

Effective Management On Conservation Of Irrigation For Sustainable Development

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Abstract: Irrigation has become a life lone of agriculture people. The early civilizations flourished along the river valleys. The importance of water is inevitable for the sustainable development of a nation as it is closely linked with social, cultural, economic and environment benefits. Over the years the country is learnt to have understood the importance of management in the course of irrigation development scenario of continuing pressure on water resources and its essentiality for the sustenance of life has evolved concept of conservation. Following which many efforts have been taken like watershed development scheme, water harvestment, renovation of ponds, tanks, De-silting of canals, strengthening of bunds and introduction of micro irrigation schemes and so on to conserve water. Even then the issues of water scarcity, droughts, salinity, depletion of ground water, lack of adoption of advanced irrigation technologies, fund crunch, drainage problems and the inefficient operation, maintenance and monitoring mechanisms prevailed. To overcome from these shortfalls water the effective managerial practices can be followed by considering cost, time, quality, organizational designed and implementation dynamics. Develop an integrated approach for the effective management of water resources through networks, linkages, co-ordination, co-operation and harmonization. With the improved research, collaborating technology transfers and dissemination of advanced irrigation practices can eliminate or mitigate the existing issues of low water efficiency, low water productivity, in-equity and adopting to the effective managerial irrigation practices can resolve the issues in the irrigation conservation and restore ecological balance for the sustainable development.

Index Terms: Conservation of water, Effective water conservation, Irrigation practices, Irrigation management, Sustainable Development, Water Conservation resources , Water management,

1. INTRODUCTION

Conservation efforts have been made to solve the triple problems of water from the supply side, demand side and from quality angle. It's ineffectiveness is due to lack of general adoption, lack of wider participation, lack governance arrangements, and managerial ineffectiveness in terms of operation, maintenance, monitoring and use of water resources. And also due to weak planning, lack of co-ordination, in-consistency in policy measures and guidelines, poor efforts on community organization and capacity building. Deficiencies in the technical and non-technical factors have also become constraints in the system of irrigation management. These issues can be better sorted out through the effective management.

2 REVIEW OF LITERATURE

RestyNaiga (2018) in his study analysed a broad variety of water infrastructure facilities, technologies, and water source functionality rates between two districts. Governance arrangements and managerial effectiveness are analysed in terms of operation maintenance, monitoring and the use of water resources. Study findings concluded that both the institutional and individual factors played a major role in determining sustainable access to safe water. V.Basil Hans (2018) in his study analysed and concluded that the problems of property, water scarcity, food obscurity, land productivity and low water productivity were due to poor Management of Irrigation water. Findings showed that the problems are largely at Institutional, Structural and administrative in nature. Problems in Indian agriculture are linked to per capital availability of water in a cost effective manner. Water problem

is a triple problem from supply side, from demand side and from quality angle. Chandam Victoria Devi (2018) in her study analysis said that there is increasing in demand of water by all major sectors while the available fresh water remains the same explained about the irrigation development and the concept of management of irrigation system. Analysed various traditional conservation methods of irrigation and disclosed constraints like lack of registered institution, lack of legal back up or policy, lack of awareness, lack of fund and lack of gender equality and finally advised technical land non-technical factors (ways) for strengthening effective irrigation management. Sarah Ann Wheeler, Rosalind Bark, Adam Loch and Jeff Conner (2018) made their study on Global water supply and demand and the irrigation methods practiced at global level. They underlined that water is essential for life and for irrigation and pointed out the problems of high cost investment, biasness in a water resource area and corruption. The study provided strategies for effective management to improve and enhance irrigation and productive efficiency. Abhilas Kumar Pradhan (2018) in his study analysis the irrigational practices for rice crop and identified human factors, technical factors and Institutional factors responsible for low technical efficiency in resource use and suggested ways for an effective management.

Pradeep Kuman Mishra (2016) in his study, analysed the irrigation projects and revealed the short comings of the projects like weak planning, lack of coordination, no consistency in policy measures and guidelines, poor efforts on community organization and capacity building. Analysis outcome underlined the attributes to be (given managed attention) for an effective execution of irrigation projects. Susanne M.Scheirlincy and David O.Treguer (2016) in their study analysed the increasing demand on water resources as a result of demographic, socio-economic, technological and climate change. Also, Pointed out water use in agriculture tends to have relatively low returns. So other users fend to turn to agriculture as a potential source of water. The study revitalized the management of water in order to respond to the

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challenges of water scarcity. ElsLecoutere, Ben D 'Exelle and Bjorn Van Campenhout (2015) in their study showed that the influence of socio - economic differentiation linked to gender and social status on the distribution of common pool resources are to be considered in the irrigation water management. Appropriation and distribution rules could be enforceable if they are recorded. Empowerment programmes for women and people in low social status should be arranged. Zareen Pervez Bharucha, David Smith and Jules Pretty (2014) in their study on watershed development in India found out and shortfalls in it. They pointed out continuing experience of water scarcity due to lack of participatory process, inequitable distribution of cost and benefits, socio-cultural, Institutional and administrative barriers. Carlos Lopez Morales and Faye Duchin (2011) in their study findings highlighted population growth trends, affluence and climate variability will intensify pressure on country's water resources revealed the locational mismatch between irrigation infrastructure, economic activity and water availability pointed out major irrigation technologies and their application efficiencies. Suggested effective management measures to adopt new water conserving irrigation technologies capable of achieving sustainable water usage. Bharat R.Sharma, K.V.Rao, K.P.R.Vittal, Y.S.Ramakrishna, U.Amarasinghe (2010) in their study assessed the run-off water loss, water use efficiency, economic analysis of water harvesting and supplemental irrigation in rainfed areas. The study findings said that there would be a larger scope for an effective management on conserving the surplus rain for improving the rainfed agriculture. Amar K.J.R.Nayak (2010) in his study focused on the community participation in watershed development project. From this study, he understood the role of geographic boundary, topography and soil type as the influencing factors and also the institutional deficiencies of the project implementing agencies in assessing the context, need, capabilities competences of the key stakeholders, the community and the people therein finally ideas given for the success of the watershed development project. RagassaE.Namara, et.al.(2010) in their study emphasized the importance of irrigation water management concluded that it would substantially help for poverty reduction, allows diversification, to ensure reliable water supply and to improve nutritional status, health, societal equity, employment, output prices and environment. Johan Rockstrom, et.al. (2010) in their study highlighted the importance of rainfed agriculture in providing food and livelihood for increasing world population. They explained a large correlation between hydro - climatic constraints and poverty. Their findings said that there regions yield gaps and water scarcity are not due to lack of water parse, but rather due to inefficient management and concluded with new water management techniques. G.S.Hira (2009) in his study underlined that India never experienced any famine after Green revolution in 1960s. Its success were mooted mainly by introduction of HYV and Tube well irrigation which influenced land leveling and cropping pattern. They exposed the projected population growth and food demand in future and corresponding problems of depleting groundwater, deterioration of groundwater quality, increase in tube well Irrigation, Increased energy consumption, water Intensive cropping pattern, and early transplantation agricultural practice and so on. The study necessitated the need for sustainable management of groundwater. P.K.Aggarwal (2008) in his study on climate change resealed the cause of agriculture sector

towards green house gases emissions in India. The study pointed out the rate of increase in temperature leads. To frequent floods and droughts, reduce fertilizer utilization efficiency, reduce crop production, increase post population and increase in sea- level. The study concluded management strategies for adaptation and mitigation AnupamaJeevandas, R.P.Singh and Ranjit Kumar (2008) in their study analysed the high intensive agriculture practices in terms of use of inputs like land, capital, energy, irrigation water and more. The study findings showed that there were many deficiencies due to poor management like contamination of water, depletion of ground water, erratic power supply affects timely application of irrigation, and over exploitation of ground water. It necessitated effective management of irrigation water to sustain intensive agriculture and income of farmers. MrinalKanti Dutta (2007) in his study revealed the lack of irrigation infrastructure, informal institutional setup and inadequate investments in a region which has rich endowment of both surface and ground water resource. The study concluded with better management ideas to improve the reliability of water use and the utilization efficiency. MonthipSriratanaTabucanon (2006) in his study analysed the causes of pressure on water resources. Rainfall shortage, practice of high intensive cropping pattern, inadequate storage capacity, untreated domestic water and industrial discharges are the causes for concern. Improper management due to limited budgets for operation and maintenance, unclear legislation, lack of trained personnel, lack of enforcement, fund crunch, lack of political will and inadequate co-ordination among various agencies. Deterioration of watersheds, disappearance of wetlands and insufficient allocation of water resources are the cause for worries. By taking all into account the study concluded with suggestions for an integrated approach in the management of water resources. Kurt A.Schwabe, Iddokan, and kelthC.Knapp (2006) in their study identified the problems of salinity and drainage in the irrigated lands. They explained excess of water supply, continued and non-uniform Irrigation and when evaporation exceeds precipitation were the reasons behind it and suggested that with better management strategies would overcome the problems. R.K.Mall, Ranjeetsingh, Akhilesh Gupta, G.Sirivivasan and L.S.Rathore (2006) in their study analysed on the "Impact of Climate Change on Indian Agriculture". It revealed the impacts on environmental, bio-physical and socio-economic perspectives, increase of GHG, GO₂ concentration, global warming resulted in Inter annual monsoon rainfall variability, frequent floods and droughts, increased evaporation and affects Input use effecting in agriculture. Dwindling of arable land due to urbanization and Industrialization, agriculture became vulnerable to global environmental change corresponding with increased food demand. And also pointed out about 60 percent of farmers are small and marginal to face the challenges. M.Dinesh Kumar and O.P.Singh(2005) in their study analysis on water availability, water demand water efficiency and virtual water trade. The study outcome pointed out effective water management should address water use efficiency and water productivity. Access to arable land should be integrated with food and water policy making. Better manage about the distribution of fresh water between human and nature and between all sectors of use. B.A.M.Bowman, T.P.Tuany (2001) in their study underlined the alarming state of fresh water due to population growth, urbanization, industrial demand, pollution

and ground water depletion. He pointed out the dominate system of irrigated low land rice production and large quantum of water losses particularly due to seepage and percolation. And suggested effective management strategies to conserve water and to improve water and land productivity. UdaiP.Singh, M.Asce in their study on the challenges in agricultural development such as, declining water table, delivery of water for irrigation, impeded drainage and water logging, increasing soil salinity, size of land holding, limited research and extension work and unavailability of economic modern irrigation technology to Indian farmers. With these they analysed the country's irrigation development and found that there are deficiencies in the distribution system like lack of water courses, uncontrolled wild flooding, unlined water courses, diversion of water, biasness in distribution and unjudicious use of water along with improper policy measures. The study findings emphasized the need for the management of water resources to encounter the challenges in agriculture development.

3 OBJECTIVES OF THE STUDY

- To identify the development of water conservation resources and issues and challenges in it.
- To identify ideas for effective management of irrigation water
- To identify and evolve sustainable irrigation practices for effective management in water conservation for sustainable development.

4 METHODOLOGY

The present paper is conceptual in nature and it purely based on secondary data. The ideas were collected and used for this study. Apart from that, various research papers published in related journals, magazines and related theses listed in Shodhganga have been used.

5 ISSUES AND CHALLENGES ON CONSERVING IRRIGATION WATER RESOURCE

The fertile flood plains of Punjab, Haryana and western Uttar Pradesh states are considered as the food bowl of India. The water intensive agriculture practices in these area caused the problems of depleting ground water, deterioration of ground water quality and increased energy consumption. The excess and non-uniform, based continued irrigation supply resulted in Stagnation and drainage problems in the irrigated lands. Stress increases on water resources as a result of demographic, socio-economic, technological and climate change. Relatively low returns in agriculture became a cause for other users tend to turn to agriculture as a potential source of water which further built up pressure on limited irrigation water sources. Water problems in Indian agriculture is a triple problem from supply side, from demand side and from quality angle. The problems of poverty, water scarcity, food insecurity, low land productivity and water productivity are largely classified into institutional, structural and administrative in nature. Dwindling of arable land and water resources due to rapid urbanization and industrialization. Agriculture become vulnerable due to global environmental change corresponding with increased food demand. The impacts of climate change on Indian agriculture from environmental, bio-physical and socio-economic perspectives. Global warming resulted in

inter-annual monsoon rainfall variability increase pest population, increase in sea-level frequent floods and droughts, increased evaporation and also affects input use efficiency in agriculture. In India almost sixty percent (60%) of farmers are small and marginal in nature. The problems in Indian agriculture are linked to per capita availability of water in a cost effective manner. Rural poor primarily engaged in agriculture which increases pressure over local water resources. There is an existence of a large spatial variations in the availability of water infrastructure facilities, technologies and water source functionality rates. Infrastructure, economic activity and water availability. There is a lack of governance arrangements and managerial effectiveness in terms of operation, maintenance, monitoring and the use of water resources. All such issues are mainly based on institutional and individual factors which play major in determining sustainable access to safe water. Both technical and non-technical factors have become cause for constraints in the system of irrigation management like lack of registered institution, lack of legal back up or policy, lack of awareness, lack of fund, lack of gender equality and low technical efficiency in resource use. In addition to that, weak planning, lack of co-ordination, in-consistency in policy measures and guidelines, poor efforts on Community Organization and capacity building have become responsible for shortfalls in any irrigation projects. Watershed development projects have showed there is the existence of institutional deficiencies of the project implementing agencies in understanding the influence of geographic boundary, topography and soil types. And their inefficiency in assessing the context, need, capabilities and competences of the key stakeholders, the community and the people their in. The continuing experience of water scarcity in the watershed development areas due to lack of community participation, inequitable distribution of cost and benefits, socio-cultural, institutional and administrative barriers. In the dominant system of irrigated low land rice production, there is a large quantum of water losses occurred particularly due to seepage and percolation. The problems of high cost investment in irrigation technologies biasness in a water resource, area, corruption, over exploitation of ground water, contamination of water, erratic power supply are large due to poor management in the high intensive agriculture practices in terms of use of inputs like land, capital, energy, irrigation water and more. The rain fed agriculture has a large scope in providing food and livelihood for increasing world population. These regions yield gaps and water scarcity are not due to lack of water perse, but rather due to inefficient management. Rainfall shortage, practice of high intensive cropping pattern, inadequate storage capacity, untreated domestic water and industrial discharges, deterioration or watersheds, disappearance of wetlands and insufficient allocation of water resources are the causes for pressure on water resources. The size of land holdings, impeded drainage and water logging, limited research and extension work are the causes for concern. In the course of Country's irrigation development found that there are deficiencies in the distribution system like lack of water courses, uncontrolled wild flooding, unlined water courses, diversion of water, leakages in the distribution live, biasness in distribution and unjudicious use of water along with improper policy measures. Improper management due to limited budgets for operation and maintenance, lack of trained personnel, lack of enforcement, fund crunch, lack of political will and inadequate Co-ordination

among various agencies. Though various projects and schemes have been implemented for the conservation of irrigation water like introduction of micro irrigation methods, construction of water harvesting structures, introduction of watershed development schemes, creation of recharge pit, deepening of tanks, strengthening of bunds, desilting supply channels, repairing sluices and more but relatively ineffective in completion due to lack of effective management. Effective management involves planning, developing, distributing and managing the optimum use of irrigation water resources to meet out the present and future needs of people. It aims to get desired results at a reasonable cost and with minimal adverse effects. It helps to ensure both technical and economic efficiencies simultaneously in the usage of water. Ultimately, by which can evolve and adopt advanced / effective / appropriate managerial practices for conserving irrigation water resources without any adverse effects for the sustainable development. Conserving water by adopting modern irrigation technologies like sprinkler and drip irrigation to reduce evaporation loss and to enhance application efficiencies. Flood water is managed by constructing embankments along rivers and water channels. Redistribute excess storm water and floods through canal system river links and ex-situ reservoirs. Rational use of available water by means of advanced methods.

5.1 EFFECTIVE MANAGEMENT PRACTICES FOR SUSTAINABLE DEVELOPMENT

Conserve water by following proper crop-mix and cropping pattern in respect to agro-climatic conditions. Improve forest cover in the uncultivable waste land and hilly areas through agro-forestry and afforestation programme as it requires less water than crops in order to conserve water while maintain regular income to the farmers. The demand for water can also be controlled through population control. Conserving available water resources by protecting it from pollution and encroachments. Conserve water by renovating traditional water conservation practices like tanks in Tamilnadu; Nadi, Toba, Tanka in Rajasthan; kere in Karnataka ; Jackwell in Andaman and Nicobar Islands; Aabi tanks in Haryana ; Zaba in Nagaland ; water kundis in Nagaland; Dong in Assam, Jing in Ladakh and Kuhul in hilly areas and by maintaining environment balance. Construction of recharge pits, trench and shafts and revival of un-used bore wells for artificial recharge of ground water.

1. Net working mechanism

Establish a proper network between research institutions across India. Institutional links with other countries provides grants for the development of research and innovation. Strategic partnership and technology transfer to adopt best practices and for maximum profits. Need based research is needed in water management techniques, for an example ; land drainage system which suits to local conditions. Effectiveness can be increased by conduct research in agricultural and engineering colleges apart from agricultural research institutes. The government should provide financial assistance to the farmers to make use of agricultural extension services properly. Improve research on irrigation methods, policies, institutions and dissemination of time-tested technical know-how to cater farmers needs. Establish a link with all water management programmes at national level, regional level, citizen's initiatives, NGO's and so on. All successful

models should be revitalized in all state. Make a collaboration of related ministries with civil society for demand driven approach. Establish both a horizontal and vertical linkages between various agencies for Co-operation and for the effective execution.

2. Participation

Encourage participation of farmers in planning, operation and maintenance for the desired results in terms of equity, efficiency and economy. Management approach should be decentralized, participatory and integrated. Gradually decentralizing functions to local governments. Recognize the role of local governments and civil society in improving and protecting water quality. The role of water users Association (WUAs) and its effectiveness may be replicated in other irrigation projects. Implement participatory irrigation management (PIM) act in all states to give legal support to farmers. Influence the performance of water user Associations be rewarding and recognizing them. Attention must be given to technical factors (like water measuring device, irrigation structure) and non-technical factors (like mobilize farmers, incentivization in improving the effectiveness).

3. Capacity

Provide literacy programme and training programme to government officials, farmers and other functionaries of agencies to improve their skills. Encourage poor and marginalized farmers to form cooperative association to avail need based assistance to achieve higher technical efficiency in resource use and resource management. Conduct awareness generation programme by using scientific knowledge for advertising and educating them. Engage panchayat raj Institutions (PRIs) and elected representatives to ensure for the wider community participation. Understand farmers attitudes and perceptions on irrigation. Empowerment programmes for women and people in low social status should be arranged. Arrange training programmes, promote campaigns, and organize awareness raising programmes to build their capabilities. Increase their additional source of income by encouraging them to adopt agro-forestry and animal husbandary as to reduce their dependence on local water resources for those who primarily engaged in agriculture activities. Provide economic incentives, rewards on sustainable irrigation management adoption by end-users. Educating people to clear prosopisjuliflora and plastic waste in the tanks and for preventing defecation on the bunds. The growth of weeds and grass in the canals and tanks can be removed by government machinery with the active public participation / support. The government should provide incentives to adopt agriculture extension services and encourage informal irrigation like use of marginal quality water. Conserve traditional water bodies protect irrigation capacity to ensure for effective management.

4. Investment

Generating source for investment and investing in the advanced irrigation techniques and methods will help for sustainable utilization of irrigation water resources. Resource pricing, user charge and selective waste water charges can be followed to enhance source for financing. Recover full cost through water pricing. Area pricing instead of volumetric pricing, secure marginal pricing instead of applying uniform pricing are the effective ways of fixing prices. Encourage low

cost technologies under competent local management authority can be applied for an example, oxidation ditches, aerated lagoons, stabilization ponds and activated sludge treatment process can be followed for waste water treatment. Provide incentives and training to invest in adaptation of new methods. Technical interventions like water control structures, drainage management and conservation measures must be complimented by institutional interventions like apply institutional charges, training, management transfer and equity distribution for an effective management. Efforts to be taken to enhance water use efficiency and water productivity. Adoption of water saving irrigation technologies such as drip irrigation, irrigation scheduling and mulching will increase water productivity and help to conserve water and to maintain soil moisture level. Instead of deep-tube well irrigation, install tubewell for irrigation using multiple well points as not to affect ground water table. Renovating and desilting water bodies like tanks and ponds helps to harvest rain water and to improve the ground water level. In-situ and ex-situ interventions and management at all levels showed improvements in performance like improved ground-water aquifer, soil-moisture availability, reduced outflow soil erosion and flooding for an example, construction of check-dams as an in-site harvestment technique as to reduce soil erosion and to reduce run-off water losses. Construction of large reservoir outside the farm land as an ex-situ harvestment technique as to store flood water during the peak monsoon and for harvesting surplus rain. It helps for supplemental irrigation during the water deficit period. Use of early maturing rice varieties shifting of rice transplantation to June 15th instead a early transplantation as to reduce evaporation loss. Investment in engineering and technology measures to reduce evapotranspiration and to conserve water. Both the public and private investments should be stepped up. Improve investment in water storage and efficient water use technologies. Diversify the rural income sources as to reduce pressure over local water resources. Use grass saver tiles on the roadside and parking lots to allow rainwater to percolate rapidly into the soil and to reduce sewage water load. Through farm-level management techniques agricultural drought and dry spells caused by management induced water scarcity can better be regulated. In-situ water harvestment techniques at farmland like non-inversion cultivation (ripping), direct planting techniques can be followed for water conservations. Establish a real-time co-management of electricity and ground water irrigation which improve the revenue of the electricity board. Intelligent schedule of power supply will improve the reliability and quality of power supply. It will ensure the reliability of water supply and water utilization efficiency with reduced water loss.

5. Policy Regulations

Policies and programmes should be more focused. Importance must be given to the features like cost, time, quality, organization design (must be recognized, flexible, deliberative, collaborative and to build competences among care (workers) and the implementation dynamics (involve interactive, policy change, leadership change, fund release, co-ordination and to build a network of implementing agencies) for an effective management of any schemes or projects. Adoption of different mix of irrigation technologies according to regional differences in factor cost and by regional endowments to reduce water stress. Combination of pricing

policies and improved technology to save water without effect on commodity prices. Regional specific fees and withdrawal restrictions can be applied. Encroachment of water bodies should be prevented with regular monitoring by officials and by marking of its boundaries for protecting the irrigation capacity of water resources. Appropriation and distribution rules could be enforceable if they are recorded. A model frame work us to be made by scientists by considering future population growth, changes in dietary preference, impacts of climate of climate change on the availability of water. Damaged pipelines have to be repaired to control leakages. Transmission losses in the main canal, branch canal, distributories and field channels can be reduced with canal linings. Reduce depth of ponded water, keeping the soil just saturated, and alternate wetting and drying reduce seepage and percolation rates. Establishment of underground drainage connection to all households restricts flow of sewage water into the storm water drain. policy measures like drainage water charge , marketable permits restricts over use of water, clearly defined boundaries for water source, provision and appropriation rules according to local conditions, monitoring mechanisms, enforcement, collective choice arrangements to modify the operational rules and governance activities are organized in multiple layers of nested enterprises for the successful execution of any project. Improving the management of existing systems is the preferred strategy. Distinguish surface and ground water sources to isolate the overdraft aquifers. Disaggregate agricultural sectors to distinguish the crop water demands to improve the application efficiency. Public policy should be made to compliment individual activities towards desirable outcome from a social point of view. Any measure to be taken according to local context by considering renewable water source, water scarcity and irrigation usage of a region for its sustainability. Policy measures should improve water use efficiency, productivity, management and allocation through market based approach (like subsidy, charge..) non-market based approach (like permits...)and information and other instruments (like metering , labelling and certification). Always should address institutional and governance issues ahead of water resource information and management deficiencies. Reconsider a divide between rainfed and irrigated agriculture in favour of a governance, investment and management paradigm.

6. Effective Integration

Integrated policy making including investment in adaptation measures for economic growth and environmental sustainability. Adaptation Investments should be made at different scales from the field and farm levels to the policy and institutional levels. Recognize resource management communities towards an integrated approach to utilize natural resources by strategic collaboration for sustainable ecosystems, rural livelihoods and food security in qualitative and quantitative dimensions. Develop and integrated approach in the management of water resources. Harmonizing functions and laws by addressing overlaps in institutions and jurisdictions. Consider all water options like green, blue and grey water in the integrated water resources management. Management approach should be multi-dimensional in both the scale (water, infrastructure) and Types of access rights (from farmers, farmer groups, irrigation service, local governments, Basin authority, national government, regional level and to global level). Access to arable land should be

integrated with food and water policy making. Effective inter-departmental coordination is needed for location specific framework of sustainable water management and recycling. Integrated study of biophysical, environmental and socio economic sectors is needed at regional level for policy response towards mitigation and adaptation to climate change. Integrated management of water -food- energy nexus and integrated approach between water providers, agriculture authorities, farmers and irrigation technology providers.

7. Total Quality Management

Quality of the water resources is to be conserved for sustainable use. Domestic sewage and industrial discharge are to be processed before disposal. Recycle it as to reduce demand and to prevent it from polluting water bodies. Water logging and impeded drainage can be effectively managed by reuse of drainage water or by disposal into natural sinks. Salinity can be managed better by source control measures like revegetation with salt tolerant crops. Regulating irrigation water application rates and by installing uniform irrigation system. prevention of return flow from the outflow water and prevent emergence of underground water through seepage by controlling excess supply of water, for an example, alternate wetting and drying mechanism. Reduce green house gases (GHGs) emission by management practices like mid season drainage and alternate drying. Strengthen enforcement mechanisms for increasing compliance with environmental standards. Policy, Plans, water quality standards and budgets are the measures taken to address water pollution.

8. Equity Distribution

Regional, Socio-gender, economic and ecological equity can be achieved through an effective management approach. Conjunctive use of surface and ground water in order to achieve technical and utilization efficiency for sustainable use of irrigation water. Distribution of fresh water resources between human and nature and between all sectors of use to maintain eco-balance and equity. Optimum allocation of irrigation resources between various economic sectors and ecosystems for improving the reliability, utilization capacity and for sustainable development. Protect flood plain sites and inter-connected watersheds for maintaining the ecological balance. Priority in water allocation may be given to supplementary irrigation. Inter-basin transfer of water should be increased in areas where feasible from the technical, economic, environmental and sociological point of view. The timely supply and equitable distribution of water between head end and tail end farmers and between various agro climatic regions can be achieved through better coordination among the government departments operating at the same level and among the various levels. Divert flood water to saturate the water deficient areas as to conserve water and to maintain equity in regional distribution. Consider the influence of socio-economic differentiation linked to gender and social status on the distribution of common pool resources in the irrigation water management.

6. CONCLUSION

Effective management of conservation measures alone could ensure its sustenance and success of it. Erstwhile conservation measures have been adopted so far have showed signs of discrepancies and deficiencies on it. With the effective management measures can harvest rain water and

improve water storage and can enhance irrigation capacity. Technical, economic, utilization and application efficiency can be improved by adopting cost effective advanced irrigation technologies. Percolation and seepage water losses, run-off water loss and transmission leakages can be effectively managed by recycling of water, re-use of water and through constant monitoring and regulating mechanisms. Increase financial capacity through water pricing mechanisms and functional capabilities through awareness creation, training, and empowerment programmes. Advanced practices can be adopted through an improved research and extension services, policy measures like collaboration and technology transfers. The problems of water pollution, drainage issues, conflicts in the implementation can be better regulated through focused study and harmonization efforts. Steps have been taken to meet out social, economic and regional equity by means of rational allocation and distribution by considering various sectors, abiotic and biotic stress in it. By strict enforcement of environmental compliance, revival of water bodies and restorage of ecological balance can ensure for sustainable development.

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