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MINIMIZING ADVERSE IMPACT OF DROUGHT: ROLE OF GOVERNMENT AND FINANCIAL INSTITUTIONS

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ABSTRACT

For India, droughts and floods in one or the other parts of the country are regular features every year. History records 24 major drought years during 121 years from 1891 to 2012 that include 15 droughts since country's independence. The year 2015-16 [July-June] was predicted to be a drought year since the India Meteorological Department had projected 88% of normal monsoon rainfall. This is expected to produce 253.16 million tons of food output much less than 265.04 million tons in 2013-14.According to the latest press reports in April-May 2016 already quarter of the country, 313 districts, 1,58,205 villages and 4,44,281 dwellings in 12 States have been hit hard drying up traditional source of drinking water too as on end-April 2016.Coping with drought requires meticulous planning to conserve rainwater and economize on its use. Water-guzzling crops like sugarcane, paddy and even hybrid cotton need to be discouraged in water-stressed area. Around 15.38% of 650 billion cubic meters [BCM] water available for irrigation is used by sugarcane (the crop uses water from reservoirs as well as groundwater), which is planted on no more than 2.5% of India's farmland. Sugarcane uses a disproportionate amount of water. This paper focuses the need to make the role of the Government and rural financial institutions effective to minimize impact of drought and suggests the strategic action plan to harness the available irrigation potential including recycling the use of wastewater and improving water use efficiency through micro-irrigations schemes with the support of institutional credit.

Keywords:
Drought, Irrigation System, Rain-fed Farming, Dry Land Farming.

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1. INTRODUCTION

For India, the year agricultural year July2015-June 2016 was predicted to be a drought year since the India Meteorological Department had projected 88% of normal monsoon rainfall. The year

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received 14% lower rainfall than long period average out of 614.districts, 274 [44%] & 30 [5%] districts received deficit & scanty rains. Net impact of drought is reflected in less production by 2.26 million tons [MT] the kharif food output at 124.05 million tons [MT] in 2015-16 as against 126.31 MT in 2014-15. Total food output is estimated to be 252.23 MT being 0.21MT higher than 252.02 MT in 2014-15 but significantly less than 265.04 MT & 257.13 MT in 2013-14 & 2012-13 respectively. According to the latest press reports in April-May 2016, already 313 districts of 12 major States [Uttar Pradesh, Karnataka, Madhya Pradesh, Andhra Pradesh, Telangana, Maharashtra, Gujarat, Odisha, Jharkhand, Bihar, Haryana, and Chhatisgarh] had been reeling under drought affecting 330 million people. More importantly, 1,58,205 villages & 4,44,281 dwellings had been hit hard drying up traditional sources of drinking water for human beings & cattle. For the first time in the history of independent India, the Supreme Court had to draw Government's sharply focused attention to policy directives to mitigate the adverse impact of recurring drought through initiating five specific actions under the National Disaster Mitigation Act, 2005. It is against this background this article briefly highlights the Government's policy initiatives to minimize impact of drought, current scenario of irrigation development, financial institutions' credit support and suggests the strategic action plan to harness the available irrigation potential including recycling the use of wastewater and improving water use efficiency through micro-irrigations schemes with the support of institutional credit.

2. DROUGHT

The year is officially declared drought when shortfall in monsoon rainfall exceeds 10%. Indian sub-continent is predominantly characterized by a tropical monsoon climate and entire region is distinguished mainly by the differences in rainfall in terms of onset, distribution, quantity and withdrawal. While south-west monsoon accounts for 80% and north-east 20% of rainfall there is a large variability in the monsoon rainfall on both space and time scales.

Only 63 million hectares [45%] of net cropped area is irrigated. Consequently, some parts of the country experience drought or flood almost every year. In past, country experienced 24 large-scale droughts in 1891,1896, 1899, 1905, 1911, 1915, 1918, 1920, 1941, 1951, 1965,1966, 1972,1974, 1979, 1982, 1986, 1987,1988, 1999,2000,2002,2009 and 2012.. About 49.8 million hectares [15.2% of geographical area] is flood-prone and 10 to 12 million hectares are actually flooded each year.

In last two decades, India recorded [i] negative farm growth during five years which were drought years and [ii] 42% increase in the population as compared to 32% increase in food output. Between 1994-95 and 2013-14, availability of food grains per capita increased marginally from 471 grams to 511 grams.

According to IIM, Ahmedabad, India's urban-rural divide widened between 1993-94 and 2011-12 as [i] Per capita GDP for urban India increased eight times against seven times for rural India [ii] urban per capita GDP was 2.3 times more than that in rural in 1993-94 which increased to 2.5 times in 2011-12. Thus, drought can have a devastating effect on income disparities between rural and urban areas. In this context, it is most relevant what our Prime Minister, Shree Narendra Modi said on 8th June 2015 "*India must quickly expand its irrigation network and*

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improve water usage to offset the impact of less monsoon rainfall than usual and asked officials to ensure quick results for farmers by reviewing administrative mechanisms, financial arrangements and technology use in irrigation"

Ecological deterioration because of unabated deforestation and excessive grazing, among others, has led to significant soil erosion, desertification and declining land productivity. About 20% of country's area is periodically subjected to the onslaught of droughts leading to huge losses of agricultural output and livestock wealth, besides causing untold miseries to the people living in these areas. Drought causes uncertainty in sowing, shortfall in the area sown, poor germination, mortality of germinated seedlings, wilted crops, excessive consumption of energy in extracting groundwater etc. While in most drought affected areas normal cropping systems and cultivation practices are not possible under rain-fed agriculture, in irrigated areas, too, significant efforts are required for efficient use of resources with appropriate water management strategy and agronomic manipulations in view of higher water demand and reduced supplies. Under such situation farmers need to grow alternate crops, change crop varieties, adopt special cultural practices, integrated plant protection and nutrient management strategy, efficient soil and water management practices that can contain reduction in crop productivity to the extent possible. Recurrence of drought makes farmers unable to benefit from new farm technology as compared to other areas where such a calamity occurs less frequently or with less severity. This increases income disparities between regions affected by drought and those unaffected.

Government's initiatives: Government has initiated following policy and programs to minimize the impact of drought on country's economy.

Drought Prone Area Program: During the fifth plan [1974-75], the DPAP was launched in 74 districts [where around 12% population lived] across 13 States based upon the rainfall pattern, incidence of drought, extent of irrigation etc. The DPAP aimed at [i] reducing the severity of the impact of drought [ii] stabilizing the income of the people [iii] restoration of ecological balance. Important components, *inter alia*, included [i] soil and moisture conservation measures [ii] development and management of water resources[iii] restructuring cropping pattern, use of drought-resistant crop varieties and changes in agronomic practices [iv] afforestation with emphasis on social forestry and farm forestry [v] development of pasture lands and range management in conjunction with promotion of sheep breeding [vi] animal husbandry development [vii] development of non-farm/ subsidiary occupations.

Exploiting Irrigation Potential: The word "*drought prone area*" suggests that these areas are subject to the deficiency of rainfall periodically and creation of assured irrigation facilities can in the long term alleviate the impact of deficiency in rainfall. About 60% of cultivable area is rain-fed/unirrigated, 80% of horticultural and 100% of forest products come from unirrigated areas. Deficiency in rainfall in rainfed farming makes food, fodder, farmers' income and livelihood of the population unsecure. Even, deficient rainfall in the assured irrigated regions has far reaching consequences in terms of surface water supplies, groundwater over extraction, power consumption and overall crop production.

Food grain productivity per hectare in rain-fed areas ranges from one to two tons compared to four tons and more in irrigated areas. India's 56% rainfed land produces 44% food grains

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whereas irrigated land produces 56%. Government has, therefore, prioritized creation of irrigation facilities right from the First Plan by exploiting surface water resources through major, medium and minor irrigation projects whereas farmers promoted lift irrigation schemes and extracted groundwater through sinking shallow and deep tube wells mostly through institutional credit.

Command Area Development Program: During the Fifth Plan [1974-75] Government launched centrally sponsored CADP to bridge the gap between irrigation potential created and its actual utilization, develop adequate irrigation delivery system up to farmers' fields, enhance water use efficiency, bring changes in cropping pattern, strengthen research, extension and training facilities, organize field demonstrations and make high-yielding variety seeds and fertilizers available that can ultimately increase the productivity of crops per unit of land and water resources.

Accelerated Irrigation Benefit Program: According to the Ninth Plan [1997-02], the ultimate irrigation potential had been assessed at 140 million hectares, which included 59 million hectares from major and medium irrigation projects and 81 million hectares from minor irrigation schemes. The latter included 17 million hectares from surface water minor irrigation schemes and 64 million hectares from groundwater resources. The exploitable irrigation potential was 21.4 million hectares from major and medium irrigation projects. However, of this 13.4 million hectares [62.6%] were locked up in a large number of projects in the pipeline. Accordingly, in 1996-97, Government launched AIBP to complete incomplete irrigation schemes. Up to 31-03-2014, out of 294 incomplete major and medium irrigation projects and 16,456 surface minor irrigation schemes, 142 [48.3%] major and medium projects and 12,083 [73.4%] minor irrigation schemes were completed. Till March 2013, irrigation potential of 85.03 lakh hectares was created under AIBP. Total irrigation potential created under all types of irrigation structures was 94 million hectares till the end of Ninth plan, which increased to 102.8 million hectares by the end of Tenth plan [2002-07] and now it is 109 million hectares. The CADP has been subsequently amalgamated with the AIBP and renamed as Command Area Development &Water Management [CAD&WM] from 1-4-2004 and is being implemented as State sector scheme from 2008-09 and as pari-passu with AIBP during the Twelfth Plan. Since 1974-75 to 31-03-2013 the CADP/ CAD&WM covered about 20.5 million hectares of field channels. .

National Mission on Micro Irrigation: In June 2010, Government established National Mission on Micro Irrigation to increase water-use efficiency and promote micro-irrigation scheme viz. drip and sprinkler irrigation systems. Target for Eleventh Plan [2007-12] was 1.32 million hectares and Twelfth Plan [2012-17] are 7.62 million hectares including 0.25 million hectares of micro-irrigation in Public-Private-Partnership mode.

Bharat Nirman: under Irrigation component of the Bharat Nirman irrigation potential of 16.26 million hectares was created during 2005-06 to 2012-13.

More Crop and Income per Drop of Water: The concept of more crop and income per drop of water [2006-07] aims at improving crop productivity and farmer's income. It seeks to implement 5000 Farmer Participatory Action Research Programs [FPARP] in 5000 villages of different agro-climatic regions of the country with the help of research institutes viz. State Agricultural

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Universities, ICAR Research Institutes, ICRISAT, Water & Land Management Institute etc. In these villages all the available technologies are taken to farmer's fields. In each of 5000 villages, one woman and one man from Gram panchayat need to be trained as Water Masters to launch water literacy movement involving research institutes. Under the FPARP the quantity of water actual saved through efficient management of water and the additional income generated is calculated. The Gram Sabha in each village serves as Pani-panchayats and provides guidance and support. The FRARP is so designed that a small program involving farmers, research institutes and PRIs can trigger a mass water movement for more yield and income per drop of water.

Augmentation of water supply: The Eleventh Plan [2007-12] included specific measures for augmentation of water supply, viz. water control measures, bench marking of irrigation projects, reforms in water harvesting norms, refocusing on tanks and ponds as main water harvesting components. On demand management side, it emphasized micro irrigation techniques like drip/ sprinkler including drip fertigation, system of rice intensification technique, improving soil health, weather based crop insurance, market improvement and capacity building of farmers. It, also, envisaged a Research Network on biotechnology and water security in order to keep pace with the future demand. The Twelfth Plan [2012-17] targets [i]creation of 2.4 million hectares of additional irrigation potential through completion of ongoing and initiating new projects and restoration of lost irrigation potential [ii] creation of 1.0 million hectares of additional irrigational potential through completion of ongoing and initiating new surface Minor Irrigation schemes and [iii] bridging the gap between the irrigation potential already created and utilized by 3.6 million hectares..

Water Users Associations For efficient utilization of irrigation potential already created 15 States [Andhra Pradesh, Assam, Bihar, Chhatisgarh, Goa, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh have either enacted exclusive legislation or amended their irrigation Acts for involving farmers in irrigation management. So far 63,167 Water Users Associations are formed covering 14.62 million hectares.

Reclamation of water logged areas: In nine States [Bihar, Gujarat, J&K, Karnataka, Kerala, Maharashtra, Odisha and Uttar Pradesh] 7,82,780 hectares of water logged areas reclaimed up to 31-03-2013..

Agro-met Centres: ICAR has funded All India Coordinated Project on Agro-met at 22 centres with objectives of the characterization of climate, crop-weather relations, crop-weather modelling, weather-related forewarning of outbreak of pests and diseases and issuing agro-advisory services to farmers. Department of Earth Science disseminates weather-related information through its network of 82 Agro-met Advisory Services units located in State Agricultural Universities & ICAR units.

3. CURRENT SCENARIO

- According to World Development Indicators [1998] in the mid-1990s, the percentage of irrigated area in India was less than in Bangladesh, Nepal and China and less than half that in Japan and Korea. Yield of crops in Indian agriculture is relatively lower than that

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in East Asia and has almost stagnated despite a holding size that is lager on an average than in China. Rice yields in India are exactly half that in Japan, an economy of smallholder agriculture. The Economic Advisory Council to the Prime Minister [2007] reported that India has very low level of irrigated area by international standards.

- As against potential of 140 million hectares around 109 million hectares [77.8%] of irrigation facilities are created and of this 85 % is being utilized.
- Only 63 million hectares [45%] of net cropped area is irrigated.
- The wide gap between gross cropped area and gross irrigated area has not improved much since the First Plan period.
- Groundwater irrigation from shallow and deep tube-wells which accounted for just 1% to total irrigation in 1960-61significantly increased to 30% in 1990-91 and 45% in 2011-12. Share of canal irrigation declined from 36% in 1990-91 to 25% in 2011-12. While farmers owning tube-wells too have been affected by erratic monsoon and excessive extraction of groundwater, most small and marginal farmers [accounting for about 85% of the total holdings] not having their own tube-wells and pump-sets have to buy water at substantial cost.
- According to the Parliament question, despite the central Government provided over Rs.53,000 crore to State Governments for irrigation projects during 2004 to 2014 implementation of 163[54.9%] out of 297 projects was delayed, including some for over 20 years.
- Current scenario exhibiting 557 incomplete projects accompanied by low utilization of irrigation potential created and time and cost over-run ranging from 138% to 1000% for 12 and more than 24 projects respectively shows that return on capital invested in creating irrigation facilities is inordinately delayed or almost lost.
- Irrigation potential remains unutilized primarily because of [i] inadequate budgetary provision for operation and maintenance of the irrigation system [ii] non-completion of distributaries, minors, field channels and on-farm development works [iii] changes from the initially designed cropping pattern [iv] diversion of irrigable land for other purposes.
- Indiscriminate use of canal water has resulted in water logging of 2.46 million hectares and 3.4 million hectares suffering from surface water stagnation which, if left uncorrected, eventually leads to salinization. Although irrigation and drainage should go hand in hand, the drainage aspect has been neglected in major and medium irrigation projects. In Japan, drainage is an integral part of irrigation system, called *irrinage*.
- Canal water carrying toxic chemicals/heavy metals pose a serious source of soil contamination.
- Groundwater which irrigates 60.86% of area has manifested following problems.
- Inadequate and untimely availability of electricity and costly diesel
- Although about 70% of groundwater potential has been utilized there are serious problems of over exploitation of groundwater.
- Existing irrigated areas have been experiencing serious water stress as reservoir and groundwater resources have been depleting in several parts.
- Excessive withdrawal of groundwater, besides rendering huge private investments infructuous by depleting water tables and drying up tube wells, has also been the cause of water salinity and extracting hazardous chemicals in some parts. .
- Soil erosion has been causing land degradation.

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- Excessive and unbalanced use of fertilizers is fraught with serious soil health problems.

Institutional Credit: In order to create additional irrigation facilities and efficiently utilise irrigation banks have been, since 1970s, financing individual farmers for following purposes

- [i] purchase of oil-engines, electric motors, pumping sets [centrifugal, turbine, submersible] [ii] sinking of surface wells, shallow or deep tube-wells [iii] deepening and cleaning of existing wells [iv]laying out open or underground field channels [v] construction of bandharas [vi] installation of lift irrigation unit on river basins, tanks, bandharas, and other catchments [vii] construction of pump-houses [viii] any other structure that creates irrigation potential
- For improving water use efficiency, banks finance for micro-irrigation system viz. sprinklers and drip irrigation system, land development works, viz. embankments,, terracing, land levelling and shaping,
- For kyari-making, drainage, reclamation of saline, alkaline and degraded land, ravine lands, soil and moisture conservation measures etc.
- Banks have been financing State-owned Irrigation Corporations, such as Gujarat Water Resources Development Corporation
- Banks consider cost of irrigation as component of scale of finance for crop cultivation.

With the nationalization of private banks, irrigation development through groundwater extraction acquired new dynamism during 1970s and 1080s as groundwater irrigation from shallow and deep tube-wells which accounted for just 1% to total irrigation in 1960-61 significantly increased to 30% in 1990-91. Thus, increased irrigation facilities at individual farmer's fields facilitated high-yielding seeds accompanied by fertilizers to express their full yield potential for significant increase in crop yields leading to Green Revolution. Between 1900-91 and 2011-12 groundwater irrigation further increased to 45% to total consequent upon which the share of surface irrigation declined.

Credit for irrigation accounted for 8.15% of agricultural term-loan and credit for land development 3.05% during 1990-91 to 2009-10. Average amount of credit disbursed for irrigation per annum between 2004-05 and 2010-11 increased substantially to Rs.4662 crore [397%]as against Rs.1174 crore during 1991-92 to 2003-04. However, share of credit for irrigation in total agricultural term loan declined significantly to 7.5% from 15.34% during the corresponding periods.

Rural Infrastructure Development Fund: Since 1995-96 the RIDF has been primarily created to extend loans at lower interest rates to State Governments to facilitate them to complete irrigation projects, among others, which were started in the past but could not be completed for want of funds. RIDF has been created by way of deposits out of the shortfall in commercial bank's lending to agriculture and is operated and managed by NABARD. Under the RIDF irrigation potential has been created to the extent of 3,68,89,465 hectares since 1995-96 till 2013-14.

Micro-irrigation: Since mid-1990s use of micro-irrigation comprising Drip and Sprinkler irrigation system has been encouraged as it is the most efficient method to save water and increase water use efficiency as compared to the conventional surface method of irrigation, where water use efficiency is only about 35%-40%. Water saving due to Drip is between 12%

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and 84% depending upon crops, sources of lifting water, etc. Studies reveal that water saving including water use efficiency and productivity gains are higher in those crops cultivated under Drip as compared to Sprinkler. Around 80 crops can be cultivated under Drip and Sprinkler. While Drip is most suitable for wide spaced horticulture and other crops, Sprinkler is for closely-spaced crops. .

Micro-irrigation reduces energy consumption, weed infestation, soil erosion and cost of cultivation on one hand and enhances crop yields on the other. Researches have established that investment in micro-irrigation is financially/economically viable. The internal rate of return (IRR), which varies across States and categories of farm-sizes, was ranging from 3% to 35% for marginal farmers, 14% to 88% for small farmers and 15% to 128% for large farmers. The IRR was higher among large farmers of Kerala and Maharashtra because of diversified intercropping pattern in orchard/plantation crops. Micro-irrigation promises farmers not to overexploit groundwater.

The study of nine promising States in 2010 revealed that area covered under Drip and Sprinkler was 14,28,460 hectares[12,25%] and 24,42,430 hectares [7.99%] as against potential of 1,16,59,000 hectares and 3,05,78,000 hectares respectively. Thus, after two decades total area under Micro-irrigation was only 38,70,860 hectares[9.16%] as compared to potential of 4,22,37,000 hectares. Out of this, about 30 million hectares are suitable for Sprinkler irrigation for crops like cereals, pulses, oilseeds and fodder crops and a potential of around 12 million hectares under Drip for cotton, sugar cane, fruits, vegetables, spices, condiments and some pulse crops like red gram, etc. Only a few states like Andhra Pradesh, Maharashtra and Tamil Nadu have expanded area under micro-irrigation. Factors attributed to low adoption rate include high investment cost, complex technology and socio-economic issues such as, a large number of small and marginal farmers, fragmented landholdings, cumbersome procedure to access institutional credit and Government subsidies, farmers' limited knowledge in operating and maintaining systems as often the system is facing problems of clogging of filters and drippers, besides the required pressure from the pumps not being maintained due to the poor conditions of the pump sets resulting in low pump discharge,

Investment: Protected cultivation of vegetables and logistics of their transport from normal/excessive rainfall area to deficient areas should be arranged to minimize inflation. Large-scale public and private investments are called upon for safe and scientific storage, transport, grading, processing, packaging, and timely marketing of perishable fruits and vegetables as well as relatively less perishable cereals. Productivity of vegetables and flowers under poly/net/shaded houses is 5-10 times higher and produce of high quality and that too during off-seasons when market prices are very high. It, also, saves scarce and costly inputs like water, fertilizers, pesticides, etc. from 30% to 60%. It provides best safety net against pests and diseases and minimizes use of pesticides, fungicides and impact of weather abnormalities etc. It is the best compensatory production strategy. At village level individuals as also SHGs can be trained, encouraged and financed to take up micro enterprises involving vegetable/fruit growing, one/two milch animals, back yard poultry, sheep/goat breeding, inland fishery, mini-scale agro-processing units etc. Between 22% and 78% of replenish able groundwater is unutilized in different States of Eastern and North Eastern regions which need to be taped through proper planning and investments. Groundwater irrigation is more amenable for adopting efficient

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system of sprinklers, drippers, piped conveyance, ridge & furrow planting system etc. Water use efficiency can be improved by financing farmers for repairs to field channels, weed control, land levelling and land shaping, installation of energy efficient electric motors, diesel pump-sets, sprinklers and drippers etc. Even, irrigation in furrow and bed system saves 20%-30% water. Billions of rupees spent every year on drought relief should lead to drought mitigation, modernization and reduce vulnerability in long term which necessitates R&D, scientific planning and meticulous implementation accompanied by robust monitoring system.

District level contingency plans: Central Research Institute for Dryland Agriculture has prepared district level contingency plans [covering all farming situations within the district] for most of the districts in major States. These plans incorporate details of all contingency measures that farmers can adopt for all crops [including horticulture, fruits and vegetables] in the event of different climatic vagaries/aberrations.

Technology: ICAR centers and State Agricultural Universities have developed technologies involving high-yielding varieties and agronomic practices that can minimize water requirements of crops and increase yield per hectare for different agro-ecological regions. For example [i] with short duration variety of soybean accompanied by improved agronomic practices land degradation can be minimized on about two million hectares of water logged area in MP [ii] chickpea with better agronomic practices can be successfully planted on 12 million hectares of rice fallows in MP, Odisha, Jharkhand, West Bengal and Chhatisgarh [iii] In Kashmir region micro-irrigation can increase productivity of safflower by 50%, pressurized irrigation system can increase apple yield more than 40 tons/ha, Strawberry under low cost poly-house matured 45 days earlier than outdoors and productivity increases substantially [iv] In Tamilnadu, precision farming approach involving drip and fertigation and pit method of irrigation in sugarcane increased the yield by 20 %.[v] In Gujarat, G-9 variety of drilled paddy increased the crop productivity to 2.5 tons/ha with better water use efficiency [vi] About 10 million hectares are water logged in coastal Orissa, Andhra Pradesh, West Bengal and Bihar. Digging out aquaculture ponds raised about 35% of the area under embankment by 1to1.5 meters. Growing fish and prawn in dugout ponds and fruits and vegetables on embankments and rice in part of the farm increased the water productivity up to 7 times [vi]Irrigation responds to Integrated Nutrient Management including required supply of micro-nutrients like zinc, boron and sulphur [vii] Since water shortage is experienced in different seasons, promotion of crop diversification with high value but less water requiring crops like pulses and oil seeds and multiple uses of water will enhance crop yield.

System of Rice Intensification technology: System of Rice Intensification technology (SRI) requires less quantity of seeds, less nursery area, saves water and labor and enhances yield. This method can be extended to other crops like sugarcane. Further, upland rice technologies like periodical wetting and drying should be expanded which will also help control mosquito breeding in the rice fields.

Need for Strategic Actions: India, learning lessons of frequent droughts and water scarcity experienced each year, needs to seriously demonstrate the political commitment and administrative skill to initiate strategic actions to resolve following serious issues in order to ensure that share of food output under irrigated farming increases to 70% from 56%.

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- **Incomplete projects:** There has been an increase in the number of projects awaiting completion since the end of IV Plan. The backlog has remained between 500 and 600 projects since then. The backlog declined at the end of VII Plan but increased again to the present level. Currently, there are 557 irrigation projects yet to be completed. Andhra Pradesh has completed only 17 projects out of the allotted 105 projects, followed by Karnataka [33/305], Maharashtra [94/186] and Madhya Pradesh [90/242] projects. Major factors responsible for this include, inter alia, improper synchronization of project components and delayed tendering and contract management, land acquisition, delays in construction of railway/highway crossing. All incomplete projects need to be completed by 2017-18 by drawing a suitable road map indicating specifically the role, responsibility and accountability of officials, department and ministry concerned.
- **Time and Cost overruns:** Worst part of the inordinate delay in completion of projects has been the time and cost overruns. A study by the Planning Commission on cost overruns found that for a representative 12 projects, there was an escalation of the order of 138% over the original cost [i.e. escalation of 1.38 times the approved cost]. There was a very high cost escalation of the order of 1,000% and more for 24 out of the 151 major projects taken up earlier than 1980 and the average escalation is around 200% for major projects starting from 1985. In the case of medium projects, there are 24 projects with a cost escalation of 500% or more.
- **Underutilization:** The gap between the irrigation potential created [IPC] and the irrigation potential utilized [IPU] is steadily increasing from the First Plan. Currently IPU is 80 million hectares [73.39%] as against IPC of 109 million hectares. Factors responsible for low utilization of irrigation as studied by Indian Institute of Management [Ahmedabad, Bangalore, Kolkata and Lucknow] focus on lack of proper operation and maintenance, incomplete distribution systems, non-completion of CAD works, changes from the initially designed cropping pattern and diversion of irrigable land for other purpose, among others. Inadequate provision of budget provision for operation and maintenance of the irrigation system is significantly responsible for underutilization followed by non-completion of distributaries, minors, field channels and on-farm development.
- Over the years, there has been a manifested lack of attention to water legislation, water conservation, water use efficiency, water harvesting and recycling and infrastructure.
- India has a weak framework for sustainable irrigation management. States can consider policy, regulatory and institutional framework for the efficient, sustainable and equitable allocation of water.
- **Management:** Integrated Water Resource Management [IWRM] in agriculture is a concept of sustainable development, allocation and monitoring of water resource and its use in agriculture. IWRM has also a role to meet social, economic and environmental objectives. This concept has been successfully applied more in areas relating to domestic and industrial use in several countries like Australia, Mexico, and Korea. In India, notwithstanding a full-fledged river-basin approach is yet to be developed and used extensively, existing sources of water availability for agriculture[rains, surface and groundwater in particular] have to be sustainably developed, judiciously allocated and their equitable distribution and efficient use monitored rigorously. Operationalization of the concept necessitates initiation of water reforms, enactment of laws and establishing institutions to enforce them, through consultations with the farmers. In this process,

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Government has to assume the responsibility of a regulator and facilitator and transfer its current role of implementing irrigation projects to autonomous water services management organizations, community-based organizations and the private sector. Policy interventionists and planners of water resource development and management should invariably seek participation of farmers as ultimate water users who can be organized into legal bodies called "Water Users Associations". Women have been found playing effective role in the provision, management and safeguarding of water for agriculture and non-agriculture purpose.

- **Other measures:** Other important measures need to include [i] The policy and programs related to water should focus equitable sharing of water; integrated management of surface water, soil water and groundwater; intra-basin and inter-basin water transfer; participation of an enlightened public in decision making and welfare of socially, economically and politically weak segments of society, among others.[ii] Irrigation accounts for 83% of the water consumed. As per estimates of the National Commission for Integrated Water Resources Development Plan, the irrigation sector will consume about 79% of the available water resources in 2050. The efficiency of irrigation system of the Government and private irrigation projects should be improved by 50% more from the current level of 40% and 65% respectively. Even a 10% improvement in the efficiency of agricultural water use is likely to result in the availability going up by 40%. This calls for focused attention to promote improved water management practices in irrigation projects suffering from operational deficiencies and integrated water resources development and management approach [iii] Declining per capita availability and threat of river basins turning 'water scarce' necessitate well- coordinated and planned measures for storing run-off water during the rainy season. In view of this, widely acceptable and area-specific water conservation measures have to be researched and adopted. Also, it is necessary to strengthen existing irrigation infrastructure, increase water use efficiency and productivity, raise crops requiring less-water, make rainwater harvesting mandatory for all and provide shading with trees the banks of canals and other reservoirs.[iv] Despite the country gets fairly a good rainfall at about 46 inches per annum, almost 50% of its falls in a span of 15 days and 90% of the rainwater is lost due to run-off in just four months. Only about 15% of the annual rain water is used for irrigation. This water should be properly stored and efficiently used for sustained surface irrigation to enhance crop productivity at low cost and reduce excessive pressure on groundwater.
- Selection and capacity building training of waster users' association [WUA] can be on lines of selection, promotion and nurturing of Self-Help-Groups as developed by NABARD
- There is need to rationalize water rates based on cost delivery and women's involvement in participatory irrigation management [PIM]and their capacity building training
- States which have yet not enacted Act to facilitate participation of stakeholders in PIM program should indicate the current status of the PIM implementation and should formulate the roadmap for enactment and implementation of PIM by 2015-16.
- Regular monitoring and evaluation of performance of WUAs is necessary for effective implementation of the PIM program. The success and failure of the WUAs could provide useful lessons and help initiate corrective steps in formation and sustainability of WUAs at other places.

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- Other key priorities include [i] reorganization, strengthening and capacity building of irrigation and drainage departments that can successfully seek participation of farmers and other agencies in PIM [ii] improving cost delivery [iii] allocating sufficient resources for operations and maintenance, sustainability of investments and arresting rapidly deteriorating existing irrigation infrastructure.

4. MICRO-IRRIGATION SYSTEM

- A campaign should be launched to create awareness among farmers about the importance of micro-irrigation system through effective demonstrations to make them believe what they see themselves and learn from other farmers who have successfully adopted and benefited. Some resourceful farmers from Rajasthan, Gujarat and Maharashtra who have visited Israel to study the micro-irrigation system can answer If Israel can do this why our farmers cannot?
- State Agricultural Universities in each agro-ecological region need to assess the potential of micro-irrigation and demonstrate to farmers gains in terms of productivity, water saving, water use efficiency, viability of the investment, payback period to convince farmers and bankers.

5. *REFERENCES*

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