properly because of a set of severe constraints. These constraints need to be addressed.

i. Shortage of water in the river course is a severe limiting factor, governments should construct small scale, farmer managed barrages with participation of beneficiaries for storing water in reservoirs.

ii. Many units have become non-functional because of severe scarcity of electricity. The government needs to arrange for uninterrupted power supply to these units. While formulating state energy policy the government should take into account the requirements of these lift irrigation schemes also.

iii. For rationing and equitable distribution of limited water that is supplied by these Minor Lift Irrigation Schemes, Water User Associations need to be organized since command of each MLI is not large and it should be easy for a agency like CADA or University of Agricultural Sciences to facilitate formation of these associations.

iv. Since the financial feasibility analysis of normally working MLI's has revealed their relevance, they need to be continued in the state at need-based location.

2. There are mainly three types of performing MLI namely those working normally, those which require repairs and a little rehabilitation and lastly those which can not be repaired and have been abandoned. The policy prescription for each one of them would be.

i. For those which are working normally, their efficiency needs to be further improved by formation of WUAs, use of water saving devices and adoption of suitable cropping pattern.

ii. For those, which need repair and rehabilitation, the government has to formulate a rehabilitation package with substantial financial outlays.

iii. Those which are non-functional, they should be withdrawn with all their infrastructure and staff.

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APPENDIX I

INTERVIEW SCHEDULE

PERFORMANCE EVALUATION OF MINOR LIFT IRRIGATION SCHEMES IN NORTHERN KARNATAKA

I. GENERAL INFORMATION

1. Name of the respondent:
2. Age :
3. Education :
4. Village : Tq: Dist:
5. Main occupation :
6. Subsidiary occupation : (i) Service (ii)Business (iii)Others
7. Social participation : Member of panchayat/Co-op society/ If any other,specify

Particulars of family

SL.NO.	Name	Gender	Age (years)	Level of education	Occupation	Monthly income(Rs)	Total
1							
2							
3							

Cropping pattern

Field/ Season	Crops	Area (acre)	Production	Productivity	Price (Rs)	Returns	Cost of cultivation	Net Returns
Irrigated – *Kharif*								
Rabi								
Summer								
Rainfed- *Kharif*								
Rabi								
Summer								

Waste land : Dairy/ Poultry/Forestry/Trees/Others(acre)

Asset Position:
I. Land Assets

Field	Total area (acre)	Type of soil	Net sown area (acre)	Land value (Rs)	Total value (Rs)	Leased in acre	Leased out (acre)
Irrigated							
Rainfed							
Waste/fallow							

II. Non-Land assets

Sl. No.	Item	Number	Year of purchase	Purchase value	Labour
1	Tractor				
2	Sprayer				
3	Duster				
4	Electric connection				
5	Land leveling machinery				
6	Cable				
7	Over head tank				
8	Cart				
9	Bullock (pair)				
10	Iron plough				
11	Wooden plough				
12	Blade harrow				
13	Seed drill				
14	Seed cum fertilizer drill				
15	Spade				
16	Pick-axe				
17	Others : 1.				
	2.				
	3.				

III. Livestock/Assets

Sl. No	Animals	Number	Year of purchase	Purchase value (Rs.)	Current value (Rs.)
1	Dairy cows				
	i. Local				
	ii. Crossbred				
2	Buffaloes				
	i. Local				
	ii. Crossbred				
3	Bullock pair				
4	Calves				
5	Poultry				
	i.				
	ii.				
	iii.				
6	Sheep				
7	Goat				
8	Piggery				
9	Fisheries				
	i. Tank				
	ii. Farm pond				
10	Others (specify)				

Sources of income and Expenditure

A. Income

1. Net Farm income

i. Crop

ii. Live stock

iii. Lease-out

2. Net Non-farm income

i. Business

ii. Employment /Job

iii. Any Other (Specify)

B. Non-farm Expenditure Pattern

Sl. No	Basic Requirements	Amount (Rs.)/annum
1	Food	
2	Clothing	
3	Housing	
4	Education	
5	Health	
6	Social	
7	Recreational	
8	Others	

Constraints/problem faced by the farmers

Sl. No	Particulars	Severe	Medium	No problem
1	Availability of water for irrigation			
2	Co-operation of MID-staff			
3	Water charges			
4	Electricity Problems			
5	Water shortage in River			
6	Condition of irrigation structures			
7	Suitability of land			
8	Suitability of Crops			
9	Co-operation among the farmers of the command			
10	Soil Degradation (area)			
11	Availability of credit			
12	Agriculture Consultancy			

PERFORMANCE EVALUATION OF MINOR LIFT IRRIGATION SCHEMES IN NORTHERN KARNATAKA

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ABSTRACT

Minor lift irrigation schemes working under the public sector were launched with great enthusiasm in Karnataka to mitigate the drought. But, many of them have been found non-functioning. This study was taken up to evaluate the performance of minor lift irrigation schemes (MLIS). Objectives of the investigation were estimation of growth of MLIS in terms of numbers and area irrigated and financial feasibility analysis, performance evaluation and identification of constraints in working of Adihudi MLIS across Krishna River. Percentages, compound growth rate and financial feasibility tests were used for analysis.

Major findings of the study are –Growth rate of Government MLI scheme increased during 1990-2005 at a compound rate of 1.40 per cent. In the erstwhile Bijapur district, about 61 per cent of MLIS were non-working. With respect to the performance of MLI in terms of expected and actual irrigation only 31.65 per cent of the expected area was under irrigation, which reflected upon irrigation inefficiency. Financial appraisal of the project revealed that pay back period of investment in the scheme was three and half years. At 12 percent rate of discount, NPV was Rs. 10,94,18,283; BC ratio was 1.57; IRR was 70.5 per cent. Based on these it was concluded that investments made in the minor lift irrigation scheme were economically feasible. Constraints like scarcity of water, electricity and input supply and water charges fell in the severe category. As a policy it is suggested that those MLIs which are working normally, their efficiency needs to be improved through WUAs, use of water saving devices and adoption of suitable cropping pattern; those, which need repair and rehabilitation, the Government has to formulate a rehabilitation package with substantial financial outlays and those which are non-functional, they should be withdrawn with all their infrastructure and staff.