A STUDY ON COMMUNITY PARTICIPATION IN IRRIGATION TANK MANAGEMENT IN HAVERI DISTRICT

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1. INTRODUCTION

The present decade in India is characterized by the damage caused by scarcity of rainfall on one hand and flash floods due to heavy rainfall on the other. More than 75 per cent of the rainfall occurs during four months from June to September and same is compressed in a few gain hours during 25 to 60 rainy days. Therefore, for communities which are living in the low rainfall regions need to conserve rainwater for the utility during rest of the year.

The rainwater is conserved in big dams and small tanks. The large and medium irrigation projects are widely accepted because of their multiple uses in the form of electricity generation, irrigation, recreation, *etc.* however, the big dams create environment and political problems such as submergence of land and displacement of total population which have become serious problems in recent years. Hence, development of tanks assumes importance in these situations.

An irrigation tank is a reservoir constructed across the slope of a valley to harvest rainwater in rainy season and to use it for irrigation and other purposes. Tank irrigation system is less capital intensive and has wider acceptance compared to major irrigations. Tanks can be effectively used for development of backward areas. The tank irrigation system has a special significance to the marginal and small farmers who depend on the tank irrigation. With the breakdown of the institutions governing the tanks, a vast majority of tanks have been silted; thereby water storage capacity has been considerably reduced. Hence, in addition to the community participation, economic viability, social acceptability and technical feasibility of the tanks need to be strengthened.

Tank irrigation in India

Every region in the world has evolved water systems well adapted to its social, geographical, geo-morphological and climatic particularities. While the perennial streams of North India have often led to systems based on diverted flows like the kuhls, in South India traditional water systems have been based mainly on tanks, and often an interconnected cascade of tanks in the lower parts of catchments. Over centuries, a sophisticated system of irrigation had evolved around them that had incorporated regulated access and allocations between and within tanks and also provided for their upkeep and improvement. Though they were not free from the social inequalities that existed in the larger system, nevertheless they provided some minimum water assurance for those traditionally entitled to farming land. With the advent of the British rule and subsequent developments centered around modern and large irrigation systems, tanks were slowly neglected. However, even in the immediate post-independence period tanks still retained their eminence as providers of water for various livelihood purposes. Thus, tanks accounted for 1,151,082 ha in 1960-61 (39.5% of net irrigated area) in Andhra Pradesh and 335,468 ha in 1960-61 (44.18% of net irrigated area) in Karnataka.

Small water reservoirs behind earthen dams are called “irrigation tanks” in India. Tanks are providing surface irrigation, recharging ground water and serving water needs of rural households and livestock. Tank irrigation is an old established practice in most of the semi-arid tropical parts of India, where the monsoon rains disperse erratically during few months of the year and irrigation tanks serve to store and regulate the flow of water for agriculture use. Tanks are a feature in the cultural landscape of peninsular India. They are irrigating one-third of the total paddy area in the states of Andhra Pradesh, Karnataka and Tamil Nadu. The concentration of tanks is high in these states because of undulating terrain, hard rock geology, red soils and bimodal rainfall distribution. During and before 1950’s, Tank irrigation alone accounted for 47 per cent of the total irrigated area. After 1965, this proportion began declining as there has been a spurt increase in the area of canals and wells.

In 1993-94, the area irrigated by tanks was 7.8 per cent of the net irrigated area as compared to 45 per cent in1949-50. The area irrigated by wells and canals continued to increase from 20 per cent to 35.2 per cent and 23.0 per cent to 47.7 per cent of wells and canals, respectively.

South India has a long history of rain water harvesting through tanks and wells. Andhra Pradesh, Karnataka and Tamil Nadu account for nearly 60 per cent of the tank irrigated area. There are about 1, 27,000 tanks in these states as against 2,08,000 tanks in

the country. Although several reasons like deforestation, centralization of authority, poor catchment treatment, issue of private property, increase in population, agricultural transformation, unfavorable institutional framework and its capacity to handle the tank, *etc.* are quite evident from the field research and the available literature that the tank systems are on declining trend in terms of performance.

Tank irrigation in Karnataka

Karnataka has 36,672 tanks with a command area of around 6, 90,000 ha. The actual irrigated area by tank is estimated to be less than 2, 40,000 ha (35% of the total potential). However, there has been a decrease in the net irrigated area by tanks over the years in comparison with other sources of irrigation. Malnad region (Shimoga, parts of Chikmagalur, Dakshina Kannada and Uttara Kannada) has about 25 per cent of the total tanks in the state. Generally, the tanks in this region are small and mainly rain fed rice is grown with supplemented irrigation. Northern plateau (Belgaum, Bijapur, Bellary, Raichur, Gulbarga, and Bidar) has 15 per cent of the total tanks in the state. In southern plateau (Chitradurga, Tumkur, parts of Chikmagalur, Hassan, Kodagu, Mysore, Mandya, Bangalore and Kolar), tanks are well distributed and account for 60 per cent of the total tanks. About 38 per cent of the tanks in Karnataka have a command area of less than four ha and 1.4 per cent of the tanks have command area of more than 200 ha. Tanks with a command area of 4 to 20 ha form about 50 per cent and the tanks with command area of 20 to 200 ha form about 10 per cent of the total tanks (Thippaiah, 2006).

Considering the importance of tanks, GOK has initiated a project entitled “Karnataka Community Based Tank Management Project” with financial assistance from World Bank in the year 2002. Emphasis on restoration of minor irrigation tanks (with area of less than 4 ha and not more than 200 ha) through establishing a separate institution Jala Samvardhana Yojana Sangha (JSYS) with a community-based approach. Its main objective is to improve rural livelihoods, reduce poverty through management of minor tanks through an integrated approach. JSYS is managed by a governing council and executive committee with wide representation from government departments, reputed scientists, voluntary agencies and financial institutions. The project aimed to cover 2000 tanks with participation of people in communities during the period from 2002 to 2007. It was a unique initiative in the history of tank improvement works in the state. It has its basis in the belief that people in communities have a say in determining their own development.

In Karnataka, all tanks with command area of less than 4 ha are owned by the Gram Panchayat, between 4 and 20 ha by the Zilla Panchayat, between 20 and 200 ha by the Minor irrigation department and above 200 ha by the Major irrigation department.

Importance of tank irrigation

Irrigation tanks are small reservoirs impounding runoff water and they are concentrated in peninsular India. Tanks played a vital role in agricultural development in the dry regions of peninsula for centuries. These Tanks are common property resources supporting the village economy and the livelihood of many farming communities. They also impound silt by the process of sedimentation which can also be used to supplement nutrients and improve water holding capacity of soils.

Historically tanks were built by village communities, private individuals and the state. In Karnataka, the tanks have been constructed in a considering technical features, in such a way that overflows of one tank lead subsequent tank(s) in a cascading manner, so that wastage of water is minimized. Further, the storage in tanks enriches the water table by recharging aquifers. This ecological function is more crucial in recharging groundwater than the role of tanks in surface irrigation. Further, in view of the present energy crisis, gravity irrigation is favorable to lift irrigation. Historically an institutional system evolved and prevailed in maintaining tanks as a source of water for villages. This tradition of tanks as a major source of irrigation continued till mid sixties in the semiarid regions.

Raju *et al.* (2003) estimated the potential of tank irrigation in Karnataka to be 6,90,000 ha comparable to the 7,43,383 ha irrigated by large canal systems in Karnataka in 2003-04. Similarly, it has also been pointed out that tank irrigation per hectare is less expensive compared to canal irrigation. According to the data from the Ministry of Water

Resources, Government of India, the cost of creating irrigation potential for one hectare during the Eighth Plan through large and medium irrigation projects was Rs. 98,495 as against just Rs 10,051 for small irrigation projects (Guruswamy and Kaul, 2004). Tanks can play a vital role in livelihood assurance and poverty alleviation if they are rehabilitated and integrated into the larger system with an IWRM (Integrated Water Resource Management) perspective and adequate attention is paid to their advantages and limitations.

As indicated by several studies, tank systems declined in status continuously in the post independence period. By 2004-05 net area irrigated by tanks had fallen to 4,77,100 ha in 2004-05 in Andhra Pradesh (12.29% of net irrigated area) and 1,47,068 ha in 2003-04 in Karnataka (6.17% of net irrigated area). These figures also show that the advent of canal irrigation results in the neglect of tanks and the net result tends to be a replacement of tank irrigation by canal irrigation rather than an addition of canal irrigated area to tank irrigated area. Many studies have been carried out in respect of the decline of tanks. Their decline can be traced to a chain of events started by the takeover of community and zamindari tanks (private tanks) by the state. This had led to an institutional breakdown and erosion of traditional arrangements in most tanks, irregular and poor collection of water charges, lack of maintenance and increasing encroachments on tank beds and feeder channels. The decline also led to decrease in recharge of groundwater and increase in flash floods and overspills and reduced capacities. Tanks were also made redundant because of environmental degradation in upstream catchments such as deforestation, overgrazing, soil erosion and siltation. In addition, changes in land use pattern particularly in the catchment zones of reservoirs, aggravated soil erosion and subsequent siltation in tank beds. With the extension of rural agricultural community beyond the traditional sections, neo-farmers are yet to acquire proper agriculture and water management skills.

Issues in tank management

The original ownership of all tanks is with the state government, the government has delegated the authority of managing the tanks irrigating less than 200 ha of command area to the department of the minor irrigation (DMI). After the formation of the panchayat system in1987, tanks with more than 40 ha of command area continued with DMI, but tanks with less than 40 ha of command area were handed over to zilla panchayat.

Multiple government agencies still have a role in tank system, particularly in the tanks having a command area over four hectares. The departments of Fisheries, Forestry, Revenue, Agriculture and Horticulture have certain roles in the annual water cycle of the tanks in Karnataka. Over a period, due to poor maintenance of tanks, the capacity of tanks has reduced. On an average, tanks get filled up every other year though, the frequency depends on the location, rainfall, topography, soil, land use and run off conditions.

Encroachment in the tank bed area is a major problem. There is no single agency that deals with identification of encroachers going through the appropriate mechanism and following it up at the legal stage for eviction. The complication is also due to the fact that ownership and management positions are not clear and there is no tank level institution to pursue the matter. With multiple agencies looking after individual component of tank systems, there is no effort to go beyond narrow departmental interests.

When people have multiple benefits from the tanks, the interest of the beneficiaries varies depending on the amount of water, season and extent of economic benefits. There are clear cases of conflicts of interests. Even one group among beneficiaries will amplify the conflicts in their interests. In the command area different cropping pattern requires different volumes of water. Among different class of users, the conflicts of interests may arise regarding impounding or releasing of water, fish rearing in impounds water but irrigation requires releasing of water from the tank. Low economic and social interests are probably the causes for virtually neglecting even the maintenance of records of physical characteristics including location of such tanks.

Participatory approach in tank management

Participation as a process is a dynamic, non-quantifiable and essentially unpredictable element. As a process, participation will change the life of the project into a permanent dynamic movement. Participation may not be seen merely as a managerial

technique, but more as a technique to enable rural people to have a more direct involvement in development projects. Participation of farmers is essential dimension for agricultural and rural development and is one of the crucial components of success in irrigation, livestock, water and agricultural projects. People's participation in watershed development and irrigation management programme is very essential for its success. Every piece of land in a tank area should be managed with appropriate soil and water conservation measures and used according to its capacity. This is possible only when everybody having land in a command area voluntarily accepts and implements the recommended plan.

Community participation, as prescribed in the CBTMP (Community Based Tank Management Project), is the foremost feature in the rehabilitation and livelihood enhancement objective of the project. This will be translated into action through the willingness of the community to carry out, contribute and participate in the entire rehabilitation and restoration programmes of the tanks and consequent livelihood enhancement interventions.

The Community Based Tank Management Project in Karnataka aims at improving the rural livelihoods and reducing poverty by developing and strengthening community based approaches to manage 2000 tanks spread over in nine districts of Karnataka. It is envisaged that the project interventions will result in increased productivity as well as irrigable area in the tank commands and catchment; increased households income of direct stakeholders, besides creating other impacts.

To achieve increased productivity, expansion of irrigable area in the command as well as to strengthen the livelihoods of rural poor, landless, SC/ST and women, the educational activities adopted in CBTMP were 1) On-farm demonstrations on water use efficiency, arable and horticulture crops production 2) Training farmers and farm women 3) Farmers Field Schools 4) Study tours 5) Workshop and approaches like (i) Technical and financial support for poor, landless, SC/ST and women groups to enhance their incomes (ii) Enhancing the technical competence of CFTs, ANGOs and the departments field level functionaries through systematic training and capacity building activities (iii) Preparing youth to work as para technicians in project village through establishment of Samudaya Tantrika Vedike (STV) (iv) Adoption of integrated approaches in crop production and management of natural resources and (v) Identification/development of suitable technologies for minimizing water conveyance losses, conjunctive water use plant and desiltation techniques through pilot studies on the principles of participatory technology mode.

Formation of Tank User Groups (TUGs) registered under Karnataka Societies Act comprising of all residents of village(s) associated with system (not only command a farmers), Construction of Tank User Committees with representation of all interest groups including vulnerable segments such as women and tribals, Transfer of main development, operation and maintenance responsibilities from Government to User Groups through planning and implementation of Integrated Tank Development Plans (ITDPs). Cost sharing arrangements for tank development initiative to help and assure. TUGs are committed to the proposed interventions. Strengthening interfaces between user groups and Panchayat Raj Insttitions (PRIs) and line departments to help and improve plot project sustainability.

People organize best around the problems they consider as the most important one, in assessing the needs and planning initiatives to meet the same. They make rational economic decisions in the context of their own environment and circumstances. Voluntary commitment of labour, time, material and money to any project is both an evidence of participation and a necessary condition for breaking pattern of development paternalism. Local control over the amount, quality and distribution of benefits increase self sustainability.

There are many factors, which make the tank management successful. Peoples willing cooperation is definitely the basic one. Tank management is essentially a group action involving the entire population of the tank command area. In order to see that the Tank management gets going and achieves the envisaged results, it is imperative to enlist people's active participation in all the phases of planning and implementation of the management. Therefore, guidelines of the tank management need to be honestly pursued to ensure peoples participation.

However, no attempt has been made to study such aspects in this irrigation tanks. Hence, the present study was formulated and designed with the following specific objectives:

1. To know the extent of participation of farmers in irrigation tank management
2. To study the tank management practices adopted by the tank user groups
3. To ascertain the impact of people participation and irrigation management practices on crop productivity and income of farmers, and
4. To understand the constraints experienced by farmers in irrigation tank management.

Importance of the study

This study is a pioneer attempt of its kind in two ways, firstly; it aims to study the extent of people's participation in irrigation tank management. Secondly, to assess the impact of people's participation and irrigation tank management on crop productivity. The results of the study would help extension agencies, scientists, policy makers and administrators to initiate suitable modifications in the tank management for its great success. In addition, the study focuses on the constraints in tank management. Further, the outcome of the study will be useful to modify the existing strategies and overcome the barriers involved in planning, implementation and enlisting higher level of people's participation in other similar management practices.

Limitations of the study

The study was confined to assess the extent of people's participation in irrigation tank management. Further, the study was restricted to only four tanks in Karnataka state. A wider coverage of the area was not possible due to the limitations of time and other resources at the disposal of the student investigator. However, sufficient care was taken to make this study as objective and systematic as possible. Hence, the findings may be applicable to other irrigation tanks with similar socio-economic background and agro-ecological conditions.

Presentation of the study

The whole process of the study is presented in seven chapters. The first chapter is introduction, which includes objectives, importance and limitations of the study. The relevant review of literature is presented in the second chapter. The third chapter refers to the methodology used for the study, followed by results as the fourth and discussion as fifth chapters. Summary has been dealt in chapter six and references are given in chapter seven and remaining relevant details are presented in appendix at the end.

2. REVIEW OF LITERATURE

A comprehensive review of past studies is very much essential for any research, as it provides the empirical evidence to support the findings. Keeping this in view, an attempt has been made to review available literature on different aspects of the problem under investigation. The review is presented under the following heads.

2.1 People's participation in irrigation management
2.2 Crop management practices in command area
2.3 Impact of irrigation management on crop productivity and income of the farmers
2.4 Constraints experienced by farmers in irrigation tank management

2.1 People's participation in irrigation management

Paliniswami and Easter (1984) studied the management strategies and investment alternatives of irrigation tanks in south India and concluded that farmer's cooperation for efficient management of tank irrigation was very important. They have suggested that farmer's organizations should be encouraged. Further, identification of a strong local leadership was also stressed as a first step in helping farmers to organize.

Raby (1991) evaluated the experience of participatory irrigation management in Sri Lanka and observed that the inclusion of farmers in the decision-making process of management of irrigation systems has been now accepted as necessary to increase productivity and income among the poor in the third world. Therefore, he argued that the farmer participation was not simply a call for empowerment and mobilization of a hither to powerless group but, more fundamentally a development strategy.

Tekynel *et al.* (1997) studied Turkish experiences on participatory irrigation management. This study highlighted the achievements in the process of transfer of irrigation systems to the users. Beyond all expectations, it showed remarkable success. The government encouraged participatory approach through establishing Irrigation Groups (IGs) or Water User Groups (WUGs).

Ul-Haq *et al.* (1997) summarized the strategies and models proposed by various agencies for PIM (participatory irrigation management) and evaluated their main strengths and weaknesses. They also discussed major issues and options for improved irrigation performance and outlined the prospects for the farmer's participation in irrigation management. Their overall recommendation was to pursue comprehensive and integrated strategies for improved irrigation management which needed to be done in conjunction with the institutional framework of the local society.

Yasin and Ahmad (1997) studied modernization of irrigation schemes in Pakistan, of the 17.5 Mha-m of water available in Pakistan Rivers, 10.5 Mha-m was lost through inefficiencies in the national irrigation system. In this context the study described the system's major constraints and outlined the rationale for introducing participatory irrigation management for reduced governmental costs, improved system performance, better response to external pressures and improved environmental sustainability of system.

Heymans (1998) described the implementation of irrigation schemes according to the Scheme Development Process (a participatory irrigation implementation method) within the PATA project (Integrated Agricultural Development Project for selected zones of the Provincially Administered Tribal Areas) in the North West Frontier Province of Pakistan. Farmer managed irrigation scheme was implemented according to a clear step-wise approach in which design, construction and extension were integrated. Farmers participated in all decisions and in all steps of the implementation process and paid 10 per cent of the investment costs before implementation starts. The study suggested that participatory approaches required time consuming preparations but in the end produced the required output.

Shashikumar (1998) reported that people's participation was found to be significant in different programme planning steps *viz*., implementation, execution and evolution stages complemented by NGOs in Karnataka.

Sharma (2001) reported that the success of the watershed development implemented by an NGO Tarun Bharat Sangha (TBS), based at Kishori village of Alwar district in Rajasthan was due to effective participation of beneficiaries in the programme. The NGO formed a Jal Biradari (water work force), the Biradari has people from rural as well as urban areas, who work together to make community participation in watershed development programme.

Chandran *et al.* (2001) reported that, Farmers' participation through Water Users' Associations (WUAs) under Command Area Development Programme (CADA) in Malampuzha Irrigation Project, Kerala State has been quantified. The study has shown that only about 30 per cent of participatory activities envisaged for WUAs are being undertaken by farmers and hence participation is low. Most of the activities undertaken are related to irrigation water management. Activities such as consolidation of landholdings, group farming, adoption of suitable cropping pattern etc are not carried out by most of the WUAs. Farmers were found to contribute money / labour for maintenance of concrete field channels constructed by CADA in order to ensure water availability. However, a system of farm channels for carrying out scientific on-farm water management through channel to field irrigation and Rotational Water Supply (RWS) does not exist for majority of the WUAs. Location (reach) of WUAs on the canal network was not found to influence farmer participation since water scarcity was not a problem in the different reaches. However, size of their landholding was found to influence extent of participation.

Madhavareddy (2001) reported that majority of the NGO beneficiaries had high level of participation in the watershed development programme activities like planning steps *viz.*, collection of facts (66.70%), analyzing the situation (80%), identifying the problem (78.30%), deciding objectives (68.30%), developing a plan of work (66.80%) and execution of plan (66.80%) and medium level of participation was observed in determining the progress (63.40%) and reconsideration with evaluation (66.80%).

Mirani and Menon (2001) reported that, Sindh is the second important province of Pakistan. It has dual economy industrialization in Karachi, Hyderabad and other few cities and agriculture in the rural Sindh. About 70% of the province's population depends on the farming systems for income and employment. This demands sustainable land and water use for poverty alleviation and food security in the rural areas of the province. At present, more than 50% of the rural population is estimated as poor. Among other causes of rural poverty, water logging and salinity are major problems, degrading about 40% of the cultivated area in the province. The Government of Pakistan through the provincial governments has introduced the institutional reforms, envisaging farmer's participation in the management of irrigation and drainage system. It is expected that the reforms would reclaim degraded land, increase the cropping intensity on the same discharge of water courses, and ensure equitable distribution of water.

Abdulkadir *et al.* (2002) recorded experiences in farmers' management of large scale irrigation and drainage projects in Nigeria. Nigeria's experience in farmers' participation in management of irrigation and drainage schemes has been described and the general status of both irrigation development and participatory irrigation management has been outlined. Seven projects were briefly reviewed to assess the levels of farmer's participation in local project management. Nigeria had not yet recorded many success stories on PIM (participatory irrigation management), PJM (participatory joint management) or on WUAs (Water User Associations). Two cases of fairly success of PIM and WUA activities have been noted - at KRIP (in Kano State) and in Jigawa State. At the state level, there were also reports of WUAs functioning marginally satisfactorily at 3 schemes. While the future of PIM and WUAs is highly promising in Hadejia Valley, most other places showed much less promise of WUA sustainability.

Mohan (2002) discussed the earlier and recent experiences with participatory irrigation management (PIM) and the irrigation tank systems in Tamil Nadu and Andhra Pradesh, India. The implications of the existing water policy from the point of view of irrigation tank systems were discussed. The effective involvement of water user's associations can be expected when they were entrusted with meaningful role with sufficient empowerment in terms of financial resources and decision-making abilities.

Wijayaratna (2002) reviewed five resource papers and thirteen selected country papers from the APO Seminar on Organizational Change for participatory irrigation

management held at Philippines. The country papers revealed that all the participating countries took initiatives in PIM. The efforts as well as the successes, however varied across countries due to country-specific socio-political, economic, cultural, and historical factors as well as due to differences in relation to such factors as the stage of irrigation development, characteristics of the organizational structures established for irrigation management and the degree of external assistance.

Douglas and Vermillion (2004) studied on irrigation, collective action, and property rights. They observed that Governments were shifting their role from direct management of irrigation systems to regulation of the water sector, provision of support services to water user associations and capacity building among water user associations and irrigation service providers. International experience suggested that successful irrigation sector reform programs establish both a policy working group and a national secretariat that help to guide and coordinate the planning and implementation of the reform process. The process included strategies such as participatory planning; research and stakeholder consultations; mobilization of political support; design and adoption of an appropriate policy, legal, institutional, and regulatory framework; strategy to coordinate lending and technical assistance; public awareness campaigns and monitoring, evaluations and course corrections.

Heyd and Neef (2004) Drawing on a study of water management in the Mae Sa watershed, northern Thailand, this study analyzed to what extent the constitutional right for participation has been put into practice. In conclusion, the participation of local people in development activities and in the conservation and management of natural resources seems to be currently at the stage of passive or, at best, consultative participation. In order to deal with the severely increasing water problems in northern Thailand, decision-makers have to recognize the value of participation and promote a change of government officers' attitude towards local people through training programs and incentives. Communities and individuals need to be made aware of their constitutional rights and potentials for cooperating with government agencies and participating in their projects.

Sakthivadivel *et al.* (2004) reported that, a study of 41 irrigation tanks in 22 districts of 8 Indian states was conducted under the IWMI-Tata Programme to identify the characteristics of high-performing local-managed tank institutions. This paper discusses some best management practices used by high-performing tank institutions with respect to the following key functions: water acquisition; water allocation and distribution; decision making; enforcement of rules and punishment of violators; and mobilizing financial resources.

Talati and Tushaar (2004) studied institutional vacuum in Sardar Sarovar Project - framing rules of the game. The Sardar Sarovar Project (SSP) in Gujarat was envisioned to blaze a new trail in farmer participatory irrigation project design and management with water user associations building and their own distribution systems. The paper suggested that it was unlikely that the overall vision of the Sardar Sarovar Project for irrigation management will play out for several seasons to come. Farmers were certainly not ready and even the Sardar Sarovar Project was not quite ready to implement its strategy. Institutional alternatives for the Sardar Sarovar Project were recommended.

Yoganand and Gebremedtion (2006) reported that International development goals moved beyond increasing food production to include poverty reduction and protecting the environment in a sustainable way. Degradation of natural resources due to exploitation coupled with population pressure in developing countries causing food insecurity and environmental degradation. Further, participatory watershed management approach is proposed to address this problem effectively.

Bhavsar and Bhagale (2007) revealed that Major parts of the earth do not receive the rains throughout the year. The average rainy days may vary from 10 to 45 from the arid to semiarid region. Therefore, management of the water resources became an essential function of the society. Community management of the water resources had proven over time to be very successful and sustainable. This approach ensures its optimum utilization, conservation, and maximizes the benefits, large numbers of such example are scattered throughout India. Involvements of the people's participation in construction of water harvesting structures and irrigation water management of harvested water shows that the community can bring revolution in the water management sector. The success story sets very good examples of participatory approach and could inspire the people facing the problems of water crisis. This

paper illustrates few successful cases of the participatory Irrigation management practiced in India.

Singh *et al.* (2008) reported that, as in the earlier participatory approach the farmer's involvement in planning and implementation is poor, introduction of participatory process and technologies/practices remains no longer sustainable and once the financial support from the project area is withdrawn farmers' follow the same age old traditional practices. This led to realization that perspectives of local people's needs to be in the center of development, research and extension efforts, if substantial impact is to be made. The objective of this paper is to share the experiences of a multi disciplinary and multi institutional participatory approach undertaken in India, to improve livelihood of community including poorest of the poor through integrated land and water management. The purpose here is to establish a more differentiated communication and a conceptual framework, which can help researchers and practitioners to make better choices and more informed decisions when designing their research, communication and dissemination approaches.

Suresh and Ramesh Babu (2008) conducted a study during 2006-07 in Tumkur district of Karnataka. Majority of the respondents had medium extent of participation (64.77 %) followed by high (28.33%) and low (7.5%) extent of participation. Majority of the respondents had medium extent of participation followed by high and low in activities like motivational meetings (62.50%, 26.67% and 10.83%), planning (68.34%, 23.33% and 8.33%), implementation (62.50%, 25% and 12.50%), maintenance (67.50%, 28.33% and 4.17%) and evaluation (66.75%, 29.16% and 4.17%).

From the above studies, it could be inferred that more number of farmers had medium levels of participation, more number of farmers have actually participated in planning and implementation stages.

2.2 Crop management practices in command area

Vijay Kumar and Narayanagowda (1989) conducted a study on adoption pattern and certain aspects of marketing of potato by farmers in Malur taluk, Kolar district of Karnataka and reported that, majority (38.33%) of the farmers had low adoption level followed by medium (35.00%) and high (26.67%) level adoption category respectively. Further its was reported that among seven recommended practices, only two practices namely, improved seed and seed treatment were followed by cent per cent of farmers. It was also observed that majority of the farmers had adopted optimum spacing (97.00%) and recommended seed rate (95.00%) where as the other recommended practices namely application of farm yard manure, fertilizers and plant protection chemicals were adopted to the extent of 39, 31 and 55 per cent. respectively.

Girase *et al.* (1994) reported that a majority of farmers in Maharashtra adopted recommended practices for kharif jowar like selection of proper soil type, proper preparatory tillage, use of improved varieties, seed rate, time of sowing, spacing and intercultural operation. The adoption was noted to be less of proper doses of chemical fertilizers, use of manure and plant protection measures.

Bagdi *et al.* (1997) in their study revealed that majority of the respondents (80%) adopted intercropping practices on their fields, 64 per cent of them practiced summer ploughing, gully ploughing, mulching and leveled their field and other soil and water conservation practices.

Bhople *et al.* (1997) in their study conducted in Akola district of Maharashtra reported that majority of the respondents have used improved varieties and adhered to recommended sowing time, planting, spacing and irrigation interval for both brinjal and tomato majority of the fruits and vegetables farmers were found to be making partial use of practices related to soil type, seed rate, application of FYM, chemical fertilizers and plant protection measure.

Raghavendra (1997) found that all the arecanut farmers of South Canara district in Karnataka adopted practices namely weeding, harvesting and processing. Majority of them adopted the practices namely application of green leaf and compost, plant protection measures, irrigation, drainage and right spacing.

Ravishankar and Katteppa (1997) in their study on adoption behaviour of potato growers noticed that cent per cent of the growers fully adopted the practice of improved seed.

The practices which were adopted partially by potato farmers were recommended seed rate (81.66%), FYM (56.66%), use of insecticides (28.33%) and use of fungicides (24.16%).

Goud (1998) corroborated that 51.17 per cent of registered sugarcane growers adopted earthing up, followed by spacing (40.05%), fertilizer application (33.33%), seed rate (26.92%), variety (25.06%), plant protection measures (14.67%) and ratoon management (14.61%). Whereas, in case of unregistered growers 34.33 per cent of sugarcane growers adopted earthing up, followed by fertilizer application (20.87 %), variety (16.01%), spacing (15.23%), seed rate (13.33%), ratoon management (4.78%) and plant protection measures (4.17%).

Venkatakumar *et al.* (1998) reported that more than 97 per cent of the respondents of Coimbatore district in Tamil Nadu had adopted recommended variety, correct spacing and method of planting while 45.13 per cent of the farmers adopted water management practices and 28.32, 16.81, 41.6 and 45.1 per cent of the farmers adopted fertilizer application as per schedule, application of micronutrients, application of chemicals for pests and diseases and application of chemical in correct dose, respectively. Only 22.3 per cent of them had taken control measure for button shedding.

Waman and Patil (1998) a study conducted in Nasik district of Maharashtra revealed that 39.33 per cent of onion growers could identifies the pest and disease and only 32.00 per cent of onion growers adopted control measures for the pests and diseases of onion during storage period.

Jahagirdar and Sundaraswamy (1999) reported that majority of the cotton growers adopted practices like seed rate (92.22%), use of certified seed (91.10%) fertilizer application (60.00%), plant protection measures (76.76%) and spacing (52.22%).

Kalaskar *et al.* (1999) in their study conducted in Bhatkali district of Maharashtra reported that majority of respondent adopted the cultural practices like grazing by sheep and goat in cotton field after last picking (85.45%) to check the further liberation of insects, deep ploughing (100%) for exposing soil hibernating states of crop rotation (95.15%) for interruption breeding and multiplication of pest and using pest resistant tolerant variety (92.73%) as per the recommendation.

Dubolia and Jaiswal (2000) revealed that extent of adoption of groundnut cultivation were maximum in respect of sowing time, method of sowing, improved varieties, land preparation, seed rate, intercultural operation, other practices like summer ploughing, doses of fertilizer *etc.* were partially adopted. However, the method of fertilizer application, soil treatment and seed treatment was very low adoption and cent per cent farmers were not using the groundnut culture.

Kubde *et al.* (2000) in their study in Pune district of Maharashtra reported that, the potato growers had partially adopted recommended spacing (97%), plant protection measures (82.0%) manures (64.5%) and fertilizers (55.5%).

Shinde *et al.* (2000) revealed that the adoption of indigenous agricultural practices by the dryland farmers were found to be quite satisfactory *i.e.*, above 90 per cent of the respondents adopted these practices. It was further noted that the cent per cent respondents adopted the crop rotation, seed treatment (90%) with cow urine and dung slurry. East-west sowing in kharif and North-South in rabi season, intercropping (56.67%) under rainfed condition.

Sriram and Palaniswamy (2000) reported that summer ploughing season, hand weeding and synchronized planting were adopted by cent per cent of the farmers. Majority of the farmers adopted practices like mechanical control of pests (99.17%), crop rotation (69.17%), trap cropping (61.67%) and botanical pesticides (61.67%). A less percentage of the respondents adopted seed treatment with bio-fertilizer (27.50%), biofertilizer application in soil (10.83%), alternate furrow irrigation (37.50%), use of pheromone trap (39.17%), yellow sticky trap (10.83%), bio-control agents (30.83%) and destruction of affected plant parts (25.85%).

Vasanthakumar (2000) in his study on knowledge, adoption and economic performance of coffee growers revealed that majority of the small farmers had not adopted the recommended variety (58%), control measures against pests (50%), irrigation (60%), drying yard specification (58%) and recommended moisture content (55%), whereas higher

percentage of both big (72%) and small (82%) growers had not adopted control measures against diseases.

Manjunatha *et al.* (2001) conducted study in Mandya district of Karnataka state on adoption pattern of sustainable water management practices by sugarcane farmers observed that majority (75.50%) of the sugarcane farmers had irrigated the crop grown in red soils once in 5-8 days as recommended, while 18 per cent and 6.5 per cent of them had irrigated the sugarcane crop once in 9-15 days and once in more than 15 days, respectively. All the sugarcane farmers had followed the furrow method of irrigation.

Doraiswamy *et al.* (2002) this paper deals with the comparative analysis of traditional water management practices in tank systems and water sector reforms carried out by Andhra Pradesh, Karnataka and Tamil Nadu in South India. It is well established fact there are certain weakness in traditional system of water management particularly in the society, which is influenced by caste and class structure. Moreover, we cannot push back our clocks to several decades to repeal the traditional practices, but certainly one could learn from positive sides of these cultural practices, which is still unchallengeable in some respects by recent reforms. An attempt is made in this paper also to draw attention on such normative framework prevalent in tank systems that could be better capsules to design participatory irrigation management programme more effectively.

Sudhakar and Kanagasabapathi (2002) noticed that most of the respondents in Viruthunagar district of Tamil Nadu adopted practices like cotton rattoning (95%), summer ploughing (90.95%), crop rotation (90.34%) and use of light traps (85%) and they further reported that nearly three-fourth of respondents adopted correct spacing and intercropping (72.50%).

Vedamurthy (2002) in his study on arecanut growers of Shimoga district reported that, majority of the arecanut growers adopted cultural practices (90.66%) while 68.00 per cent of the growers adopted age of the seedlings, 73.00 per cent adopted the advocated spacing and 59.33 per cent of growers fully adopted the recommended practices of harvesting and processing.

Palanisami (2006) Tank irrigation systems of India are a century old. Most of the tanks have, over time, degraded into open access resources due to weak property relations. Encroachment, privatization and government appropriation of the tanks have been the main outcomes of the failure of local authority systems to enforce the institutional arrangements under the common property resources management regime. About 2% of the tanks in the tankless intensive region and 67% of the tanks in the intensive region have become defunct. Wells that are supposed to be security against late season tank water scarcity have of late become a major threat to the very survival of the tanks. Taxes from multiple uses of the tanks, if collected by a single agency are sufficient to meet the operation and maintenance expenditures of the tanks both in the short run and in the long run. The modernization options derived from a simulation model indicate that software strategies such as sluice management will have a higher pay-off than hardware strategies such as canal lining and additional wells. Policy interventions include physical investments, management and legal aspects.

Thippaiah (2006) studied encroachment of water spread area of tank in Karnataka. Traditional water bodies called tanks were built mainly for catering to the irrigation and drinking needs of the village communities until 1950-51, they played a significant role in helping the rural economies. Over the years, they have lost their significance due to a variety of reasons. Although, many factors have contributed to the dysfunctional conditions. The encroachments upon foreshore/water spread area have played a major role in making the tanks non-viable. This paper focuses on this issue covering aspects like extent of encroachment, encroaches background, reasons for encroachment, consequences of encroachment and remedial measures for the eviction and prevention of encroachments.

Narayana Moorthy (2007) reported that tanks are one of the important traditional sources of irrigation in India, irrigating nearly three million hectares even today. Though considered to be a low cost source with few environmental problems, the performance of tank irrigation has been poor and has deteriorated over the years. Several studies have analysed the performance of tank irrigation using field survey data, but not many studies seem to have analysed the trends and determinants of tank irrigation covering various states as well as national level data in recent times. In this study, using time series data from 1950/51 to

1999/2000, an attempt is made to study the growth pattern of tank irrigation across different periods both at the national as well as across states level, to study the nexus between rainfall and area under tank irrigation at a specific state, which has relatively larger area under tank irrigation, to find out the losers and gainers of tank irrigation among different size of farmers, and to suggest policy measures to rejuvenate tank irrigation in India.

It can be inferred from the above reviews that majority of the respondents were adopted the crop management practices like spacing, seed rate, crop rotation *etc.*

2.3 Impact of irrigation management on crop productivity and income of the farmers

Sisodia (1992) evaluated the impact of warabandi programme on land use, cropping pattern, cropping intensity and yield levels of principal crops in two selected districts of Madhya Pradesh during 1982-83 to 1986-87. As a result of introduction of the programme, irrigation ratio had increased from 40.19 per cent in 1981-82 (before warabandi) to 87.39 per cent in 1986-87. The intensity of cropping showed a modest increase from 104.75 per cent in 1981-82 to 108.93 per cent in 1986-87. After enforcing warabandi, kharif crops as a proportion of net area sown rose to 10.32 per cent, which was worked out to 4.99 per cent earlier and the cropping pattern tilled towards non-food grains, which were more remunerative. The yield rates of bajra, wheat, gram and sugarcane increased by 174 per cent, 41.94 per cent, 46.87 per cent and 20.83 per cent, respectively.

Daghari and Laroussi (1997) studied on training and research for more active farmer's participation in the management of irrigation schemes in Tunisia. The management of water resources was coordinated at the central level by the Agricultural Engineering Directorate and at the local level by the Development Bureau. Together with these structures, new organizations had been promoted like the Public Concern Associations that took the responsibility on behalf of farmers in maintenance, distribution and use of waters.

Groenfeldt and Sun (1997) studied the concept of participatory irrigation management and observed that the inefficiency of the public administration and the market failure in managing water resources necessitated new organizational and managing systems to deal with irrigation policy. User involvement in managing water resources was the most suitable solution to this kind of problem. Spain, USA, Australia and the developing countries had all adopted this practice. Advantages derived from farmer's involvement included a direct knowledge of area specific needs, easier cost control and improved flexibility.

Jairath (1999) studied the participatory irrigation management in Andhra Pradesh. In 1997 the Andhra Pradesh Farmer's Management of Irrigation Systems Act was passed to enable participation of farmers in the maintenance of irrigation systems. She observed that while that led to many initiatives on the irrigation and water-use front, the reforms needed to be carried forward beyond supply-side initiatives to include the critical realm of end-use regulation of water, which would affect cropping patterns and agricultural practices.

Veni and Bhave (1999) reported that while the income of the largest single group was 30 per cent at a reported level of Rs. 2401 to 3500 and the income level of Rs. 3501 to 4800 were very close to the frequency. The income of farmers depends on numerous factors like his interest in farming, his involvement in non-agricultural activities and his other economic sources

Patil (1999) conducted a study on evaluation of land treatment for in- situ moisture conservation in Maize and Seamum crop on medium deep soil found that, positive change in productivity and increase in fodder production due to watershed development programme in various parts of the country.

Sharma (2001) reported that, increase in productivity of the crops over the previous year was due to the effective participation of beneficiaries in watershed development programme.

Ramesh and Gowda (2001) in the study on economic analysis of watershed development programme reported that, the small and large group of farmers in Kabbalanla watershed area of Karnataka obtained comparatively higher productivity out of scarce resources than their counter parts in the non-watershed areas.

Behera and Reddy (2002) estimated the impact of water pollution on crop productivity and area under cultivation in Andhra Pradesh. The study reported that the farmers had incurred substantial losses in both area and the yield. Yield loss was about 76 per cent as against 14 per cent of area loss. In general, marginal farmers had suffered maximum loss in terms of area (33%) as well as yield (80%). This was because the marginal farmers had no access to well irrigation.

Sridhara (2002) evaluated the study on watershed programme and found that, the productivity in the pre-post project period by virtue of implementation of DWDP. It could be inferred that percentage increase in productivity obtained by the farmers was considerably higher over pre project period. 43 per cent of the respondents belonged to income group of Rs 11,001 to Rs 22,000 per annum.

Jiang (2003) Research findings include that the establishment of WUAs has positive effects both on water delivery and rice production. About 80 per cent of the interviewees believe that the introduction and implementation of WUAs has had positive impacts. WUAs has had a positive impact on farmers' willingness to participate in irrigation project, notably in construction and maintenance of infrastructure. WUAs could be a direction and a choice for irrigation devolution reform

Nirmala (2003) in her study on impact of watershed development programme on socio-economic dimensions of beneficiaries revealed that, the productivity obtained under watershed area was found higher as compared to those in nonwatershed area in all the crops both in kharif and rabi seasons.

Chandrasekaran *et al.* (2004) studied participatory irrigation management for efficient water use and enhanced rice productivity in Tamil Nadu. They reported the results of community based on-farm irrigation management trials. Experiments were conducted during 1992-97 at two different sites of the Cauvery Delta Zone to determine the requirements and benefits of improved irrigation management. Treatments included continuous flooding (control) and improved irrigation management (intermittent). Improved irrigation management reduced water use at the head and middle reaches and spared more water for farmers at the tail-end compared with the control. Under the control treatment, inadequate water supply at the tail-end area led to low rice yields, whereas the improved irrigation management permitted judicious use of water by the farmers and resulted in increased rice yields by 40 per cent at the head, middle and tail-end areas. Results indicated that farmers in an irrigation system could increase crop productivity through the judicious management of irrigation water and equal sharing of water from the head to the tail-end area.

Verma *et al.* (2004) in the study on national watershed development programme perceived that the average yields per hectare of Soybean, Maize, wheat and Potato were 15.66, 14.59, 2347, and 213.45 quintals. Respectively in NWDPRA area as compared to 10.54, 9.48, 14.76, and 153.34 quintals in non-NWDPRA area.

Charan (2005) in his study on profile of Sujala watershed project beneficiary farmers revealed that, 18 per cent of the respondent families had annual income above Rs 33,000, 48 per cent of respondent families had annual income between Rs 11,001 to Rs 22,000.

Hosamani and Janawade (2005) studied the effects of irrigations and nutrient management on groundnut oil yield and characteristics of soil. Results of investigation revealed that scheduling of irrigations at pre-sowing, pegging, pod formation and pod filling stage recorded significantly higher oil yield (717 kg/ha) over farm practices (619 kg/ha).

Ninga Reddy (2005) in the study on knowledge, extent of participation and benefits derived by participant farmers of the watershed development programme reported that majority of the respondents belonged to income group of Rs 11,001 to Rs 22,000 per annum (60%) followed by Rs 22,001 to 33,000 (20%) and Rs 11,00 to Rs 33,000 (10%).

Amaranth and Rajap (2006) there has been a growing realization for rehabilitation and restoration of irrigation tanks with farmers' participation. The study has presented the costs and benefits of tank rehabilitation and financial feasibility of investment in tank rehabilitation. The total annual income has been found higher in the rehabilitated tanks than the non-rehabilitated tanks and amongst the rehabilitated tanks, panchayat tanks with community well have depicted the highest annual income. The investment analysis has revealed the net present worth to be positive, the B-C ratio to be more than 1.5 and the

internal rate of return to be more than the opportunity cost of capital. This shows that all the three investments in tank rehabilitation are economically viable. The study has suggested that rehabilitation work should be undertaken in all the non-rehabilitated tanks also. Besides, efforts should be made to provide supplemental irrigation to crops and to improve the PWD tank management regime.

Dasaratharamaiah *et al.* (2006) reported that 10.0 per cent of beneficiaries had income between Rs.7,201 and above, 20.67 per cent had income between Rs.4,801 to 7,200 and 31.33 per cent have income Rs. 3,601 to 4,800 and 38.00 per cent had income below Rs.3,600 per annum after implementation of DWCRA. And it was found that there are no persons without any income.

Shanthamani (2007) reported that the watershed programme has resulted in significant increase in socio-economic status (9.72) mean score, of land productivity increased in yield of Red gram 1.20 q/acre and Jowar 1.02 q/acre and annual income of beneficiaries increased to Rs 22,950. The investigation identified that majority of the respondents were participated in all most all the stages of watershed programme development and implementation.

Savita (2008) reported that difference in crop productivity in the pre and post project period, in case of sugarcane increased from 35 tonnes/acre to 40 tonnes/acre rising by 5 tones/acre. Similarly, in case of redgram increased from 3.5 q/acre to 6.0 q/acre rising by 2.5 q/acre, jowar increasing from 8 q/acre to 13 q/acre rising by 5 q/acre. It was observed that, the increase in annual income of the beneficiaries in case marginal farmers increased from Rs 8,000 to Rs 17000 followed by, semi medium from Rs 13,000 to Rs 26,000, medium from Rs 19,000 to Rs 37,000, big farmers income from Rs 29,000 to 54,000 after implementation project.

Reddy and Behera (2009) Using 'before and after' and 'with and without' methods, this paper assesses the economic and ecological impacts of tank restoration in three villages in Andhra Pradesh, India. This study finds positive impacts of tank restoration on economic and ecological indicators that unequivocally support the rationale for tank restoration in the drought-prone regions. Moreover, the impact is greater in the case of small and marginal farmers when compared with large farmers, indicating a positive effect/influence on poverty. This study also documents the improvements of the groundwater table in the programme villages and the resultant increase in rabi (the second crop in the agricultural season (December–April)) crop acreage and yield rates. Availability of fodder (ecological impact) has strengthened the livestock economy of the programme villages. The economic and ecological impacts of the programme are significant in the case of tanks restored before 1995–1996, indicating the sustainability of the programme.

From the above studies, it could be generalized that there was positive and significant impact of tank irrigation management on the income and crop productivity of the farmers.

2.4 Constraints experienced by farmers in irrigation tank management

Umashankari (1991) assessed tank irrigation in Chittor district of Andhra Pradesh. The inadequency in supply of water by feeder chemicals because of non-participation in cleaning, encroachment of tank bed for cultivation and inadequate repairs, weed infestation and siltation are responsible for disintegration of the traditional system.

Janakarajan (1993) discussed the economic and social implications of ground irrigation in Tamil Nadu. The development of well irrigation in the tank command areas has been one of the main contributing factors in the disintegration of traditional irrigation institutions. The existing regulatory measures and utilization of traditional irrigation systems are totally ineffective in India.

Reddy *et al.* (1993) examined the factors contributing to the deterioration of tank irrigation in Andhra Pradesh with special references to drought prone areas of semi tropic and tropic regions. Severe financial stringency coupled with historical, institutional and technological factors influence the decay of tank irrigation system. In their view, tanks had to be restored and maintained in the interest of the ecosystems of these regions. The suggestions include regular maintenance and repair of the tanks, rising bunds and waste

weirs to recover the tank capacity lost due to siltation. Afforestation and soil conservation in the tank water spread area and in foreshore area help to minimize siltation in the tank water spread area.

Angadi (1995) indicated that there has been a drastic reduction in actual irrigated area as reflected in the tank register, ranging from 16 per cent to 39 per cent. This was due to reduced poor capacity of canals, absence of on farm development works, excessive evaporation loss and poor water management practices. At present by restoration, the capacity regained is equal to the volume of silt removed on the principle of parity of silt volume to water volume. It is estimated that the cost of restoring irrigation facility per acre of achkut for semi dry crops would be around Rs 80, 000 to Rs 1 00,000. Hence, the other method proposed is to raise the waste weir and the tank bund to increase storage capacity, which will be cost effective.

Niranjanram (1995) sharing his experience in rehabilitation of tattamachanahalli tank in Devanahalli taluk suggested that water management should be through introduction of coping mechanism in command area by changing crop pattern from paddy to semi dry crops. Around 26 per cent of the tank has reduced due to siltation. The excavated silt was disposed to structural strengthening of bund, road expansion, pottery, handicrafts, *etc.* the desiltation cost per m^3 of silt removed was Rs. 32.5 at 1990 prices.

Shivanna (1995) stressed the need for rehabilitation of irrigation tanks by restoring them to their original capacity. This could be done in two ways *viz*., dredging and conveying, strengthening and raising the embankment about 1 to 1.5 meters and finally by contour bund method. The contour bunds are used to check the silting of tanks. He also felt the need to create a special division in minor irrigation for rehabilitation and maintenance of tanks, which are the saviors of rural people.

Arumugam and Mohan (1997) examined some major considerations related to tank irrigation systems in south India. The major deficiencies that influence the sustainability are given as inadequate maintenance, reduction in storage capacity, heavy seepage losses in the delivery system, and poor water management techniques. A pressing need is identified to evolve and implement appropriate strategies that are sound on technical, social, institutional and economical dimensions for sustainable development and management of tank systems. Important practical solutions are discussed for urgent action in the context of sustainable development and management of these irrigation systems.

Sharma and Khan (1999) Results showed that the majority of the farmers with irrigation facilities was 73.47% but was supplied during kharif season only. There were 14.28% respondents who reported that they had irrigation facilities for *kharif* and *rabi* seasons, 3.06% of the respondents were found to have perennial irrigation facilities while 9.18% were observed to have no irrigation facilities. It was found that canals were the major sources of irrigation. Other sources were ponds, wells and tanks. It was also found that the problems most perceived was that the seasonal irrigation water was not available whereas the least problems faced was having high losses of water due to muddy irrigation channels. It is suggested that the water reservoirs that were used to provide water for irrigation should have more capacity to store comparatively more water, which may be used for irrigating the fields and as protective irrigation for crops during different seasons.

Sridhara (2002) an evaluative study of watershed programme in pavagada taluk of Tumkur district in Karnataka was carried out during 2002 and reported that the major constraints in soil and water conservation practices faced by farmers were loss of cultivable area, water stagnation near bunded area and time consuming operations. In case of crop production practices the constraints faced by farmers were non availability of labour, lack of finance, heavy risk due to failure of monsoon and costly chemicals.

Palanisami (2006) reported that encroachment, privatization and government appropriation of the tanks have been the main outcomes of the failure of local authority systems to enforce the institutional arrangements under the common property resources management regime. About 2% of the tanks in the tankless intensive region and 67% of the tanks in the intensive region have become defunct. Wells that are supposed to be security against late season tank water scarcity have of late become a major threat to the very survival of the tanks. Taxes from multiple uses of the tanks, if collected by a single agency are

sufficient to meet the operation and maintenance expenditures of the tanks both in the short run and in the long run.

Navaneeth *et al.* (2007) conducted a Study in the Krishna Basin of Karnataka to document the potential created, utilization and to identify the constraints in the development of minor irrigation. Minor irrigation components considered for the study included tanks, barrages, pick-ups and lift irrigation schemes (LIS). The study was reported that Encroachment and siltation of tank bed, poor maintenance, inadequate power, lack of institutional support were identified as the major constraints in the development of minor irrigation in the basin.

From the above reviews, it was concluded that encroachment of tank bed, poor water management techniques and siltation were the important constraints experienced by farmers in irrigation tank management.

3. METHODOLOGY

The materials used and methods carried out during the research period are presented under the following sub-heads.

3.1 Research design
3.2 Locale of the study
3.3 Description of study area
3.4 Selection of villages and respondents
3.5 Measurement of the dependent variables
3.6 Measurement of the independent variables
3.7 Collection of data
3.8 Statistical tools used in the study

3.1 Research design

The research design adopted for this study was ex-post-facto design, since the phenomenon had already occurred.

Ex-post-facto research is the most systematic empirical inquiry in which the researcher does not have direct control over independent variables because their manifestation has already occurred or because they are inherently not manipulatable. Thus, inferences about relations among variables were made without direct intervention from concomitant variation of independent and dependent variables.

3.2 Locale of the study

The present study was conducted in Hanagal taluk of Haveri district during 2008-09.The study was focused on the irrigation tank management undertaken by community. It was preferred to conduct the study in Haveri district of Northern Karnataka state which comes under the jurisdiction of University of Agricultural Sciences, Dharwad. Among the nine districts covered under KCBTMP, six districts fall in North Karnataka. Among the six districts, Haveri district was selected for the study because of higher number of irrigation tanks and it comes under jurisdiction of University of Agricultural Sciences, Dharwad.

Among seven taluks of Haveri district, Hanagal taluk was purposively selected keeping large command area under irrigation tanks as criteria. Number of tanks covered were Doddakere-158 (Akki Alur), Hirekere-23 (Adur), Doddakere (Balambeed), Singapurkere (Singapur),

3.3 Description of study area

3.3.1 Haveri district

Haveri district falls under the northern tract of Karnataka state. It geographically lies within the interior of Deccan peninsula between 14^0 19^1 and 14^0 48^1 north latitudes and between 70^0 15^1 and 75^0 50^1 east longitudes. The geographical area of the district is 4, 85,000 ha and it is bounded on the north by Dharwad and Gadag districts, on the south by Shimoga and Davanagere districts, on the east by Bellary district and on the west by Uttar kannada district.

3.3.1.1 Population and Demography

The geographical area of Haveri district is 4, 85,156 ha spread over seven talukas *viz*., Haveri, Byadagi, Savanur, Ranebennur, Hirekerur, Hanagal and Shiggaon. The population of district according to the year 2003-04 was 14,39,116 with 1000:961 male and female ratio. Out of the total population in the district, 11,40,096 were in rural areas and rests was in urban and semi urban areas. The overall population density of district is 296 per sq.km the growth rate of population in the district was 13.29 per cent (2001).

The geographical area of Hanagal taluka was 77,525 hectares consisting of 3 hoblies and 51 villages. The population of the taluka was 2,30,750 and the density of the population of the taluka was 301 per sq. km, the growth rate of population in the taluka was 13.15 per cent (2001).

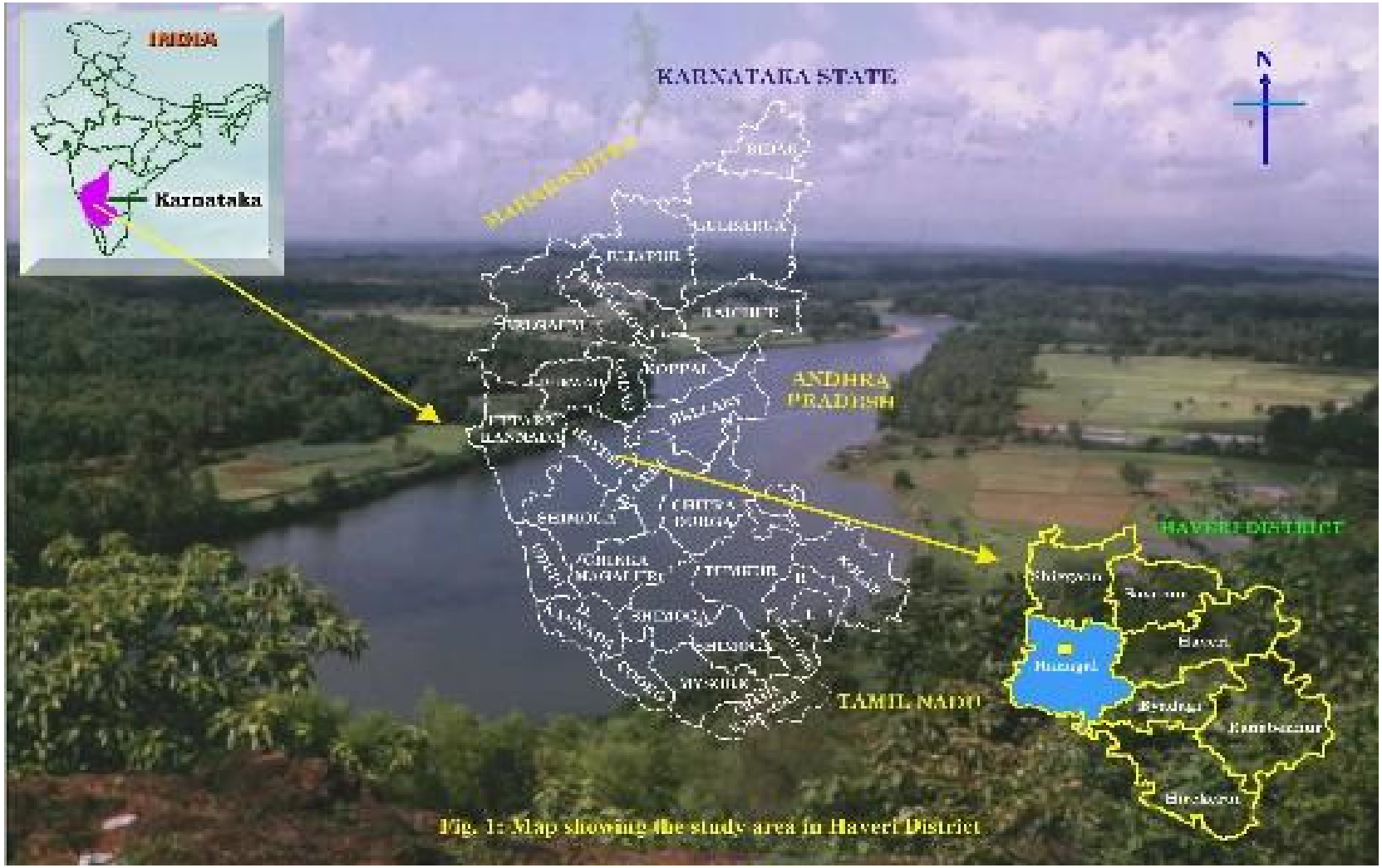


Fig.1 Map showing the study area in Haveri District

Table 1: General features of Haveri district

Sl. No.	Particulars	Haveri district	Hanagal taluk
1	Geographical area (ha)	485156	77525
2	Hoblies (No)	19	3
3	Villages (No)	698	151
4	Population (No)	1439116	230750
5	Rural population (No)	1140096	205829
6	Sex ratio (%)	961	953
7	Density of population (sq. km)	298	301
8	G.R. of population (%)	13.29	12.9
9	Average rainfall (mm)	707.9	956.1
10	Normal rainfall (mm)	752.8	933.4
11	No. of rainy days (average)	655	79
12	Temperature		
	Minimum (^{0}c)	16	14
	Maximum (^{0}c)	36	36

Source: District Statistics Office-2007-08

Table 2: Land use pattern in Haveri district

SL. No.	Particulars	Area (in ha)
1	Geographical area	485156
2	Forest area	47454
3	Net cultivable area	356829
4	Total irrigated area	51002
5	Land not available for cultivation	37370
6	Fallow land	30339
7	Source of irrigation	
	i. Tanks	10579
	ii. Wells	205
	iii. Bore wells	23995
	iv Others	28007

Source: District Statistics Office-2007-08

3.3.1.2 Climate, rainfall and soil type

There are three distinguishable agricultural seasons in the district *viz*, *kharif* (June-September), *rabi* (October-January) and summer (February-May), the south west monsoon commences by about the end of the May or early June and it continues intermittently till the end of September.

The average rainfall in the district was 708.1mm with a major portion of the same being received from south west monsoon only. The average temperature ranges from 16^0c to 36^0c.

3.3.1.3 Land use pattern in Haveri district

The total geographical area of the Haveri district was 4,85,156 ha, out of which the net cultivable area was 3, 56,829 ha, the total irrigated area was 51,002 ha, out of which 10,579 ha, 205 ha and 23,995 ha were irrigated by tanks, wells and bore wells respectively. The area not available for cultivation was 37,370 ha, fallow land was 33,779 ha and 47,454 ha were under forests.

The total geographical area of the Hanagal taluka is 77,525 ha, out of which the net cultivable area was 52866 hectares. The total irrigated area was 17,188 hectares, out of which 6,926 ha, 143 ha and 9,591 ha were irrigated by tanks, canals and bore wells respectively. The area not available for cultivation was 8,364 ha, fallow land was 1,885 ha and 8,474 ha was under forest.

3.4 Selection of Villages and Respondents

From the selected taluka, four villages were selected based on highest command area under irrigation tanks in consultation with JSYS Office, Haveri. The villages selected were Akki Alur, Balambeed, Adur and Singapur.

List of the tank users was ascertained with respect to 4 villages from the office of the JSYS Office, Haveri. Keeping tank management experience as criteria 30 farmers from each village were selected randomly comprising 120 total respondents. The farmers whose lands are in the command area and who are members of tank user group was considered for selection. Thirty farmers from each tank user management were selected by simple random sampling procedure.

Selection of talukas, villages and respondents for the study

Sl. No.	District	Taluka	Village	No. of respondents
1	Haveri	Hanagal	Akki Alur	30
			Balambeed	30
			Adur	30
			Singapur	30
		Total		120

3.5 Measurement of the dependent variables

Keeping the objectives of the investigation in view, two dependent variables *viz.* extent of participation and crop productivity were selected and measured as detailed below.

3.5.1 Extent of participation

The extent of participation was operationlised as the degree to which the farmers (tank users) have involved in different stages (activities) of tank irrigation management. In all, 41 items were identified at two stages of participation *viz.*, tank rehabilitation and crop planning. In this, tank rehabilitation was divided in to two sub stages *viz.*, planning stage which includes preparation of Integrated Tank Development Plan (ITDP) and implementation stage. Both the stages cover 27 items. Remaining 14 items come under crop planning stage. To find out the extent of participation of farmers in tank irrigation management, the responses were collected on three point continuum *viz.*, regularly participation, occasionally participation

and never participation in the activities and the responses were given a score of 2, 1 and 0, respectively. The extent of participation in each activity was computed by totaling the scores obtained by each respondent. The scores obtained on all the steps constituted the total of participation scores of the respondents in tank irrigation management.

The total participation score was worked out for each respondent by adopting the procedure as detailed below.

$$TPS = \sum (e_1 + e_2 + e_3 + e_4 \ldots\ldots + e_{41})$$

Where

TPS = Total participation scores

e_1, e_2, e_3, e_4 = Number of activities in which the respondents participated at the 2 stages of tank irrigation management

The overall participation index was calculated using the following formula

$$\text{Overall participation index (OPI) in tank irrigation management} = \frac{\text{Total scores obtained}}{\text{Maximum possible scores}} \times 100$$

3.5.2 Crop productivity

The ultimate aim of the tank irrigation management is to increase the crop yield. The level of crop yields attained by farmers is a good indicator of the effectiveness of the tank irrigation management. *kharif, rabi* and summer crops were selected. The data on yield per acre of the crops during pre tank rehabilitation period were collected during interview process with the farmers. The per acre yield after tank rehabilitation were also collected during the personal interview with the farmers. The yield obtained with respect to these crops by the respondents in the previous season was considered in terms of quintals per acre. This measure was directly used in computing the relationship with other independent variables.

3.6 Measurement of the independent variables

3.6.1 Education

It refers to the number of years of formal schooling completed by the respondent. Education of the respondent was quantified using the procedure followed by Jetley (1977) and accordingly one score was assigned to each year of formal schooling successfully completed. Further, the respondents were classified into six categories based on classification followed by Trivedi (1963).

Category	Education	Score
Illiterate	Cannot read and write	0
Primary school	1 to 4th standard	1
Middle school	5 to 7th standard	2
High school	8 to 10th standard	3
Pre-university	11 to 12th standard	4
Graduate	Above 12th standard	5

3.6.2 Land holding

It refers to the number of acres of land possessed by the farmer. Using the criterion prescribed by the Karnataka land Reforms Act 38 of 1966 (part –B) 99, 195-96 under section 2(a) 32, one acre of irrigated or garden land was equated to 3 acres of dry land.

The criterion prescribed by Ministry of Rural Development, Government of India vide circular No. 280-12/16/19 RD-III (Vol. II) dated 15th November 1991 and as followed by Shashidhara (2003) was used and the respondents were grouped into different categories as detailed below.

Category	Land holding (in acres)
Marginal farmers	Up to 2.50
Small farmers	2.51 to 5.00
Semi-medium farmers	5.01 to 10.00
Medium farmers	10.01 to 25.00
Big farmers	Above 25.00

3.6.3 Annual Income

Annual income of the family refers to the income earned by all the members of the family of the respondents from different sources per year. Categories of the annual income were done as follows.

The similar classification was followed by Deepak (2003) as per the classification suggested by Ministry of Rural Development, Government of India.

Category	Family income/year (Rs.)
Low income	Upto 17,000
Semi-medium income	17,001-34,000
Medium income	34,001-51,000
High income	Above 51,000

3.6.4 Family size

In the present study, the family size of the respondents was operationally defined as total number of members residing in the family, including new born baby also. It was categorized as small and large family by following the general norm.

Category	Score
Below 5	1
5 and above	2

Usharani (1999) followed the same procedure.

3.6.5 Mass media participation

It refers to frequency in using mass media such as Radio, Television, News papers and Farm Magazines by the respondents. Each respondent in the study area was asked to indicate whether he subscribes to or own the media as mentioned. Then respondents were asked to indicate their degree of participation in terms of listening habit, viewing behavior and reading habit. Then the data was presented in terms of frequency and percentage. The variable was quantified on the basis of procedures followed by Meti (1998).

Subscription	Score
Subscriber	1
Non-subscriber	0

Habit of listening/reading/viewing	Score
Regular	2
Occasional	1
Never	0

3.6.6 Organization participation

Organizational participation is the degree of involvement of the farmer from mere membership to organizational position and his active participation in the meetings of local formal organizations like gram panchayat, co-operatives, youth clubs and other unregistered organizations. The data is presented in frequency and percentage. The variable was quantified on the basis of procedure followed by Saravanakumar (1996). The scoring pattern followed was as under.

Item	Score
Member of an organization	1
Office bearer of an organization	2

The scoring pattern for the attendance at the meetings of the organization was as follows.

Item	Score
Regular	2
Occasional	1
Never	0

Based on the total scores obtained the respondents were classified into three categories, keeping the mean and standard deviation as check.

Low	: Below (Mean – 0.425 SD)
Medium	: Between (Mean $\pm$ 0.425 SD)
High	: Above (Mean + 0.425 SD)

3.6.7 Farming experience

It refers to total number of years of experience in cultivating crops by the farmers. The experience of the farmer in completed years at the time of investigation was considered and the procedure followed by Krishnaprasad (2005) was used to categorize into three groups and taking mean and 0.425 standard deviation as measure of check.

Sl. No.	Farming experience category	Years
1	Low experience	<10
2	Medium experience	10-20
3	High experience	>20

3.6.8 Innovative proneness

It referred to the behaviour pattern of an individual who has interest and desire to seek change in farming techniques and ready to adopt such changes into high operations where practical and feasible. Moulik's (1965) self-rating innovation proneness scale was used to measure the innovation proneness of a farmer. The scale consists of eight statements; each statement contained three statements with weightage of 3, 2 and 1 indicating high, medium and low degree of innovation proneness. After obtaining the respondents most like and least like choices as in original score, responses of each statement, three score was given to most like response and 1 for least like response. The scoring was done by summing up the scores of the weights of the most like statements and weightage of least like statements. As there was three sets of statements for innovation proneness scale, the sum of scores for the three sets was considered as respondents self-rating scores for three sets was considered as respondents self rating score for innovation proneness. The score ranges from minimum of 18 and maximum of 54 respectively. Then respondents were categorized into three categories *viz*., high, medium and low based on mean and standard deviation as the measure of check.

Low	Below (Mean – 0.425 SD)
Medium	Between (Mean $\pm$ 0.425 SD)
High	Above (Mean + 0.425 SD)

3.6.9 Economic motivation

Economic motivation was defined, as the degree to which a respondent was oriented towards profit maximization in main occupation.

The scale constructed by Supe (1969) was used. The scale consists of six statements. The responses were measured on a five point continuum *i.e.* 'strongly agree' 'agree' 'undecided' 'disagree' and 'strongly disagree'. The scoring pattern adopted was 5, 4, 3, 2 and 1 for the positive statements.

Sl. No.	Category	Score range
1	Low economic motivation	10-12
2	Medium economic motivation	12-14
3	High economic motivation	14-16

The data obtained was analyzed by using frequency and percentage.

3.6.10 Crop management practices

Schedule developed for the study to measure this variable. Number of suitable statements were developed and used in the present study. A score of one was assigned for the 'Yes' response and 0 score for 'No' response in case of positive statements. The scores obtained on each statement were summed up to obtain the total scores for a respondent on this variable. The maximum score obtainable by a respondent was 25 and the minimum was 0. This scoring procedure was adopted to quantify this variable.

3.7 Data collection

A draft of interview schedule against set objectives of measuring the variables of the study was first prepared and pre-tested with respondents in the non-sample area. In the light of pre-testing, necessary changes were incorporated in the format of items. The final total of structured interview schedule was used to elicit the required information from the respondents.

The data collection was done by personal interview with the respondents during April, 2009 at their homes /farms.

3.8 Statistical tools used in the study

The data collected from the respondents were scored, tabulated and analyzed by using suitable statistical methods. The statistical methods used in the present study are described below.

Frequency, percentage, mean, standard deviation and chi square were used to interpret the categories of personal, socio-economic characteristics and extent of participation and crop productivity of the respondents. They were also used for interpreting the constraints and suggestions given by the respondents.

Variables selected for the study

Sl. No.	Variables	Empirical measurement
A.	Dependent variables	
1.	Extent of participation	Schedule developed for the study
2.	Crop productivity	Schedule developed for the study
B.	Independent variables	
	Personal, socio-economic and psychological characteristics	
1.	Education	The procedure followed by Jetley (1977)
2.	land holding	The procedure followed by Shashidhara (2003)
3.	Annual income	Procedure as followed by Deepak (2003)
4	Family size	The Procedure followed by Usharani (1999).
5.	Mass media participation	The procedures followed by Meti (1998).
6	organization participation	The procedure followed by Saravana Kumar (1996)
7	Farming experience	The procedure followed by Krishna Prasad (2005)
8.	Innovative proneness	Procedure used by Moulik (1965) with slight modifications.
9.	Economic motivation	Method followed by Supe (1969) with suitable change
10.	Crop management practices	Schedule developed for the study

4. RESULTS

The results are presented under the following major heads in accordance with the objectives of study.

4.1 Personal, socio-economic and psychological characteristics of the farmers
4.2 Extent of participation of the farmers in the tank irrigation management
4.3 Impact of people participation and irrigation management on crop productivity and income of the farmers
4.4 Tank management practices adopted by farmers in tank command area
4.5 Constraints experienced by farmers in tank irrigation management

4.1 Personal, socio-economic and psychological characteristics of the farmers

The data in the Table 3 depicts the personal, socio-economic and psychological characteristics of the farmers. The results are presented under the following paragraphs.

4.1.1 Education

It was clear from the data that nearly 27.50 per cent of the respondents had education upto high school, followed by middle school (26.67%) and primary school (24.17%), while 11.67 per cent of them were illiterates, only 5.83 and 4.17 per cent of respondents had education upto college and degree programme.

4.1.2 Land holding

The distribution of respondents according to land holding revealed that comparatively more number of farmers (30.83%) belonged to semi-medium category, followed by 25.83 per cent in small category and 25.00 per cent in medium category, whereas 11.67 per cent of them had marginal land holding and a meager 6.67 per cent of them belonged to big land holding category.

4.1.3 Annual income

The results indicated that 40.83 per cent of the respondents belonged to high income category (>Rs. 51,000) followed by 29.17 per cent of them belonged to medium income category (Rs. 34,0001 – Rs. 50,000) and 24.17 per cent of them belonged to semi- medium category (Rs. 17,001 – Rs. 34,000), whereas 5.83 per cent of respondents belonged to low annual income category (<Rs. 17,000), respectively.

4.1.4 Family size

It was evident that majority of the respondents had small family size (65.83%), followed by big family size (34.17%), respectively.

4.1.5 Farming experience

It can be confirmed from the table 3 that nearly half of the farmers possessed medium farming experience (40.83%) followed by high (32.50%) and low (26.67%) farming experience.

4.1.6 Innovativeness

The data in Table 3 indicates that more than half of the respondents (52.50%) belonged to medium innovativeness category, whereas 26.67 and 20.83 per cent of them belonged to high and low level of innovativeness categories, respectively.

4.1.7 Economic motivation

The results in Table 3 indicated that, 40.00 per cent of the respondents had medium economic motivation, whereas, 34.58 per cent and 25.75 per cent of them had high and low level of economic motivation, respectively.

Table 3: Socio-economic and psychological characteristics of the farmers

(n = 120)

Sl. No.	Characteristics	Frequency	Percentage
I.	Education		
1.	Illiterate	14	11.67
2.	Primary school	29	24.17
3.	Middle school	32	26.67
4.	High school	33	27.50
5.	College	7	5.83
6.	Degree	5	4.17
II.	Land holding		
1.	Marginal (upto 2.50 acre)	14	11.67
2.	Small (2.51-5.00 acre)	31	25.00
3.	Semi-medium (5.01-10.00 acre)	37	30.83
4.	Medium (10.01-25.00 acre)	30	25.83
5.	Big (Above 25.00 acre)	8	6.67
III.	Annual Income		
1.	Low (up to Rs 17,000)	7	5.83
2.	Semi-medium (Rs 17,001-34,000)	29	24.17
3.	Medium (Rs 34,001-51,000)	35	29.17
4.	High (Above Rs 51,000)	49	40.83
IV.	Family size		
1.	Small (Below 5)	79	65.83
2.	Big (Above 5)	41	34.17
V.	Farming experience		
1.	Low (up to 10 years)	32	26.67
2.	Medium (10-20 years)	49	40.83
3.	High (Above 20 years)	39	32.50
VI.	Innovative proneness		
1.	Low (Mean – 0.425 SD)	25	20.83
2.	Medium (Mean $\pm$ 0.425 SD)	63	52.50
3.	High (Mean + 0.425 SD)	32	26.67
VII.	Economic motivation		
1.	Low (Mean – 0.425 SD)	31	25.75
2.	Medium (Mean $\pm$ 0.425 SD)	48	39.67
3.	High (Mean + 0.425 SD)	42	34.58

4.1.8 Mass media participation

The data pertinent to mass media participation of the respondents as presented in Table 4 revealed that 47.86 per cent of the respondents possessed radio sets. Out of total respondents, 8.33, per cent listened agriculture programmes regularly whereas 7.50 per cent listened news regularly. Nearly seven and five per cent of farmers listened regularly listened entertainment programmes and advertisements. Similarly 34.17 per cent of farmers occasionally listened entertainment programmes, followed by 31.67, 26.67 per cent and least 24.17 per cent farmers listened occasionally advertisement, news, agricultural programmes, respectively. Further, a maximum of 67.50 per cent of farmers never listened agricultural programmes and 65.83 per cent never listened news followed by 63.33 and 59.17 per cent never listen advertisement and entertainment programmes.

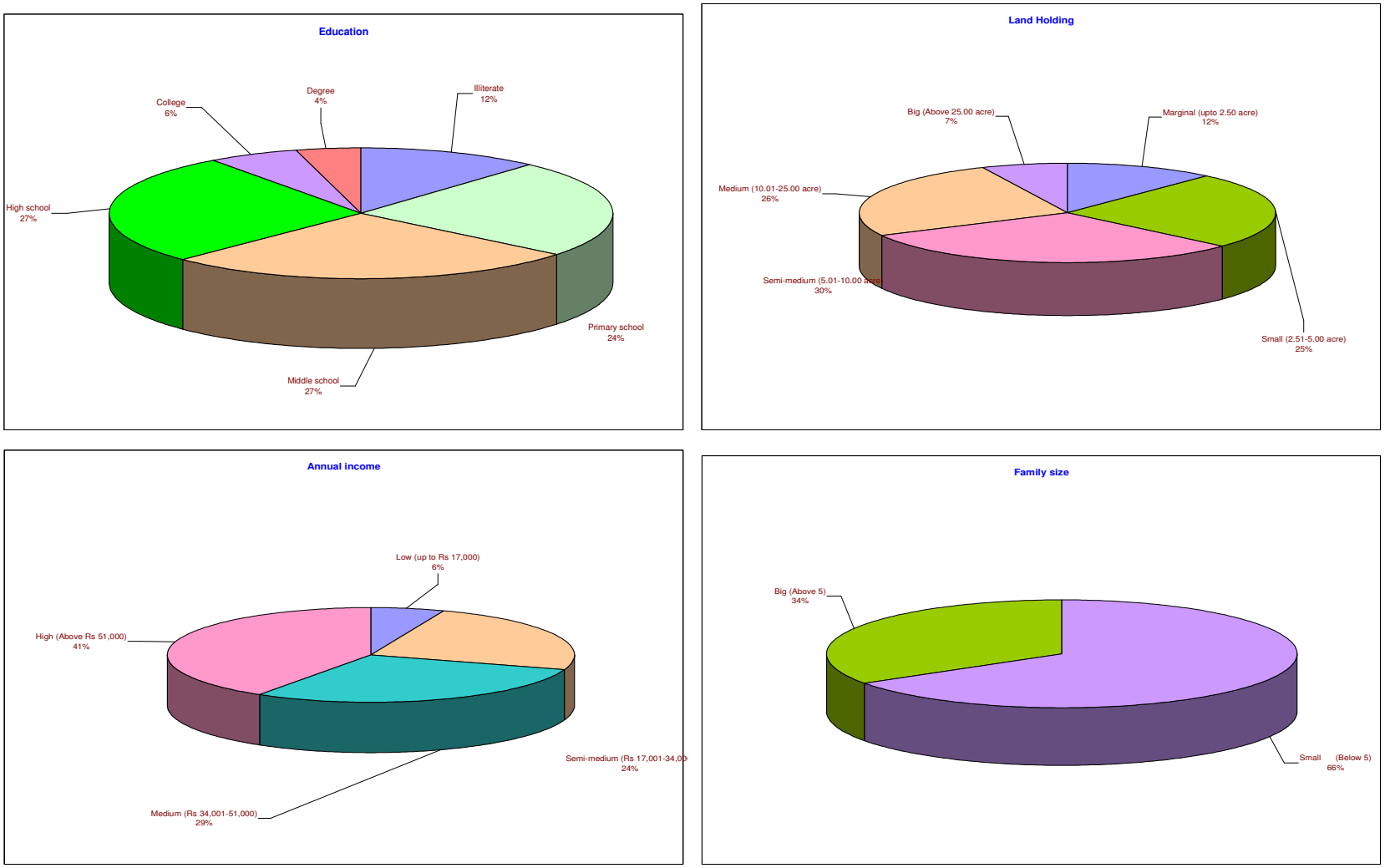
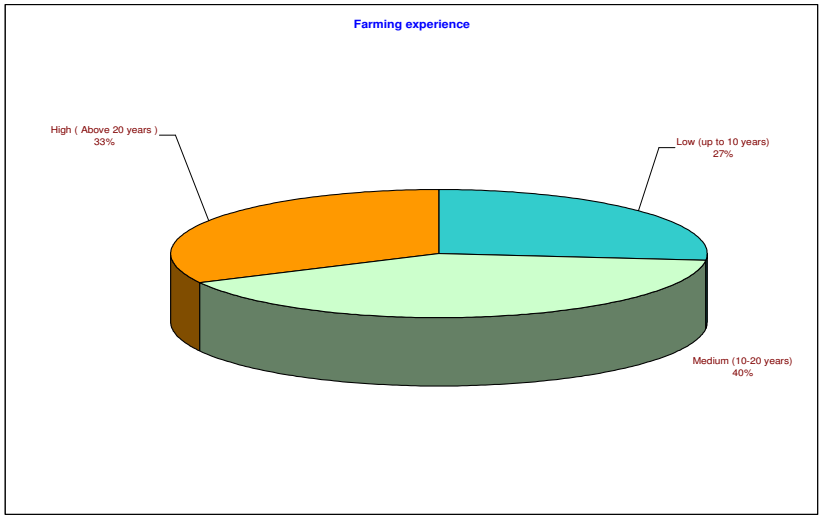
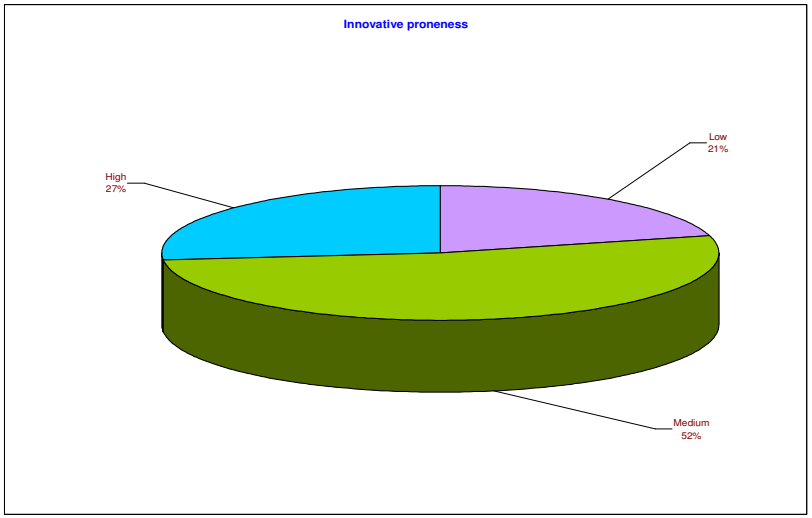


Fig. 2: Socio-economic and psychological characteristics of the farmers

Fig.2 Contd…..


Farming experience
High (Above 20 years)
33%
Low (up to 10 years)
27%
Medium (10-20 years)
40%


Innovative proneness
High
27%
Low
21%
Medium
52%

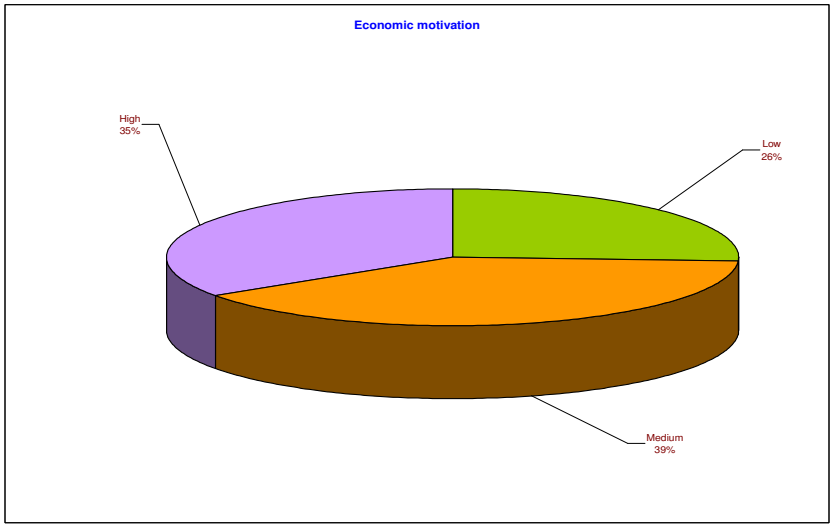

Economic motivation
High
35%
Low
26%
Medium
39%

Table 4: Mass media participation

(n = 120)

Mass media	Owner/Possessed		Extent of reading/listening/viewing					
			Regularly		Occasionally		Never	
	Freq.	Per cent	Freq.	Per cent	Freq.	Per cent	Freq.	Per cent
Radio	57	47.86						
Agricultural programmes			10	8.33	29	24.17	81	67.50
News			9	7.50	32	26.67	79	65.83
Entertainment			8	6.67	41	34.17	71	59.17
Advertisement			6	5.00	38	31.67	76	63.33
Television	97	80.71						
Agricultural programmes			21	17.50	55	45.83	44	36.67
News			57	47.50	33	27.50	30	25.00
Entertainment			53	44.17	39	32.50	28	23.33
Advertisement			32	26.67	62	51.67	26	21.67
Newspaper	37	30.17						
Agricultural information			12	10.00	46	38.33	62	51.67
News			41	34.17	39	32.50	40	33.33
Entertainment			27	22.50	51	42.50	42	35.00
Advertisement			24	20.00	46	38.33	50	41.67
Farm Magazine	18	15.00						
Agricultural information			33	27.50	4	3.33	83	69.17
News			10	8.33	6	5.00	104	86.67
Entertainment			3	2.50	5	4.17	111	92.50
Advertisement			22	18.33	36	30.00	62	51.67

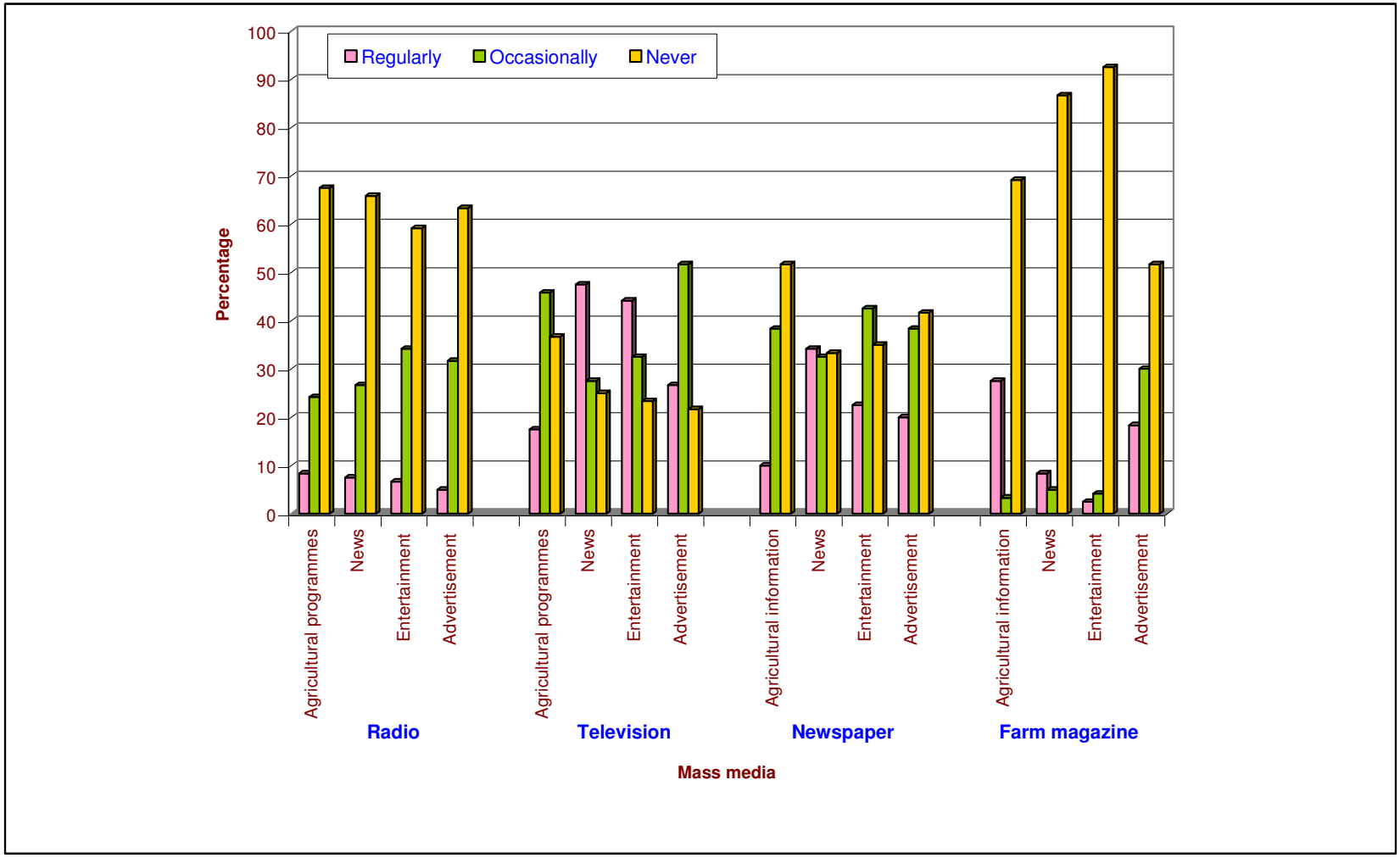


Fig. 3: Mass media participation

Table 5: Organizational participation

(n=120)

Sl. No.	Institution	Membership				Extent of participation					
		Member		Office bearer		Regular		Occasional		Never	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
1.	Gram Panchayat	9	7.5	12	10.00	28	23.12	50	41.66	42	35.22
2.	Farmers service co-op. society	11	9.17	10	8.33	26	21.50	56	46.54	38	31.96
3.	KMF (Karnataka milk Federation) society	25	21.00	0	0	12	10.00	13	11.0	95	79.00
4.	Youth club	12	10.00	7	5.83	19	15.66	12	10.34	89	74.00
5.	SHG (Self Help Group)	17	14.00	0	0	10	8.00	7	6.00	103	86.00
6.	TUG (tank user group)	120	100	0	0	80	66.84	26	21.66	14	11.50
7.	Banks	8	7.00	0	0	66	55.00	42	35.00	12	10.00
8.	Others(TP/ZP/Others)	6	4.66	0	0	4	3.00	2	1.66	114	95.34

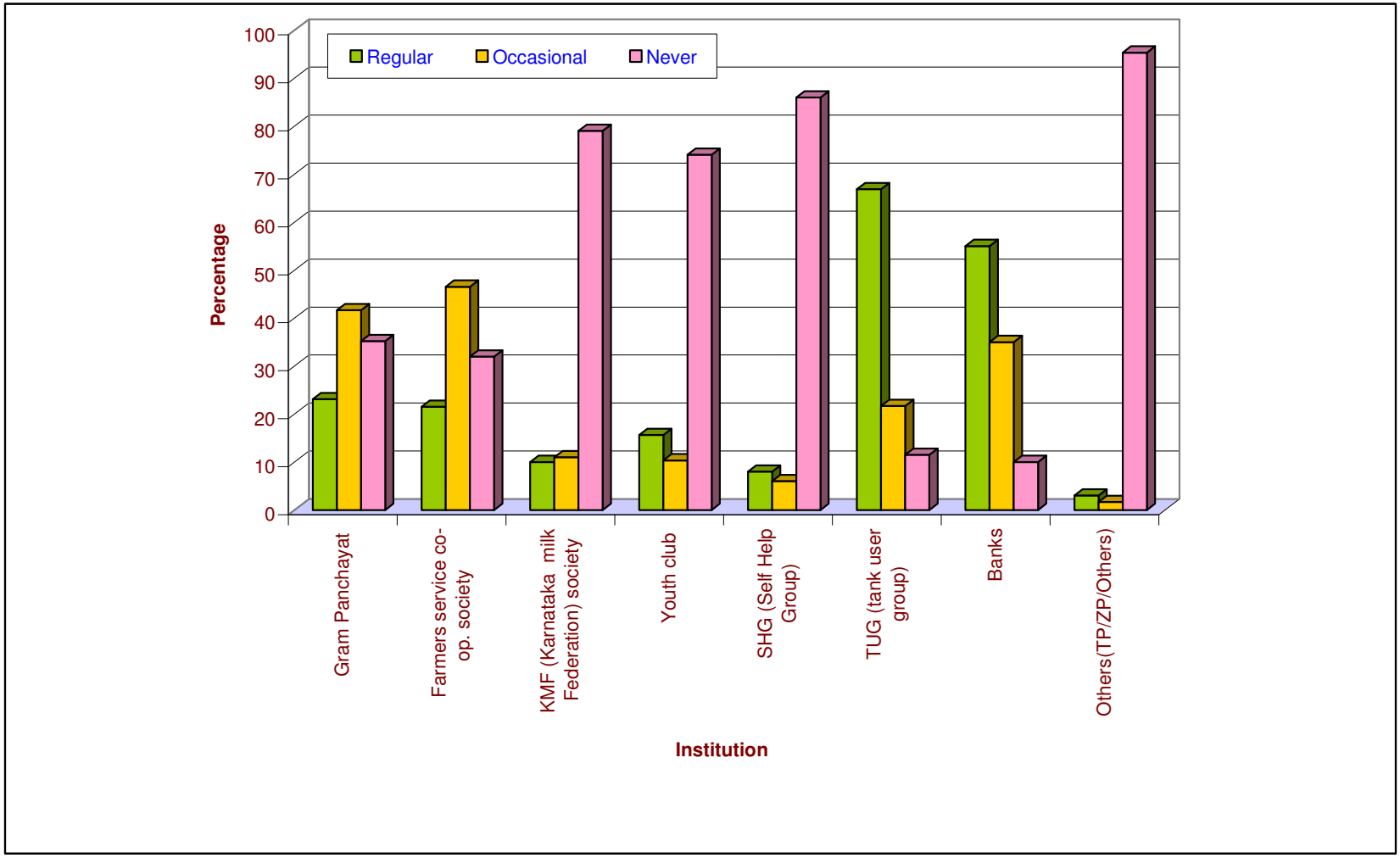


Fig. 4: Organization participation

A high majority of 80.71 per cent of farmers possessed television sets whereas 47.50 per cent of farmers regularly viewed news followed by entertainment (44.17%), advertisement (26.67%) and agriculture programmes (17.50%), respectively. Similarly advertisement was viewed by half of the respondents occasionally (51.67%) followed by 45.83 per cent (agricultural programmes), 32.50 per cent (entertainment) and only 27.50 per cent viewed news programmes. Further farmers who never viewed agriculture programmes were to the extent of 36.67 per cent, followed by 25.00 per cent (news programmes), 23.33 per cent (entertainment) and 21.67 per cent (advertisement) with regard to mass media participation respectively.

Regarding newspaper, 30.17 per cent of the respondents subscribed to newspaper. Regular reading behaviour was observed in 34.17 per cent regarding news, followed by, 22.50, 20.00 and 10.00 per cent of total respondents with respect to entertainment, advertisements and agricultural programmes, news, respectively. Further, it was noticed that 42.50 per cent of the respondents had occasional habit of reading entertainment news, 38.33 per cent advertisements, 38.33 per cent agricultural information and 32.50 news of interest, respectively. More than half (51.67%) of the respondents never had a habit of reading news paper for getting agricultural information, 41.67 per cent advertisements, 35.00 per cent entertainment and 33.33 per cent news, respectively.

Similarly regarding subscription of farm magazine a least of 15.00 per cent of the respondents had subscribed to farm magazine. However, the regular reading behaviour of the respondents was observed to maximum of 27.50 per cent of total respondents with respect to news, followed by 18.33 per cent towards advertisement, 8.33 per cent on news programmes and a least of 2.50 per cent towards entertainment, respectively. One fourth (30.00%) of the respondents were occasional readers of advertisements, followed by 5.00 per cent occasional readers with respect to farm magazine news and towards entertainment, 4.17 per cent and only 3.33 per cent about agricultural information programmes, respectively. However maximum of 92.50 per cent of the respondents never had the habit of reading the farm magazine entertainment, followed by 86.67 per cent (news), 69.17 per cent (agricultural information) and 51.67 per cent (advertisements), respectively.

4.1.9 Organizational participation

The data in Table 5 revealed the organizational participation of command area farmers. Regarding participation in gram panchayat, it was found that 7.50 per cent of respondents were members and 10.00 per cent were office bearers. Further, 35.22 per cent of the respondents never participated, while 41.66 and 23.12 per cent of respondents had occasional and regular participation, respectively.

Regarding participation in farmers co-operative society, 9.17 per cent of respondents were members and 8.33 per cent were office bearers, while 21.50 per cent of them had regular participation, followed by 31.96 and 46.54 per cent were having no participation and occasional participation, respectively.

Twenty one per cent of the respondents were members of Karnataka Milk Federation Society, while 79.00 per cent of them had no participation, whereas 11.00 and 10.00 per cent of the respondents had occasional and regular participation, respectively.

Ten per cent of the respondents were members and 5.83 per cent of respondents were office bearers of youth clubs. Nearly three-fourth (74.00%) of the respondents never participated, while 15.66 and 10.34 per cent of them participated regularly and occasionally, respectively.

Regarding participation in self help groups only 14.00 per cent of the respondents were members, while 86.00 per cent of them had no participation, whereas 8.00 and 6.00 per cent of them had regular and occasional participation, respectively.

Cent per cent of the respondents were members of tank user group. Further 66.84 per cent of the respondents had regular participation, while 21.66 and 11.50 per cent of respondents had occasional and no participation, respectively.

Whereas, 7.00 per cent of respondents were members in banks. While, 55.00 per cent of respondents had regular participation, whereas 35.00 and 10.00 per cent of respondents were having occasional and no participation, respectively.

About other organizations (taluka panchayat and zilla panchayat) 4.66 per cent of the respondents were members and majority of the respondents (95.34%) never participated, whereas, 3.00 and 1.66 percent of the respondents had occasional and regular participation, respectively.

4.1.10 Crop management practices

It is observed from Table 6 that, the crop management practices followed by the farmers are: Timely sowing of crop seeds (71.45%), suitable varieties (65.00%), selection of seeds (88.66%), suitable seed rate (85.65%), suitable spacing (65.75%), seed treatment (41.35%) and selection of drought, pest and disease resistant seeds (36.25%), germination test (35.25%), processing of seeds (29.65%) and storage of seeds (62.50%).

Regarding control of pest infestation, the respondents followed cultural methods (37.54%), mechanical methods (35.65%), biological methods (15.21%) and chemical methods (65.14%), respectively.

Further, it was also noticed that other crop management practices were followed in order of preference like: selection of suitable crops and varieties based on their water requirement (83.47%), suitable irrigation methods (65.32%), conjunctive use of rain, tank and ground water (56.34%), using water based on critical stages of crops (75.69%), using organic manures (FYM/compost, vermicompost, green manure, tank silt *etc*.) (81.33%), using bio fertilizers (16.33%) and using chemical fertilizers (NPK) including micro nutrients formulations (70.23%).

In case of control of weeds, the respondents followed cultural methods (68.21%), mechanical methods (15.33%), biological methods (21.00%) and chemical methods (31.12%), respectively.

4.2 Extent of participation of the farmers in the tank irrigation management

4.2.1 Overall extent of participation of farmers

The overall extent of participation of farmers in the tank irrigation management is depicted in Table 7.

It is observed that, over 50.00 per cent of respondents exhibited medium participation with overall participation index of 47.00 to 58.00 per cent. Less than 30.00 per cent of respondents exhibited high participation (more than 58.00%), followed by low participation (less than 47%).

4.2.2 Extent of participation of farmers in tank irrigation management

A perusal of Table 8 presents the data obtained regarding participation of people in different activities of tank irrigation management.

4.2.2.1 Tank rehabilitation

4.2.2.1.1 Planning

The regular participation of farmers in planning, while conducting Pre-planning Rapid Assessment (PRA) exercises such as, preparation of social map, preparation of resource map, collection of facts about tanks, house hold survey, transact walk were in the range of 35.00 to 53.00 per cent with highest regular participation in collection of facts about tanks (52.50%) and lowest in preparation of social map (35.83%). Further, occasional participation was observed in the range of 35.00 to 46.00 per cent in PRA exercises. Over 43.00 per cent of farmers occasionally participated in preparation of social map (43.33%) and transact walk (46.67%). No participation was observed by about 8-20 per cent of respondents in planning exercises.

Regular participation of farmers in planning stage with respect to identification of specific components such as identification of encroachment area, identification of major problem, leakages in the bund and locations for drainage works were in the range of 29.00 to 55.00 per cent, with highest regular participation in identification of encroachment area (55.00%) and lowest in identification of locations for drainage works (29.17%). Occasional

Plate 1 : Interaction with official members of TUG for elucidating the data

Plate 2 : Interaction of farmers with project staff about tank management practices

Plate 3 : Supervision of tank management by project staff

Plate 4: People participation in FFS (Farm Field School) conducted by UAS, Dharwad

Plate 5: Mechanical method (rotary weeder) to control weeds

Plate 6: Mechanical method (rotary weeder) to control weeds

Plate 7: Intercultivation in maize field

Plate 8: Intercultivation in paddy field

Plate 9 : Command Area of Akki Alur tank

Plate 10: Preparation of farmyard manure

Plate 11: Preparation of suitable spacing in paddy field

Plate 12 : Seedling treatment by *Trichoderma* solution

Table 7: Overall extent of participation of farmers in tank irrigation management

(n = 120)

Sl. No.	Participation categories	Frequency	Percentage	Chi-square
1.	Low (less than 47)	26	21.67	
2.	Medium (47-58)	65	54.17	23.55**
3.	High (more than 58)	29	24.17	

Mean = 52.79 SD = 12.84
**significant at 0.01 level of probability

participation of farmers was observed by about 25.00 to 48.00 per cent in identification process. Over 37.00 per cent of farmers occasionally participated in identification of major problem in tank bed (47.50%) and identification of leakages in the bund (37.50%). Lowest participation was observed in identification of locations for cross drainage works (25.00%).

About 26.00 to 55.00 per cent of farmers regularly participated in taking different decisions regarding tank management such as check dams, dead storages, irrigation water, tank bund, replacement of apron, feeder channels, reconstruction of barrel of sluice structure, avoiding the damages to sluice structure, giving consent to the programme and participation in the removal of silt volume in the canal with highest regular participation in decision regarding required irrigation water (57.50%) and lowest in decision regarding selection of site for check dams (26.67%). Occasional participation of farmers was observed in the range of 18.00 to 46.00 per cent in taking different decisions regarding tank management practices. Over 40.00 per cent of farmers occasionally participated in giving consent to the programme (45.53%) and decision regarding reconstruction of barrel of sluice structure (41.67%). About 9.00 to 45.00 per cent of farmers never participated in taking different decisions with lowest participation in taking decision about creation of dead storages.

4.2.2.1.2 Implementation

About 36.00 to 62.00 per cent of farmers regularly participated in implementation exercises such as carrying out desilting activity (56.67%), repair sluice structures (60.83%), strengthening of tank bunds (61.63%), resectioning of bunds (50.00%), aforestation in tank foreshore (57.50%), arrangement of labour (38.33%), supervision of tank management practices (35.83%) and assigning responsibility to the farmer (45.83%). Highest regular participation was observed in strengthening of tank bunds (61.67%) and lowest in supervision of tank management practices (35.83%). Occasional participation of farmers was observed in the range of 26.00 to 46.00 per cent in implementation exercises. Over 40.00 per cent of farmers occasionally participated in resectioning of bunds (42.50%), arrangement of labour (44.17%), supervision of tank management practices (45.83%) and assigning responsibility to farmers (40.83%). No participation was observed by about 7.00 to 18.00 per cent in implementation exercises.

4.2.2.2 Crop planning

Regular participation of farmers in crop planning exercises such as estimation of water, projecting the irrigated area, deciding the crop based on water, deciding suitable management practices, irrigation based on critical stages of crops, integrated crop management, participation in group meetings, deciding number of irrigations, scheduling of time of water release, deciding repairing of tank work, attending to repair and maintenance, monitoring of neeraganti, deciding water cess, selection and obtaining consent from the

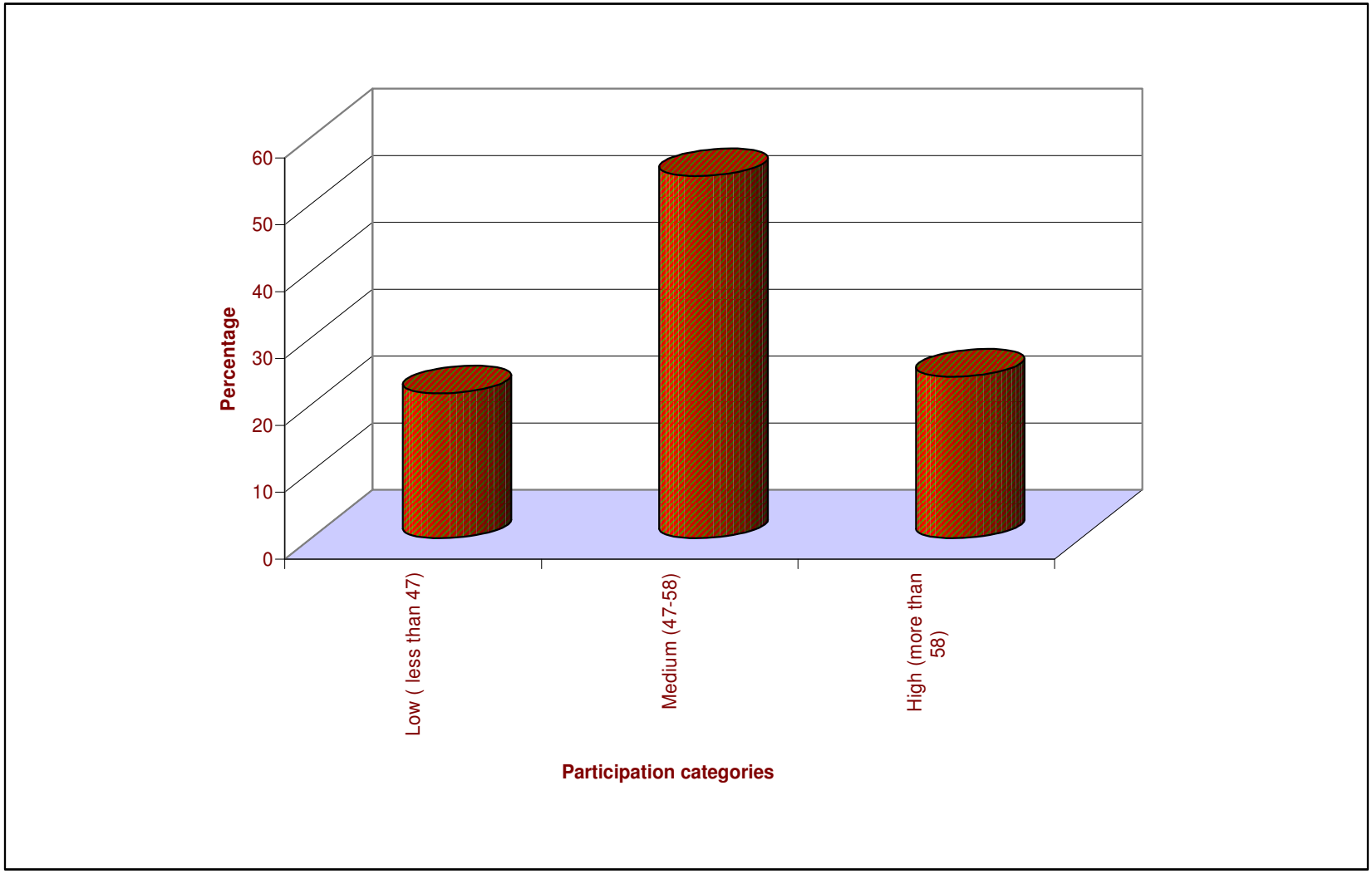


Fig. 5: Overall extent of participation of farmers in tank irrigation management

Table 8: Extent of participation of farmers in tank irrigation management

(n=120)

Sl. No	Tank user activities	Extent of participation					
		Regularly participating		Occasionally participating		Never participating	
		Freq.	%	Freq.	%	Freq.	%
A. Tank rehabilitation							
I. Planning							
1.	Preparation of social map	43	35.83	52	43.33	25	20.83
2	Preparation of resource map	49	40.83	50	41.67	21	17.50
3	Collection of facts about tanks	63	52.50	47	39.17	10	8.33
4	House hold survey	55	45.83	43	35.83	22	18.33
5	Transact walk and planning activities	51	42.50	56	46.67	13	10.83
6	Identification of encroachment area	66	55.00	35	29.17	19	15.83
7	Identification of major problem in tank bed	51	42.50	57	47.50	12	10.00
8	Identification of leakages in the bund & repairing such bund	63	52.50	45	37.50	12	10.00
9	Identification of locations for cross drainage works such as aqua duct or culvert	35	29.17	30	25.00	55	45.83
10	Deciding the selection of site for check dams	32	26.67	34	28.33	54	45.00
11	Deciding about creation of dead storages	36	30.00	29	24.17	55	45.83
12	Decision regarding required irrigation water	69	57.50	42	35.00	9	7.50
13	Decision regarding interventions in tank bund	34	28.33	35	29.17	51	42.50
14	Giving consent to the programme	54	45.00	55	45.83	11	9.17
15	Decision regarding replacement of apron	53	44.17	25	20.83	42	35.00
16	Decision regarding resectioning of feeder channels	56	46.67	22	18.33	42	35.00
17	Avoiding the damages to sluice structure	63	52.50	42	35.00	15	12.50
18	Decision regarding reconstruction of barrel of sluice structure	48	40.00	50	41.67	22	18.33
19	Participation in the removal of silt volume in the canal	65	54.17	44	36.67	11	9.17

Contd…..

II. Implementation							
1.	Carrying out desilting activity	68	56.67	41	34.17	11	9.17
2.	Repair sluice structures	73	60.83	35	29.17	12	10.00
3.	Strengthening of tank bunds	74	61.67	32	26.67	14	11.67
4.	Resectioning of bunds	60	50.00	51	42.50	9	7.50
5.	Aforestation in tank foreshore	69	57.50	37	30.83	14	11.67
6.	Arrangement of labour	46	38.33	53	44.17	21	17.50
7.	Supervision of tank management practices	43	35.83	55	45.83	22	18.33
8.	Assigning responsibility to the farmer	55	45.83	49	40.83	16	13.33
B. Crop planning							
1	Estimation of water in the tank	46	38.33	59	49.17	15	12.50
2	Projecting the irrigated area	48	40.00	59	49.17	13	10.83
3	Deciding the crops based on water availability	62	51.67	50	41.67	8	6.67
4	Deciding suitable management practices	55	45.83	54	45.00	11	9.17
5	Using water based on critical stages of crops	57	47.50	53	44.17	10	8.33
6	Integrated crop management	41	34.17	57	47.50	22	18.33
7	Participation in group meeting or gram sabha about tank management	58	48.33	45	37.50	17	14.17
8	Deciding no. of irrigations	61	50.83	48	40.00	11	9.17
9	Scheduling of time of water release	52	43.33	55	45.83	13	10.83
10	Deciding repairing of tank work	53	44.17	58	48.33	9	7.50
11	Attending to repair & maintenance	42	35.00	66	55.00	12	10.00
12	Monitoring of neeraganti	50	41.67	62	51.67	8	6.67
13	Deciding water cess selection	46	38.33	55	45.83	19	15.83
14	Obtain consent from the encroacher	44	36.67	59	49.17	17	14.17

Legend

A. Tank rehabilitation

I. Planning

1. Preparation of social map
2. Preparation of resource map
3. Collection of facts about tanks
4. House hold survey
5. Transact walk and planning activities
6. Identification of encroachment area
7. Identification of major problem in tank bed
8. Identification of leakages in the bund & repairing such bund
9. Identification of locations for cross drainage works such as aqua duct or culvert
10. Deciding the selection of site for check dams
11. Deciding about creation of dead storages
12. Decision regarding required irrigation water
13. Decision regarding interventions in tank bund
14. Giving consent to the programme
15. Decision regarding replacement of apron
16. Decision regarding resectioning of feeder channels
17. Avoiding the damages to sluice structure
18. Decision regarding reconstruction of barrel of sluice structure
19. Participation in the removal of silt volume in the canal

II. Implementation

1. Carrying out desilting activity
2. Repair sluice structures
3. Strengthening of tank bunds
4. Resectioning of bunds
5. Aforestation in tank foreshore
6. Arrangement of labour
7. Supervision of tank management practices
8. Assigning Responsibility to the farmer

B. Crop planning

1. Estimation of water in the tank
2. Projecting the irrigated area
3. Deciding the crops based on water availability
4. Deciding suitable management practices
5. Using water based on critical stages of crops
6. Integrated crop management
7. Participation in group meeting or gram sabha about tank management
8. Deciding no. of irrigation
9. Scheduling of time of water release
10. Deciding repairing of tank work
11. Attending to repair & maintenance
12. Monitoring of neeraganti
13. Deciding water cess selection
14. Obtain consent from the encroacher

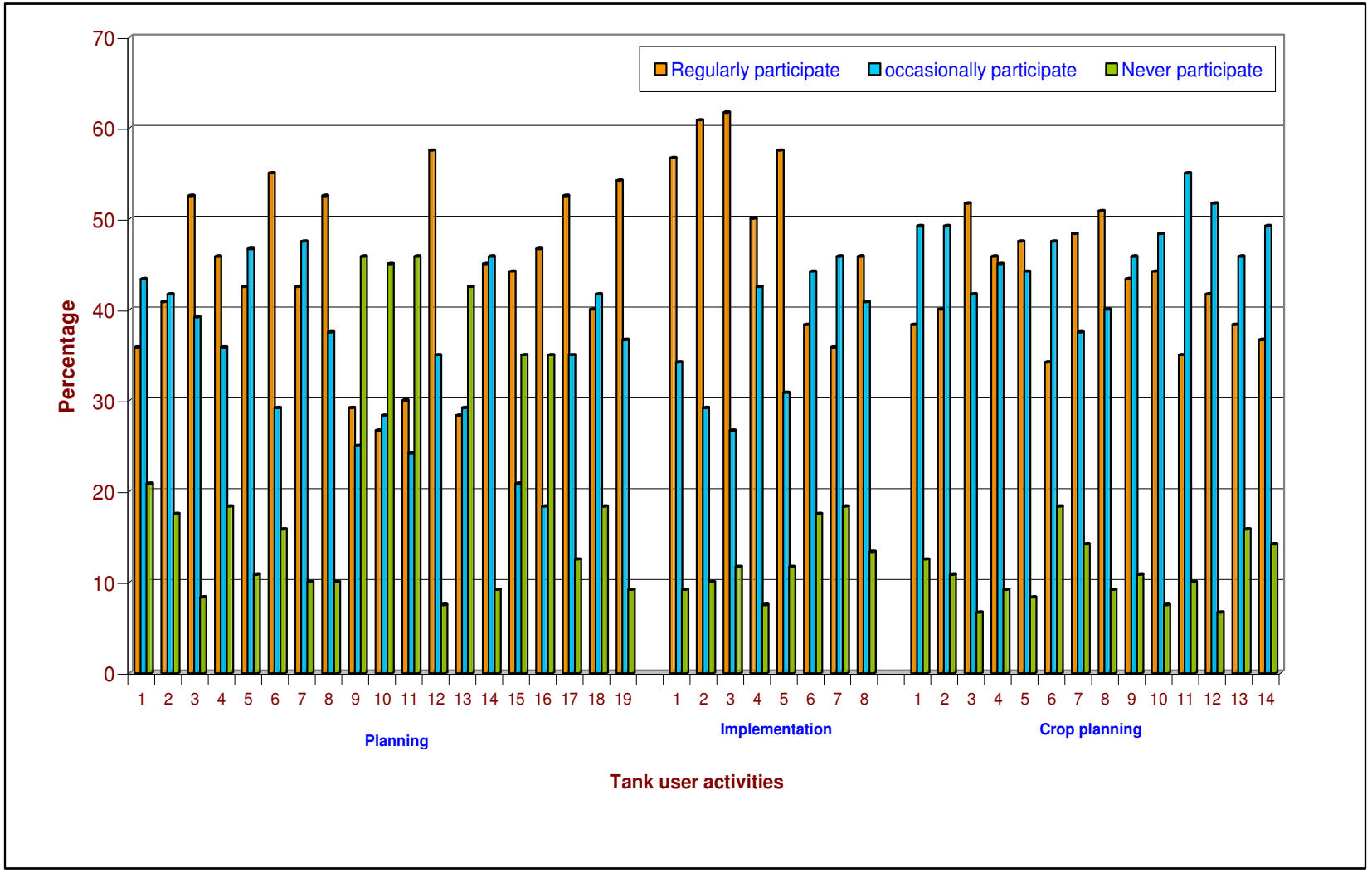


Fig. 6: Extent of participation of farmers in tank irrigation management

Table 9: Impact of people participation and irrigation tank management project on the crop productivity of the farmers

Crops	Before Tank rehabilitation (Avg. yield/acre)	After Tank rehabilitation (Avg. yield/acre)	% change in yield/acre
Cotton	10.25 q/acre	13.75 q/acre	34.14
Paddy	19.5 q/acre	23.75 q/acre	21.79
Maize	17.00 q/acre	20.00 q/acre	17.64

Table 10: Impact of people participation and irrigation tank management on the annual income of the farmers

(n=120)

Variable	Categories	Before tank rehabilitation		After tank rehabilitation		Difference	
		Freq.	%	Freq.	%	Freq.	%
Annual income	Low (below Rs 17,000)	16	13.33	7	5.83	9	7.50
	Semi medium (Rs 17,001-34,000)	35	29.17	29	24.17	6	5.00
	Medium (Rs 34,001-51,000)	45	37.50	35	29.17	10	8.33
	High (above Rs 51,000)	24	20.00	49	40.83	25	20.83

encroacher were in the range of 34.00 to 51.00 per cent, regularly with highest regular participation in deciding the crop based on water availability (51.67%) and lowest in integrated crop management (34.17%). Occasional participation was observed by about 37.00 to 55.00 per cent in crop planning exercises. Over 50.00 per cent of farmers occasionally participated in attending to repair and maintenance of tank (55.00%) and monitoring of neeraganti (51.67%). No participation of respondents was observed by about 6.00 to 16.00 per cent in crop planning exercises.

4.3 Impact of people participation and irrigation tank management project on the crop productivity and income of the farmers

4.3.1 Impact on crop productivity

It could be observed from Table 9 that, there was positive and significant impact of tank rehabilitation on crop productivity. An increase of 34.14 per cent in cotton yield (per acre) was observed after tank rehabilitation. Similarly 21.79 and 17.64 per cent increase in yield levels of respondents was observed after rehabilitation.

4.3.2 Impact on Income

The data presented in Table 10 shows that, there was positive and significant impact of tank management on farmer's income. Increase in per cent of farmers belonging to high income group (above Rs 51, 000) had doubled from 20.00 per cent before rehabilitation to 40.00 per cent after rehabilitation. Similarly the per cent of farmers belonging to low income group (below Rs. 17,000) had reduced from 13.33 per cent before tank rehabilitation to 5.83 per cent after tank rehabilitation. Further about 5 and 8 per cent reduction in per cent of farmers belonging to semi medium (Rs 17,001-34,000) and medium (Rs 34,001-51,000) category was observed before and after rehabilitation.

4.4 Tank management practices adopted by Tank User Groups (TUGs) in tank command area

The results presented in Table 11 depict the adoption level of different tank management practices by TUGs. The results are presented under following sub headings.

4.4.1 Crop planning

The results indicated that, about 41.00 to 81.00 per cent of TUG members had adopted the crop planning practices such as estimating of water in the tank, deciding crops and area in advance, preparing irrigation schedule and adopting suitable irrigation methods, with the highest adoption level observed in deciding crop and area to be sown in advance (81.35%) and lowest in suitable irrigation schedule (41.22%).

4.4.2 Water conveyance

Adoption of different water conveyance practices such as cleaning of canals, maintenance of out lets, letting out water in the field, dry and wet method of irrigation, proper irrigation method (drip/sprinkler), critical criteria according to water scarcity, adoption of second crop and water saving method were in the range of 15.00 to 74.00 per cent with the highest adoption level seen in letting out water in the field according to crop and area (74.36%) and lowest in adoption of dry and wet irrigation methods (15.33%).

4.4.3 Sluice management

The data in the Table 11 revealed that, 71.22 per cent of TUG members adopted the practice of opening and clearing of sluice structure, followed by repairing of sluice structure (54.23%) and oiling of sluice structure (46.33%).

4.4.4 Canal management

The data in the Table 11 revealed that, 85.25 per cent of TUG members adopted the practice of clearing the wastes or silts, followed by repairing of canals (74.35%) and maintaining of outlets (63.47%).

Table 11: Tank management practices adopted by the tank user groups (TUGs)

(n=120)

Sl. No.	Tank management practices	Adopted		Not adopted	
		Freq.	%	Freq.	%
I. Crop planning					
1.	Estimating of water in the tank at different time intervals	68	56.36	52	43.64
2.	Estimating of water requirement of different crop	61	51.21	59	48.79
3.	Deciding crop and area in advance	98	81.35	22	18.65
4.	Allocating the area for different crops	79	65.54	41	34.46
5.	Preparing irrigation schedule	62	51.25	59	48.75
6.	Adopting suitable irrigation methods	49	41.22	71	58.78
II. Water conveyance					
1.	Cleaning of canals before water let off	86	71.25	35	28.75
2.	Maintenance of out lets in the canal	64	53.22	56	46.78
3.	Letting out water in the field according to crop and area	89	74.36	31	25.64
4.	Adopting dry and wet method of irrigation	18	15.33	102	84.67
5.	Adopting proper irrigation method (drip/sprinkler)	42	35.11	78	64.89
6.	Adopting critical criteria according to water scarcity	82	68.32	38	31.68
7.	Adopting second crop to tank advance of residual moisture	43	36.11	77	63.89
8.	Water saving method	57	47.14	63	52.86
III. Sluice management					
1.	Oiling of sluice structure	56	46.33	64	53.67
2.	Opening and closing of sluice gate	85	71.22	35	28.78
3.	Repairing of sluice structure	65	54.23	55	45.77
IV. Canal management					
1.	Clearing the wastes /silts	102	85.25	18	14.75
2.	Repairing of canals	89	74.35	31	25.65
3.	Maintaining outlets	76	63.47	44	36.53
V. Tank management					
1.	Avoiding plants to grow	70	58.64	50	41.36
2.	Avoiding resilting	78	64.85	42	35.15
3.	Avoid grazing on the bund	72	59.61	48	40.39
VI. Tank bed management					
1.	Avoiding encroachment	75	62.36	45	37.64
2.	Avoiding weeds to grow	64	53.18	56	46.82
3.	Avoiding cultivation	73	61.05	47	38.95
VII. Catchment area and Foreshore management					
1.	Maintaining foreshore planting	84	70.38	36	29.62
2.	Maintaining desiltation	91	75.71	29	24.29
3.	Avoiding deep ploughing in the catchment area	61	51.00	59	49.00

Legend

Sl. No.	Tank management practices
I. Crop planning	
1.	Estimating of water in the tank at different time intervals
2.	Estimating of water requirement of different crop
3.	Deciding crop and area in advance
4.	Allocating the area for different crops
5.	Preparing irrigation schedule
6.	Adopting suitable irrigation methods
II. Water conveyance	
1.	Cleaning of canals before water let off
2.	Maintenance of out lets in the canal
3.	Letting out water in the field according to crop and area
4.	Adopting dry and wet method of irrigation
5.	Adopting proper irrigation method (drip/sprinkler)
6.	Adopting critical criteria according to water scarcity
7.	Adopting second crop to tank advance of residual moisture
8.	Water saving method
III. Sluice management	
1.	Oiling of sluice structure
2.	Opening and closing of sluice gate
3.	Repairing of sluice structure
IV. Canal management	
1.	Clearing the wastes /silts
2.	Repairing of canals
3.	Maintaining outlets
V. Tank management	
1.	Avoiding plants to grow
2.	Avoiding resilting
3.	Avoid grazing on the bund
VI. Tank bed management	
1.	Avoiding encroachment
2.	Avoiding weeds to grow
3.	Avoiding cultivation
VII. Catchment area and foreshore management	
1.	Maintaining foreshore planting
2.	Maintaining desiltation
3.	Avoiding deep ploughing in the catchment area

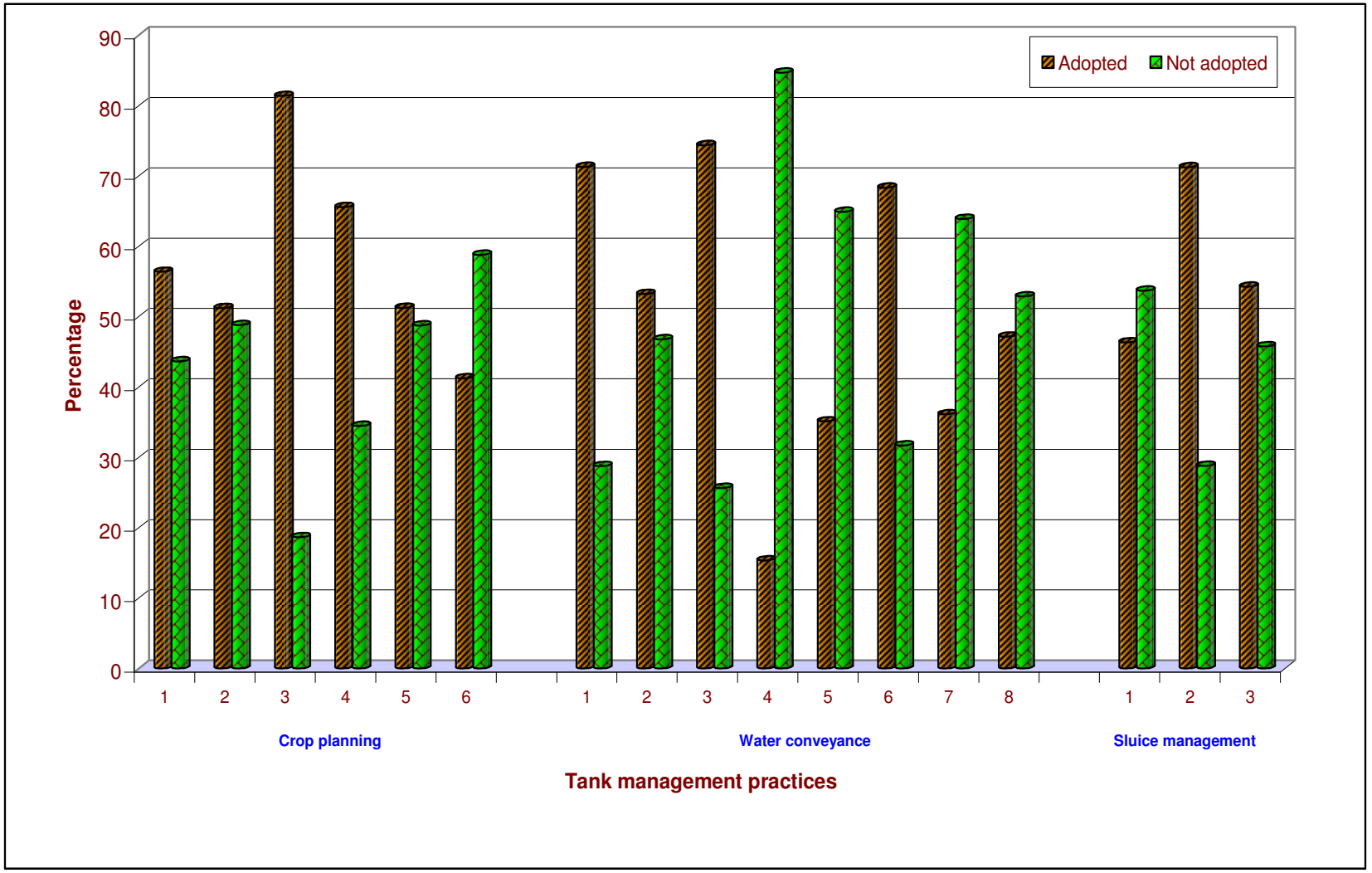
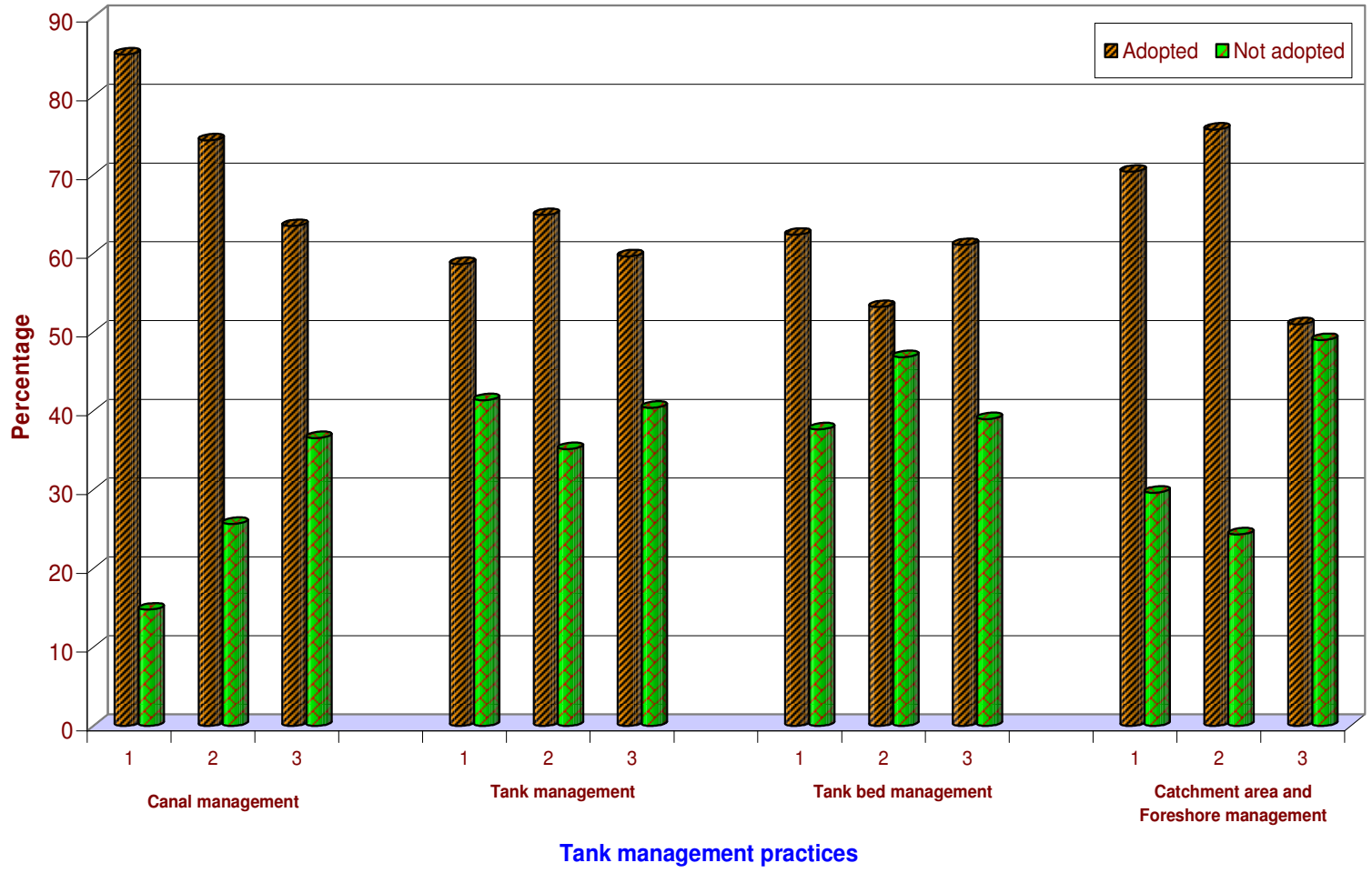


Fig. 7: Tank management practices adopted by the tank user groups (TUGs)

Fig. 7 Conrd.....


Adopted
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Percentage
90
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70
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1
2
3
Canal management
Tank management
Tank bed management
Catchment area and Foreshore management
Tank management practices

4.4.5 Tank management

The data in the Table 11 revealed that, 64.85 per cent of TUG members adopted the practice of avoiding resilting, followed by avoid grazing on the bund (59.61%) and avoiding plants to grow on bunds (58.64%).

4.4.6 Tank bed management

The data in the Table 11 revealed that, 62.36 per cent of TUG members adopted the practice of avoiding encroachment, followed by avoiding cultivation (61.05%) and avoiding weeds to grow (53.18%).

4.4.7 Catchment area and foreshore management

The data in the Table 11 revealed that, 75.71 per cent of TUG members were maintaining desiltation, followed by maintaining foreshore planting (70.38%) and avoiding deep ploughing in the catchment area (51.00%).

4.5 Constraints experienced by farmers in tank irrigation management

The information on various constraints experienced by the farmers in tank management is presented in Table 12. The constraints are grouped under different sub-heads, which are presented below.

4.5.1 Technical constraints

The major technical constraints experienced by farmers were lack of knowledge about tank management practices (79.25%), followed by non-availability of required irrigation water (65.17%), lack of time to participate in tank user group meetings (63.18%).other technical constraints faced by the farmers were lack of motivation from the tank user group leaders (58.54%), lack of knowledge about crop planning (56.24%) and lack of guidance regarding tank management practices (41.25%).

4.5.2 Tank management

The major constraints related to tank management experienced by farmers were accumulation of silt in command area (61.58%) followed by poor physical status of tank (45.36%), poor maintenance of tank structures (36.24%) and mismanagement of command areas (35.47%).other tank management constraints faced by the farmers were improper rehabilitation of tank structures (34.68%), mismanagement of catchment areas (31.65%), inadequate drainage (25.78%).

4.5.3 Other constraints

Other constraints experienced by farmers were low crop productivity (53.24%) followed by over irrigation to the crops (51.35%) and poor water distribution (22.13%).

Table 12: Constraints experienced by farmers in tank irrigation management

(n=120)

Sl. No.	Constraints	Freq.	%
I. Technical constraints			
1.	Lack of knowledge about tank management practices	95	79.25
2.	Non-availability of required irrigation water	78	65.17
3.	Lack of knowledge about crop planning	67	56.24
4.	Lack of time to participate in tank user group meetings	76	63.18
5.	Lack of guidance regarding tank management practices	50	41.25
6.	Lack of motivation from the tank user group leaders	70	58.54
II. Tank management constraints			
1.	Inadequate drainage	31	25.78
2.	Improper repair/rehabilitation of tank structures	42	34.68
3.	No regulation/control for distribution of water	26	21.31
4.	Non authorities to regulate water	20	16.25
5.	Poor physical status of tank	54	45.36
6.	Accumulation of silt in command area	74	61.58
7.	Poor maintenance of tank structures like bunds, catchment area & command area	43	36.24
8.	Mismanagement of catchment areas	38	31.65
9.	Mismanagement of command areas	43	35.47
III. Others			
1.	Poor water distribution	27	22.13
2.	Over irrigation to the crops	62	51.35
3.	Low crop productivity	64	53.24

Legend

Sl. No.	Constraints
I. Technical constraints	
1.	Lack of knowledge about tank management practices
2.	Non-availability of required irrigation water
3.	Lack of knowledge about crop planning
4.	Lack of time to participate in tank user group meetings
5.	Lack of guidance regarding tank management practices
6.	Lack of motivation from the tank user group leaders
II. Tank management constraints	
1.	Inadequate drainage
2.	Improper repair/rehabilitation of tank structures
3.	No regulation/control for distribution of water
4.	Non authorities to regulate water
5.	Poor physical status of tank
6.	Accumulation of silt in command area
7.	Poor maintenance of tank structures like bunds, catchment area & command area
8.	Mismanagement of catchment areas
9.	Mismanagement of command areas
III. Others	
1.	Poor water distribution
2.	Over irrigation to the crops
3.	Low crop productivity

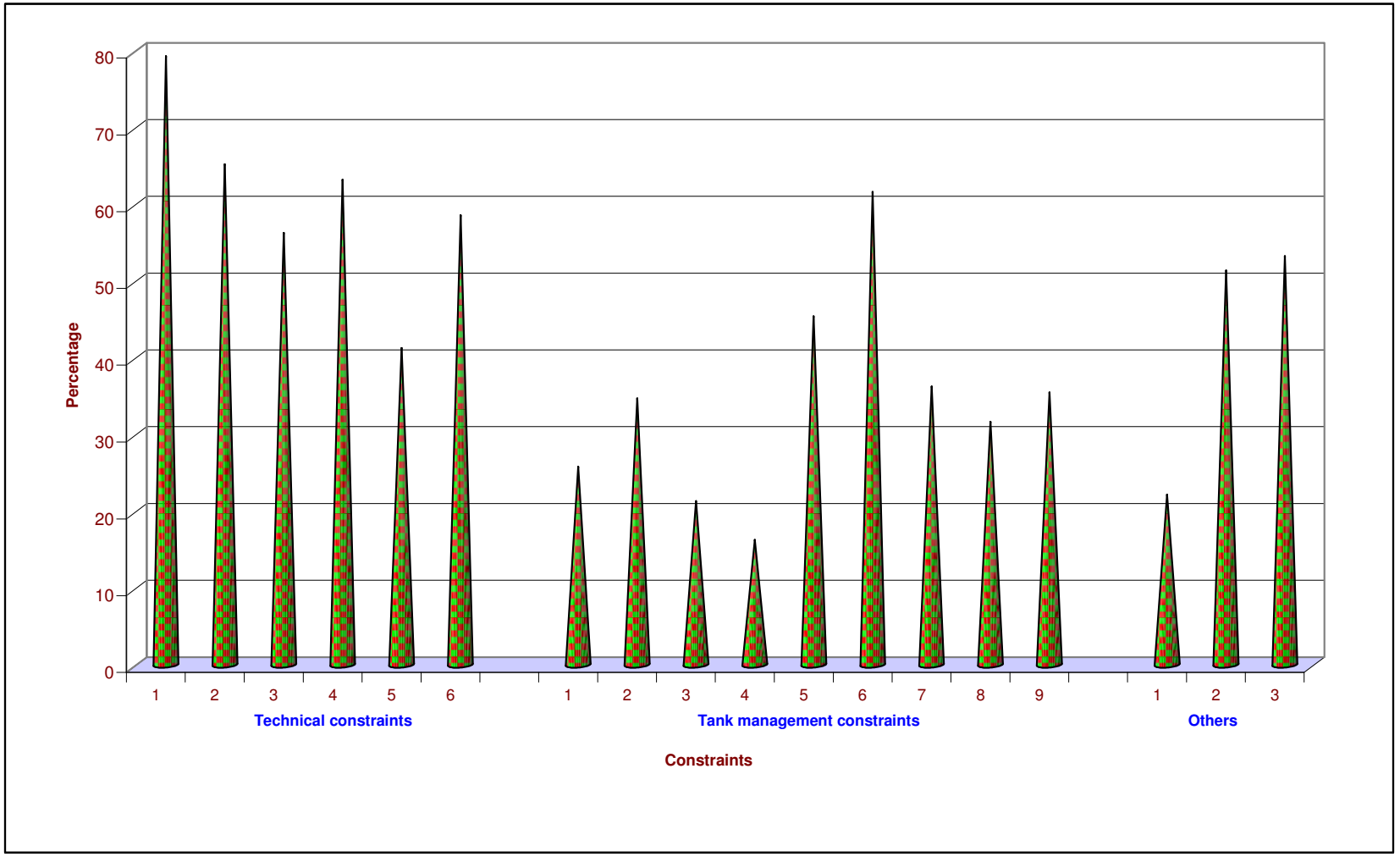

Fig. 8: Constraints experienced by farmers in tank irrigation management

5. DISCUSSION

The results of the study are interpreted and discussed in this chapter in the same order and sequence followed for the presentation of the results in the previous chapter.

5.1 Personal, socio-economic and psychological characteristics of the farmers
5.2 Extent of participation of the farmers in the tank irrigation management
5.3 Impact of people participation and irrigation management on crop productivity and income of the farmers
5.4 Tank management practices adopted by farmers in tank command area
5.5 Constraints experienced by farmers in tank irrigation management.

5.1 Personal, socio-economic and psychological characteristics of the farmers

5.1.1 Education

It was clear from the data presented in Table 3 that, nearly 27.50 per cent of the respondents had education up to high school, followed by middle school (26.67%) and primary school (24.17%), while 11.67 per cent of them were illiterates, only 5.83 and 4.17 per cent of them had education upto college and degree programme.

In general, the respondents are educated. This could be a result of a common social environment. In the present scenario, almost everybody wants to be literate because of the awareness about the importance of the education by the various government programmes. The situation might have arised due to non-realization of education in one's life. Illiteracy of parents might have come in the way of getting them better education to their constraints might have prevented the parents for providing higher education to their children. The results are inline with the findings of Moulasab (2004).

5.1.2 Land holding

In case of land holding, 30.83 per cent of respondents belonged to semi-medium category, followed by medium farmers' category (25.83%) whereas small farmers were observed to the extent of 25.00 per cent.

The probable reason for this kind of result might be due to fragmentation of farm families and increase in number of nuclear families. As a result of this, it is quite possible that farmers with their small holdings have shown keen interest to know about the new ideas and technologies to adopt resources in order to get the maximum returns from their holdings to improve their economic condition.

5.1.3 Annual income

The results regarding the annual income of the respondents indicated that, 40.83 per cent had high level of annual income of above Rs. 51,000. The possible reason that could be attributed was due to their active participation in tank management practices and their better socio-economic conditions after tank rehabilitation. The TUG members were engaged in subsidiary occupations other than agriculture might also contribute for this kind of result.

About 29.17 per cent of respondents belonged to medium income group between Rs. 34,001 to 51,000. The possible reason may be that small land holding people depend mainly on agriculture and also due to their less participation in tank management practices and their less income generating activities, which might have caused to obtain medium level of annual income.

About 24.17 per cent of respondents belonged to semi medium income of Rs. 17,001 to 34,000. Agriculture was the major source of income and it is observed that they are not adopting other subsidiary occupations. The other reason might be due to majority of the respondents were possessing small and semi-medium land holding.

The above findings are in conformity with the findings of Sridhar (2002), Nirmala (2003) and Suresh (2004).

5.1.4 Family size

It was evident that majority of the respondents had small family size (65.83%), followed by big family size (34.17%), respectively.

The possible reason for finding small size families would be that, acceptance of small family norms by the concerned helps to lead comfortable life with limited earnings and another reason might be due to awareness among farmers about problem of maintaining of large sized families.

The results are in conformity with Joseph and Easwaran (2006). Similar findings were also reported in the research studies of Jayale (1992) and Srinivasa Reddy (1995).

5.1.5 Farming Experience

It can be confirmed from the Table 3 that majority of the farmers possessed the medium farming experience (40.83%) followed by high (32.50%) and low (26.67%) farming experience. Since most of the farmers were under the category of middle age, medium farming experience is natural. Hence, majority of them belonged to medium farming experience and has the support with the findings of Hanchinal (1999), Bheemappa (2001) and Natikar (2001).

5.1.6 Innovativeness

In case of innovative proneness, higher per cent of the respondents (52.50%) were noticed in medium innovative proneness category, followed by high (26.67%) and low (20.83%) innovative proneness category, respectively. This might be due to the fact that majority of the respondents had medium level school education. Generally, farmers having higher education level have positive attitude, innovativeness and more mass media exposure also their medium and large sized land holdings might have contributed to make best use of their resources. In such situations, respondents try to gather more information and try to obtain new ideas and technologies to adopt and to improve their economic conditions.

The research study by Balasubramani (1997) also revealed similar findings.

5.1.7 Economic motivation

Majority of farmers belonged to medium economic motivation of 39.67 per cent, followed by high (34.58%) and low (25.75%) level of economic motivation categories. Similar findings were reported by Barman and Gogoi (2000), Bheemappa (2001), Natikar (2001) and Deepak (2003).

The respondents under medium economic motivation category were more in number, probably this category of respondents belonged to small and medium income group. These variables might have motivated the respondents to get more economic return resulting in profit making behaviour. Further, the educational activities and trainings on increasing agricultural production undertaken by project with community participation might have created interest to earn more and made them to fall in medium to high economic motivation category.

Less percentage of farmers belonged to low economic motivation category. This may be due to less risk bearing capacity, less education and less mass media exposure, less extension contact and low organization participation.

5.1.8 Mass media participation

The results pertaining to mass media participation presented in Table 4 indicated that 80.71 and 47.86 per cent of the respondents possessed television and radio, respectively. The radio listening behaviour and television viewing behaviour when analyzed, it was noted that these media were used mainly for the purposes other than agriculture. The less applicability and practicability of agricultural programmes for tank management might be the reason that could be attributed to this finding.

As one of the cheapest mass communication media, the newspapers were subscribed by only 30.17 per cent of the respondents. Among the total respondents, 34.17 per cent of respondents were regular readers of newspapers. The possible reason for this might be that most of the respondents were interested to know what is happening around

them. While, agricultural information was read regularly by only 10.00 per cent of the respondents. The possible reason for this might be the monotonous agricultural news and their lack of practicability. Lastly, 15.00 per cent of respondents were subscribed for farm magazine.

The results were in agreement with the findings of Hanumanaikar (1995), Patil (1995) and Sunil Kumar (2004).

5.1.9 Organizational participation

The data in Table 5 revealed the organizational participation of tank command area farmers. Regarding participation in gram panchayat, it was found that 7.50 per cent of respondents were members and 10.00 per cent were office bearers. Further, 35.22 per cent of the respondents never participated, while 41.66 and 23.12 per cent of respondents had occasional and regular participation, respectively.

Regarding participation in farmers co-operative society, 9.17 per cent of respondents were members and 8.33 per cent were office bearers, while 21.50 per cent of respondents had regular participation followed by 31.96 and 46.54 per cent of respondents had no participation and occasional participation, respectively.

Twenty one per cent of respondents were members of Karnataka Milk Federation Society, while 79.00 per cent of respondents had no participation, whereas 11.00 and 10.00 per cent of the respondents were having occasional and regular participation, respectively.

Ten per cent of respondents were members and 5.83 per cent of respondents were office bearers of youth club. While, 74.00 per cent of respondents never participated, followed by, 15.66 and 10.34 per cent of respondents participated regularly and occasionally, respectively.

Regarding participation in self help groups only 14.00 per cent of the respondents were members, while 86.00 per cent of respondents were having no participation, whereas 8.00 and 6.00 per cent of the respondents were having regular and occasional participation, respectively.

All the respondents were members of tank user group. Further 66.84 per cent of the respondents had regular participation, followed by, 21.66 and 11.50 per cent of respondents with occasional and no participation, respectively.

Where as, 7.00 per cent of respondents were members in banks. While, 55.00 per cent of respondents had regular participation, whereas, 35.00 and 10.00 per cent of respondents were having occasional and no participation, respectively.

About others (taluka panchayat, zilla panchayat, others), 4.66 per cent of the respondents were members and majority (95.34%) of the respondents never participated. Whereas, 3.00 and 1.66 per cent of the respondents were having occasionally and no participation.

The results are in consonance with the results of studies conducted by Sai Krishna (1998) and Shanthamani (2007).

5.1.10 Crop management practices

The results presented in Table 6 indicated that there was high per cent with regard to adoption of crop management practices namely suitable seed rate (88.66%), suitable seeds (85.65%), selection of suitable crops based on water requirement (83.47%), using organic manures (81.33%), using water based on critical stages of crops (75.69%) and timely sowing of crops (71.43%). The reason that may be attributed to the above finding is, as the study area is rainfed the recommended time of sowing is before June and most probably monsoon sets within June and July. This may be due to simplicity, low cost of the practices as well as to obtaining more yields. It may also be due to their experience and guidance received from project personnel. The above finding was in congruity with the findings of Balamatti (1993) and Saikrishna (1998).

It was also evident from Table 6 that very few respondents had adopted processing of seeds (29.65%), biological methods to control of pest infestation (15.21%) and using of bio

fertilizers (16.33%). The possible reason for this result might be that very few respondents had knowledge about processing of seeds, biological control of pest infestation and bio fertilizers.

5.2 Extent of participation of the farmers in the tank irrigation management practices

It is observed from the Table 8 that, majority of the respondents (54.17%) expressed medium participation, while 24.17 per cent of them had high participation. Low extent of participation was expressed by 21.67 per cent of the respondents. The results are in conformity with the findings of Ninga Reddy (2005) and Suresh and Ramesh Babu (2008) who reported that half of the farmers had medium level of participation.

The possible reason may be attributed to the fact that, UAS Dharwad had conducted various agriculture activities under Karnataka Community Based Tank Management (KCBTM) Project in the selected tanks. The project activities were developed on farmers felt needs and it had participation of farmers in planning and implementing stages. Tank management and tank rehabilitation were also important activities under project.

Regarding extent of participation in individual irrigation tank management practices, overall regular participation was observed in activities like collection of facts about tanks (52.50%), identification of encroachment area (55.00%), decision regarding required irrigation water (57.50%), avoiding the damages to sluice structure (52.50%), participation in the removal of silt volume in the canal (54.17%), carrying out desilting activity (56.67%), repair sluice structures (60.83%), strengthening of tank bunds (61.67%), resectioning of bunds (50.00%), deciding the crops based on critical stages of crops (51.67%) and in deciding number of irrigation (50.83%).

It could be inferred from the above results that regular participation in above activities could be the intensive use of extension teaching methods, use of participatory techniques, planning based on felt needs. The above results are due to participation of TUG members in tank management practices taken by KCBTM Project. The other possible reason could be that above activities are directly related to farmers and tank command area around which whole tank rehabilitation is planned.

Further, less participation was observed in activities like identification of locations for cross drainage works such as aqua duct or culvert (45.83%), deciding the selection of site for check dams (45.00%), decision regarding interventions in tank bund (42.50%), deciding about creation of dead storages (45.83%),decision regarding reconstruction of barrel of sluice structure (41.67%) decision regarding replacement of apron (35.00%), decision regarding reconstruction of feeder channels (35.00%).

The reasons to the above results may be that the respondents must have felt that the aforesaid responsibilities are departmental duties and such decisions are taken by engineers and other staff. Hence, their participation in such decision was low. Further, few of the above activities are complex in nature and requires expertise in engineering aspects which might be difficult for the farmers.

The above results of high and less participation in different activities seek support from the findings of Ninga Reddy (2005) who observed high participation in activities like collection of facts, identifying the problem, deciding the objectives, developing plan of work and less participation in activities like determining the progress and evaluation of the programme.

5.3 Impact of people participation and irrigation management on crop productivity and income of the farmers

5.3.1 Impact on crop productivity

It could be observed from Table 9 that, there was positive and significant impact of tank rehabilitation on crop productivity. 34.14 per cent increase in cotton yield (per acre) from before to after tank rehabilitation. Similarly 21.79 and 17.64 per cent increase in paddy and maize yield (per acre) from before to after tank rehabilitation.

Findings from the above results give better idea about the difference in crop productivity before and after tank rehabilitation. It could be inferred that, increase in crop productivity was considerably higher after the tank rehabilitation.

The farmers were interviewed by probing into productivity; they said that, the increase in productivity in terms of yield directly depends on the availability of water. As a result of rehabilitation of tank, there was increase in storage of water in the tank and decrease in water leakages. Obviously the water available to each farmers and frequency of irrigation had increased significantly which led to enhance the productivity. The agriculture development activities undertaken by UAS, Dharwad such as on-farm demonstrations on arable crops, horticulture crops and also water management had helped in educating farmers and adoption of improved methods. These changes contributed to crop yield in tank command area.

The findings have similarly with the findings of Chandregowda and Jayaramaiah (1990),Chandregowda (1996) and Shanthamani (2007).

5.3.2 Impact on Income

The data presented in Table 10 shows that, there was positive and significant impact of tank management on farmer's income. The per cent of farmers belongs high income group (above Rs 51, 000) had doubled from before rehabilitation (20%) to after rehabilitation (40%). Similarly the per cent of farmers belongs low income group (below Rs. 17,000) had reduced from before tank rehabilitation (13.33%) to after tank rehabilitation (5.83%). Further about 5 and 8 per cent reduce in per cent of farmers belongs to semi medium (Rs 17,001-34,000) and medium (Rs 34,001-51,000) category was observed before and after rehabilitation.

It is fascinating to note that, the annual income level of the farmers had increased after tank rehabilitation. This may be due to the good work done by the tank user groups in carrying out the tank management activities, there by increased water availability, as a result it would have facilitated for higher yield and higher income. The income generating activities taken by the project such as livestock, nursery and other off-farm activities have contributed to their income. Further, the personal characteristics of the respondents like high economic motivation of earning more money, innovativeness, risk bearing ability and timely supply of critical inputs and necessary possession of implements might have acted as incentives to the farmers and hence would have brought change in their annual income level before and after tank rehabilitation.

The above findings gained support from the studies indicated by Rama Mohanrao (1996), Chandregowda and Jayaramaiah (1990), Arun Kumar (1998), Sridhara (2002) and Nirmala (2003).

5.4 Tank management practices adopted by TUGs in tank command area

Insight into Table 11 depicts the adoption of different tank management practices by TUGs. The results of adoption are presented as follows.

More than seventy per cent of the TUG members indicated that they have adopted the practices such as desiltation, clearing the wastes or silts (85.25%), followed by deciding crop and area in advance (81.35%), maintaining silt (75.71%), letting out water in the field according to crop and area (74.36%), repairing of canals (74.35%), cleaning of canals before water let off (71.25%), opening and clearing of sluice structure (71.22%) and maintaining foreshore planting (70.38%). This may due to active participation of TUG members in the water management practices to achieve higher water use efficiency under tank fed irrigation system.

The results bring out the fact that community masses have taken the responsibility in carrying out certain activities, which are mainly concerned to improve water storage capacity and efficient conveyance of water. However, the practices related to water applications in the field were adopted by less than 50.00 per cent of the farmers. As the project envisaged community has to take total responsibility of tank management, these approaches lack professional competence, hence TUG need to be linked with concerned line departments for further upgradation of their confidence and also regular monitoring.

5.5 Constraints experienced by farmers in tank irrigation management

The information on various constraints experienced by the farmers in tank management is presented in Table-12. The constraints are grouped under different sub heads, which are presented below.

5.5.1 Technical constraints

The major technical constraints experienced by farmers were lack of knowledge about tank management practices (79.25%) and non-availability of required irrigation water (65.17%), followed by, lack of time to participate in tank user group meetings (63.18%). Other technical constraints faced by the farmers were lack of motivation from the tank user group leaders (58.54%), lack of knowledge about crop planning (56.24%) and lack of guidance regarding tank management practices (41.25%). It could be inferred from the above results that the respondents were engaged in subsidiary occupations along with agriculture. The other possible reasons could be that non-participation in group meetings, negligence of the TUG leaders and less regulatory measures regarding tank management.

5.5.2 Tank management constraints

The major tank management constraints experienced by TUG members were accumulation of silt in command area (61.58%), followed by poor maintenance of tank structures (36.24%) and mismanagement of command areas (35.24%). other tank management constraints faced by the farmers were improper rehabilitation of tank structures (34.68%), mismanagement of catchment areas (31.65%), inadequate drainage (25.78%). The reasons to above results may be that encroachment of tank bed cultivation, inadequate repairs and deforestation in catchment area.

5.5.3 Other constraints

Other constraints experienced by farmers were low crop productivity (53.24%) followed by over irrigation to the crops (51.35%) and poor water distribution (22.13%). The possible reason for this result might be that deteriorated condition of canals and reduction in the storage capacity, variation in the onset of monsoon.

This finding is in line with the findings of Singh (2000) and Golya Naik (2008).

From the discussions, it is evident that technical constraints and constraints in tank management components of irrigation tanks as stated by the farmers are the key factors which must be looked into by the government organizations and departments for successful participation of farmers in irrigation tank management.

6. SUMMARY AND POLICY IMPLICATIONS

Small water reservoirs behind earthen dams are called “irrigation tanks” in India. Tanks are providing surface irrigation, recharging ground water and serving water needs of rural households and livestock. Tank irrigation is an old established practice in most of the semi-arid tropical parts of India, where the monsoon rains disperse erratically during a few months of the year and irrigation tanks serve to store and regulate the flow of water for agriculture use.

South India has a long history of rain water harvesting through tanks and weirs. Andhra Pradesh, Karnataka and Tamil Nadu account for nearly 60 per cent of the tanks irrigated area. There are about 1, 27,000 tanks in these states as against 2, 08,000 tanks in the country. Although several reasons like deforestation, centralization of authority, poor catchment treatment, issue of private property, increase in population, agricultural transformation, unfavorable institutional framework and its capacity to handle the tank, *etc.* are quite evident from the field research and the available literature that the tank systems are on declining trend in terms of performance.

Participation as a process is a dynamic, non-quantifiable and essentially unpredictable element. As a process, participation will change the life of the project into a permanent dynamic movement. Participation of farmers is essential dimension for agricultural and rural development & is one of the crucial components of success in irrigation, livestock, water and agricultural projects.

World Bank assisted KCBTMP was undertaken from 2002 to 2007 to rehabilate the irrigation tanks with community participation and land over the tanks to them for future maintenance. The project covered 2000 tanks spread in a districts of Karnataka with budget outlay of 670.59 crores. Haveri was one of the districts, where 225 tanks were covered under the project. The project emphasized on building a local institution called Tank User Groups for tank management. Efforts were made to build the capacity of the members in operating and maintenance of tanks. It is important to study the participation levels and its impact on farmers socio-economic conditions. Hence, the present study was formulated and designed with the following specific objectives:

Objectives

1. To study the extent of participation of farmers in tank irrigation management
2. To study the tank management practices adopted by the tank user groups
3. To study the impact of people participation and irrigation management practices on crop productivity and income of farmers
4. To understand the constraints experienced by farmers in tank irrigation management

The present study was conducted in Hanagal taluk of Haveri district during 2008-09. The study was focused on irrigation tanks covered by KCBTMP in Haveri district. Hanagal taluk was purposively selected keeping larger area under irrigation tanks as criteria. From selected taluka, four villages were selected based on highest command area under irrigation tanks in consultation with JSYS Office, Haveri. The four villages selected from the taluk were Akki alur, Balambeed, Adur, singapura. Further, 30 respondents from each village were selected randomly thus total sample size for the study was 120.

The data was collected with the help of structured schedule and data was collected by personal interview. The collected data was analysed by using frequency and percentage. The major findings of the study are as follows.

1. Majority of the respondents (54.17%) had medium extent of participation in irrigation tank management practices.
2. Regarding extent of participation in individual irrigation tank management practices, overall regular participation was observed in activities like collection of facts about tanks (52.50%), identification of encroachment area (55.00%), decision regarding required irrigation water (57.50%), avoiding the damages to sluice structure (52.50%), participation in the removal of silt volume in the canal (54.17%), carrying out desilting

activity (56.67%), repair sluice structures (60.83%), strengthening of tank bunds (61.67%), resectioning of bunds (50.00%),deciding the crops based on critical stages of crops (51.67%) and in deciding number of irrigation (50.83%).

3. The positive and significant impact of tank rehabilitation on crop productivity was observed with 34.14 per cent increase in cotton yield (per acre) from before to after tank rehabilitation. Similarly 21.79 and 17.64 per cent increase in paddy and maize yield (per acre) were observed from before to after tank rehabilitation.
4. There was positive and significant impact of tank management on farmer's income. The per cent of farmers belonging to high income group (above Rs 51, 000) had doubled from before rehabilitation (20%) to after rehabilitation (40%). Similarly the per cent of farmers belonging to low income group (below Rs. 17,000) had reduced from before tank rehabilitation (13.33%) to after tank rehabilitation (5.83%). Further, 5 per cent of farmers belonging to semi medium (Rs 17,001-34,000) and 8 per cent belonging to medium (Rs 34,001-51,000) category was observed after rehabilitation.
5. Majority of the respondents were literates of which 27.50 per cent of them were studied upto high school. Majority of the respondents were found to have medium level of innovativeness (52.50%). More number of respondents (30.83%) belonged to semi-medium category of land holding. About 40.83 per cent had high level of annual income (above Rs.51, 000). Majority of the respondents had small family size (65.83%).
6. The result revealed that, 39.67 percent of the respondents belonged to medium economic motivation category. Cent per cent of the respondents were the members of water user society, 66.84 per cent of respondents had regular participation followed by occasionally (21.66%), never (11.50%). Regarding mass media participation, majority of the respondents (80.71%) possessed television and radio (47.86%). Majority of the farmers possessed the medium farming experience (40.83%).
7. The results indicated that there was high per cent of adoption of crop management practices namely, suitable seed rate (88.66%), suitable seeds (85.65%), selection of suitable crops based on water requirement (83.47%), using organic manures (81.33%), using water based on critical stages of crops (75.69%) and timely sowing of crops (71.43%).
8. The results indicated that there was high per cent with regard to adoption of tank management practices namely, clearing the wastes or silts (85.25%), followed by, deciding crop and area in advance (81.35%), maintaining silt (75.71%), letting out water in the field according to crop and area (74.36%) and repairing of canals (74.35%).
9. The results indicated that there was low per cent adoption of tank management practices viz., proper irrigation method (35.35%), suitable irrigation methods in their tank command area (41.22%) and water saving method (47.14%).
10. The results indicated that there was less participation in tank management practices like decision regarding reconstruction of feeder channels (35.00%), decision regarding replacement of apron (35.00%) and decisions about creation of dead storages (45.83%).
11. The major constraints experienced by farmers were lack of knowledge about tank management practices (79.25%) followed by, lack of required irrigation water (65.17%), lack of free time to participate in tank user group meetings (63.18%), accumulation of silt in command area (61.58%) and low productivity (53.24%).

Implications of the study

In the light of findings of the study and from the personal experiences of researcher at the time of personally interviewing respondents, following implications are made for the effective implementing of tank management practices to the concerned developmental departments.

1. In spite of systematic efforts made by the project team in forming tank user group and enhancing the participation in project management, the participation level was found to be unsatisfactory. Hence, this needs to be considered seriously and work out a strategy to strengthen local institutions to ensure participation of community in tank management. There is need to establish fundamental linkage with line departments for regular monitoring and management.
2. As high as 54.17 and 21.67 per cent of the respondents belonged to medium and low level of participation respectively in respect of tank management practices, there is a need to conduct appropriate extension programmes such as group meetings, demonstrations, field visits, study tour to impart latest practical knowledge regarding tank irrigation management so that there will be significant increase in their knowledge and their participation level.
3. The project interventions had positive impact in terms of increased irrigated area and water availability. Hence, government may have to extend its current tank rehabilitation programmes to all tanks in Karnataka.
4. The findings of the study have clearly brought out the positive relationship of education, mass media participation, organization participation, farming experience, economic motivation and awareness about the tank management in ensuring people's participation. This implies that these variables have significant contribution for the participation of farmers in tank management. Hence, the concerned individuals and institutions should wisely make use of the same for designing and implementing appropriate strategies for the development of rural people.
5. The crop yields and annual income of the participant farmers have increased considerably after the tank rehabilitation undertaken by the project with community participation. This is mainly due to improved crop cultivation methods and water management. However, there is further scope to increase crop yield and income. It is therefore suggested that integrated extension efforts should be made by the line departments through persuasion, technical guidance and input support to motivate and convince the farmers to adopt all the tank management practices in their farms.
6. It is estimated that with 10% increase in the present level of water use efficiency in irrigation projects, an additional 14 m.ha area can be brought under irrigation from the existing irrigation capacities. Hence, thrust should be given to improve water use efficiency in tank command area.

Suggestions for future line of work

The present study is a pioneering attempt to study the participation of farmers and analyze the impact of people participation and irrigation tank management on the farmers in a comprehensive way. However, the study has been limited to only one district. Therefore, it is suggested that further investigations may be taken up in different regions of the state/country with varying ecological, cultural and socio-economic backgrounds. This will help to make valid and wider generalizations regarding the impact of the programme on farmers, which could be of immense significance in designing future tank management strategies in meeting the needs of tank users on one hand, and overcoming the prevailing problems on the other.

Case studies of successful irrigation tanks practicing tank management may be taken up to draw lessons to other areas.

The impact of institutional linkages or arrangements for tank management and capacity building of extension personnel could be another area for future research work.

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Appendix

Appendix I: A STUDY ON COMMUNITY PARTICIPATION IN IRRIGATION TANK MANAGEMENT IN HAVERI DISTRICT

INTERVIEW SCHEDULE

Respondent No: --------

Mobile/land line number:

PART - I

I. GENERAL INFORMATION

1. Name of the farmer : _____
2. Village : _____
3. Gram Panchayat : _____
4. Tank name & location : _____
5. Tank command area : _____
6. Taluk : _____

II. PERSONAL AND SOCIO-ECONOMIC CHARACTERISTICS

1. Education

a) Illiterate/ Primary/ High school/ College/Degree/Master degree

2. Farming experience (in years) _____

a) In Agriculture……..

b) Others……..

3. Land holding (in acres)

Total area		Tank command area	
Rainfed	Irrigated	Area under tank irrigation	Irrigation sources
			Tank/bore well/both

4. Annual income

Sl. No.	Sources of income	Income per year (Rs.)
1.	Agriculture	
2.	Agro-based subsidiary enterprises (like poultry, dairy, goat/sheep rearing etc.)	
3.	Business	
4.	Others (specify)	
	Total	

5. Family size

Sl.No.	Member relation	Age	Education	Occupation

6. Mass Media Participation

Sl. No.	Mass media sources	Subscriber/ possessed	Programmes	Frequency of use		
				Regular	Occasional	Never
1.	Radio		Agril. Programmes/information/news			
			Entertainment			
			Advertisement			
2.	Television		Agril. programmes			
			News			
			Entertainment			
			Advertisement			
3.	Newspaper		Agril. programmes			
			News			
			Entertainment			
4.	Farm magazine		Agril. programmes			
			News			
			Entertainment			
			Advertisement			

7. Organizational participation

Indicate your participation in various social organizations as member or office bearer

Sl. No.	Institution	Member	Office bearer	Extent of participation		
				Regular	Occasional	Never
1.	Gram Panchayat					
2.	Farmers service co-op. society					
3.	KMF (Karnataka Milk Federation) society					
4.	Youth club					
5.	SHG (Self Help Group)					

6.	TUG (Tank User Group)					
7.	Banks					
8.	Others (TP/ZP)					

8. Innovative proneness

Sl. No.	Statements	Most like	Least like
1.	I try to keep myself up to date with information on new tank management practices, but that does not mean that I try out all the new methods on my farm		
2.	I feel restless till I try out a new tank management practice, I heard about		
3.	They talk of many tank management practices these days, but who knows if they are better than old ones		
4.	From time to time I have heard of several new tank management practices and I have tried out most of them in the last few years		
5.	I usually see what results my neighbors obtained before I try out the new tank management practices		
6.	Somehow I believe that traditional way of tank management is the best		
7.	I am cautious about trying new practices		
8.	After all, our forefathers were wise in their tank management practices and I do not see any reason for changing these practices		

9. Economic Motivation

Sl. No.	Statements	SA	A	UD	DA	SDA
1.	A farmer should work towards higher yields and economic profits					
2.	The most successful farmers is one who makes the most profit					
3.	A farmer should try any new tank management practices idea which may earn him more money					
4.	A farmer should grow cash crops to increase monetary profits in comparison to growing of food crops for home consumption					
5.	It is difficult for the farmer's children to make good start unless he provides them with economic assistance					
6.	A farmer must earn his living but the most important thing in life cannot be defined in economic terms					

SA-Strongly agree, A-Agree, UD-Undecided, DA-Disagree, SDA-Strongly disagree

10. Crop management practices

Sl. No	Practices	followed	Not followed
1.	Timely sowing of crop seeds / plants		
2	varieties/ hybrids		
3	seeds		
4	Suitable Seed rate		
5	Suitable Spacing		
6	Seed treatment		
7.	Selection of drought, pest and disease resistant seeds		
8.	Germination test		
9.	Processing of seeds		
10	Storage of seeds		
11	cultural methods to control pest infestation		
12	mechanical methods to control pest infestation		
13	biological methods to control pest infestation		
14	chemical methods to control pest infestation		
15	Selection of suitable crops and varieties based on their water requirement		
16.	suitable irrigation methods		
17.	Conjunctive use of rain, tank and ground water		
18.	Using water based on critical stages of crops		
19.	Using organic manures (FYM/compost, vermi compost, green manure, tank silt etc.)		
20.	Using bio fertilizers		
21.	Using chemical fertilizers(NPK) including micro nutrients formulations		
22.	Cultural methods to control weeds		
23.	Mechanical methods to control weeds		
24.	Biological methods to control weeds		
25.	Chemical methods to control weeds		
	Please suggest any other components to be included		
a			
b			
c			
d			

PART-II

1. Extent of participation of farmers in Irrigation Tank Management

Sl. No	Tank user activities	Extent of participation*		
		Regularly participate	occasionally participate	Never participate
A. Tank rehabilitation				
I. Planning/preparation of ITDP				
1.	Preparation of social map			
2	Preparation of resource map			
3	Collection of facts about tanks			
4	House hold survey			
5	Transact walk and planning activities			
6	Identification of encroachment area			
7	Identification of major problem in tank bed			
8	Identification of leakages in the bund & repairing such bund			
9	Identification of locations for cross drainage works such as aqua duct or culvert			
10	Deciding the selection of site for check dams			
11	Deciding about creation of dead storages			
12	Decision regarding required irrigation water			
13	Decision regarding interventions in tank bund			
14	Giving consent to the programme			
15	Decision regarding replacement of apron			
16	Decision regarding resectioning of feeder channels			
17	Avoiding the damages to sluice structure			
18	Decision regarding reconstruction of barrel of sluice structure			
19	Participation in the removal of silt volume in the canal			
II. Implementation				
1.	Carrying out desilting activity			
2.	Repair sluice structures			

3.	Strengthening of tank bunds			
4.	Resectioning of bunds			
5.	Aforestation in tank foreshore			
6.	Arrangement of labour			
7.	Supervision of tank management practices			
8.	Assigning Responsibility to the farmer			
B. Crop planning				
1	Estimation of water in the tank			
2	Projecting the irrigated area			
3	Deciding the crops based on water availability			
4	Deciding suitable management practices			
5	Using water based on critical stages of crops			
6	Integrated crop management			
7	Participation in group meeting or gram sabha about tank management			
8	Deciding no. of irrigation			
9	Scheduling of time of water release			
10	Deciding repairing of tank work			
11	Attending to repair & maintenance			
12	Monitoring of neeraganti			
13	Deciding water cess selection			
14	Obtain consent from the encroacher			

2. Crop Productivity

Cropping pattern followed by the farmers

Season	Crop	Cropped area (In acre)			Before tank rehabilitation			After tank rehabilitation		
		Rainfed	Irrigated	Total	Irrigated area (In acre)	Source of irrigation tank/bore well/both	Crop Yield(in qtl/acre)	Irrigated area (In acre)	Source of irrigation tank/bore well/both	Crop Yield (in qtl/acre)
Kharif										
Rabi										

Summer										

Have you obtain additional income due to tank rehabilitation? Yes/No

If Yes, what is an additional income : ----------Rs

What factor influenced in change of income?

PART-III

Tank management practices adopted by the tank user groups (TUG)

Sl.No.	Tank management practices	Adopted	Not adopted
I. Crop planning			
1.	Estimating of water in the tank at different time intervals		
2.	Estimating of water requirement of different crop		
3.	Deciding crop and area in advance		
4.	Allocating the area for different crops		
5.	Preparing irrigation schedule		
6.	Adopting suitable irrigation methods		
II. Water conveyance			
1.	Cleaning of canals before water let off		
2.	Maintenance of out lets in the canal		
3.	Letting out water in the field according to crop and area		
4.	Adopting dry and wet method of irrigation		
5.	Adopting proper irrigation method (drip/sprinkler)		
6.	Adopting critical criteria according to water scarcity		
7.	Adopting second crop to tank advance of residual moisture		
8.	Water saving method		
III. Sluice management			
1.	Oiling of sluice structure		
2.	Opening and closing of sluice gate		
3.	Repairing of sluice structure		
IV. Canal management			
1.	Clearing the wastes /silts		
2.	Repairing of canals		
3.	Maintaining outlets		
V. Tank management			
1.	Avoiding plants to grow		
2.	Avoiding resilting		
3.	Avoid grazing on the bund		
VI. Tank bed management			
1.	Avoiding encroachment		
2.	Avoiding weeds to grow		
3.	Avoiding cultivation		
VII. Catchment area and Foreshore management			
1.	Maintaining foreshore planting		
2.	Maintaining desiltation		
3.	Avoiding deep ploughing in the catchment area		

PART-IV

Constraints of Tank irrigation management experienced by farmers

Sl. No.	Constraints	Yes/No
I. Technical constraints		
1.	Lack of knowledge about tank management practices	
2.	Non availability of required irrigation water	
3.	Lack of knowledge about crop planning	
4.	Lack of time to participate in tank user group meetings	
5.	Lack of guidance regarding tank management practices	
6.	Lack of motivation from the tank user group leaders	
II. Tank management constraints		
1	Inadequate drainage	
2	Improper repair/rehabilitation of tank structures	
3	No regulation/control for distribution of water	
4	Non authorities to regulate water	
5	Poor physical status of tank	
6	Accumulation of silt in command area	
7	Poor maintenance of tank structures like bunds, catchment area & command area	
8	Mismanagement of catchment areas	
9	Mismanagement of command areas	
III. others		
1	Poor water distribution	
2	Over irrigation to the crops	
3	Low crop productivity	
4		
5		
6		

A STUDY ON COMMUNITY PARTICIPATION IN IRRIGATION TANK MANAGEMENT IN HAVERI DISTRICT

UMAMAHESHWARA M. S. 2008 Dr. L. MANJUNATH
Major Advisor

ABSTRACT

The present study was conducted in the year 2008-09 in Hangal taluk of Haveri district of Karnataka state involving120 respondents selected from four villages.

The results of the study revealed that, majority of the respondents (54.17%) had medium extent of participation in irrigation tank management practices. Regular participation was observed in activities like strengthening of tank bunds (61.67%), decision regarding required irrigation water (57.50%), carrying out desilting activity (56.67%), identification of encroachment area (55.00%) and collection of facts about tanks (52.50%).

The positive and significant impact of tank rehabilitation on crop productivity was observed with 34.14 per cent increase in cotton yield (per acre) after tank rehabilitation. Similarly, 21.79 and 17.64 per cent increase in paddy and maize yield (per acre) was observed after tank rehabilitation. There was positive and significant impact of tank management on farmer's income. The per cent of farmers belongs high income group (above Rs 51, 000) was doubled after rehabilitation (20% to 40%).

The results indicated that there was high per cent of adoption of crop management practices namely, suitable seed rate (88.66%), suitable seeds (85.65%), selection of suitable crops based on water requirement (83.47%), using organic manures (81.33%) and using water based on critical stages of crops (75.69%).

The major constraints experienced by farmers were lack of knowledge about tank management practices (79.25%) followed by, lack of required irrigation water (65.17%) and lack of free time to participate in tank user group meetings (63.18%).