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Role of Water Users Co-operative Societies in Innovative Irrigation Management: A Case Study of Ozer Village

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Abstract
Growing needs of water and competition in water use is being experienced and forecasted for the future. Accordingly, issues on water availability and management could become thrust areas of study, to work on sustainable water management practices. More number of sectors is demanding their share of water; its allocation in agricultural sector is jeopardized and considered to be pressurized. In this study an attempt is made to address and consider above problems and the Performance Evaluation of Banganga, Mahatma Fule and Jay Yogeshwar Water Users Associations Managed by Participatory Irrigation Management at Ozer village (District Nashik, Maharashtra) for the selected part of the study area. The present research is based on the secondary sources of data, efforts are made to use it as optimum as possible to the best.

Keywords
Participatory Irrigation Management, Water Users Association, Waghad Project, Water Users Co-operative Societies.

Introduction

Water is politically sensitive issue (PTI, 2016). The United Nations recognizes that water disputes results from opposing interests of water users, public of private (Sudhir B. Wadekar, Volume 2 Number 2 (July-December 2014)). United Nations Secretary General Kofi Annan said that "fierce competition for fresh water may well become a source of water conflict and wars in the future" (Postel, Sandra L. and Aaron T. Wolf, September - October 2001). Irrigation Management Transfer (IMT) or participatory Irrigation Management (PIM) is an approach of surface irrigation management wherein the management of the canal system is gradually handed over to the farmers in the command area. This approach is based on the belief that farmers have most to gain from improved irrigation services and hence, if they govern the irrigation system, then the irrigation institutions would be more accountable. (Apoorva Oza, 2007)

Participatory Irrigation Management is an approach in which farmers participate in all walks of management of irrigation system and is being implemented in almost all developed and developing countries (Er. Y.D. Sharma and Er. Rama Kant Arya, 7-8 November 2014). The approach has been designed in interaction with a multidisciplinary team of researchers, like engineering, management, etc. From the farmer managed irrigation systems research, organizing the farmers and entrusting farmers with the water management and maintenance of the system in the Philippines, Thailand, Indonesia, Sri Lanka, Nepal, Malaysia, Tanzania, Nigeria, Peru and Argentina have been seen as the most profitable way of water resources management (K. KARUNAKARAN). These problems are very crucial in Maharashtra as well as in India. In India, 72% landholdings are below one hectare in size and 12% landholdings vary from 1 to 2 ha which are not viable for modern agriculture methods and technological interventions on 'stand-alone' basis (Phanish Sinha, 2014). To overcome this problem various water conservation and management techniques have been developed and popularized over the years.

Objectives of Research

To seek insight into observed phenomenon and explain its logic and reasoning of happenings the objectives of present research study are as follows.

1. To assess the impact of irrigation management transfer of Banganga, Mahatma Fule and Jay Yogeshwar water users association (Ozer WUAs).
2. To study the socio-economic aspects of beneficiary farmers.

Relevance of Research Study

The Ozar societies have come to be known widely as an example of successful participative management. They have helped form many more societies on the Whagad system of which they form a part. Even then, there have not been too many studies carried out of the important long turn solution to the irrigation problems. The Participatory Approach involves raising awareness of importance of Water among policy-makers and

the general public. It means that decisions are taken at the lowest appropriate level, with full public consultation and involvement of users in the planning and implementation of water projects (K. KARUNAKARAN). Irrigation policy is a very strategic policy, not only crucial for rapid agricultural advance but even to insulate large part of the county from the furies of famines and even floods (H. M. Desarda, 1986). Tighter competition in water use is being experienced and projected for the future. Accordingly, issues on water availability could become crucial to study, to work on sound water management practices (Samta P. Shah, January 2013) Therefore there is a need to study irrigation management transfer of Ozer water users association.

Literature Review

Impact of Irrigation Management Transfer in Maharashtra, an Assessment (Pant, 1999)

On the basis of available sparse data this paper finds the functioning of water users' associations in Maharashtra beneficial on various fronts. Not only have the WUAs increased their irrigated area but also the water use efficiency has been found to be higher after the irrigation management was transferred to the members of WUAs. The WUAs have considerably improved the recovery of water changes thereby bringing revenue to the government. Moreover the WUAs by charging much higher amount from their water user have accumulated funds for the maintenance of their micro structures and continue to survive and thrive even after management subsidy of the government has ceased to exist.

Some Issues in Participatory Irrigation Management (Pand, 2008)

This article shortlists the conditions for success of participatory irrigation management along with an analysis of the impediments in its path. It warns that all countries should be cautious of the financial allurements of funding agencies because PIM seems to suffer from a number of infirmities that cannot be easily resolved. Though India is blessed with rich natural resources, however there are few facts which are worth mentioning at this juncture, the country constitutes about 16 % world's population, but has mere about 4 & worlds surface water resources. Still the situation is better than many other nations, so we should cherish the scenario, but also intensify our efforts for the conservation of this valuable resource.

Status of Participatory Irrigation Management (PIM) in India (Panish Sinha, 2014)

Secured water future is dependent upon water use efficiency and productivity in agriculture. Agriculture contributes 13.7 % to GDP and generates 52 % of employment. Around 44 % of gross sown area is under irrigation cover, utilizing 83 % of the country's available fresh water and contributing to 66 % of total food grain production. Average food grain productivity is 2.0 ton / ha while a food grain productivity of 6.0 ton / ha is achievable. Bridging this yield gap within the framework of maximizing economic and social welfare in equitable manner, environmental and ecological sustainability, meeting competing demand for water from other sectors, and mitigating impacts of climate change is a complex and challenging task.

Information Technology Enabled Services (ITES) which use information and communication technology and internet in combination with mobile phone or other hand held gadgets provide great promise in improving service delivery and reliable feedback from field on various parameters necessary for planning and implementing mid-course corrections. The greatest strength of ITES lies in saving in cost and time for surveys on service benchmarking, customer satisfaction, grievance redressal and online up-dation and analysis of data.

Sustainability of Water User Associations and Participatory Irrigation Management (George Chackcherry, 2014)

The success of the WUAs and PIM, and the guarantee of their long-term sustainability is dependent of how well motivated are the farmers coming together to form an association and involve in the activities. It has been observed that the farmers should be able to discern that there are sufficient gains from assuming responsibilities that were previously shouldered by the state. Because there are substantial monetary and non-monetary costs to the farmers for expanded WUA activities, unless the prescribed benefits are also substantial, farmers would clearly elect not to get involved. It is reported that the greatest opportunity lies in making irrigation systems sustainable as ownership feeling among the farmers may lead to better operation and maintenance up to tertiary canal level and greater resource mobilization on one hand and efficient utilization of funds and natural resources, viz. water and land on the other hand. It shall also ensure mutual accountability between irrigation agency and the WUAs. Better management of resources will lead to increase in yield and irrigated area and ultimately help poverty reduction and improve food security. Strong legal backing and resultant organization and procedural

changes in the agency set up are also essential for the sustenance of WUAs and PIM.

Indicators for Monitoring and Evaluation for Development of WUAs (Er. R. K. Arya, 2014)

In some cases IMT may be expected to change the way irrigation systems effect the environment. For example, improved water distribution can reduce the need for tail-end farmers to pump recycled saline water out of shallow aquifers. It can also increase the amount of fresh water available for flushing salts out of soil. The following are examples of potential indicators of environmental sustainability of irrigation.

- Irrigated are lost to production due to salinity of soil,
- Irrigated area lost to production due to water logging of land,
- Sustainability of irrigated area, measured as ratio of irrigable area to initial irrigable area, and
- Resource degradation index, measured as percentage of service area lost due to resource degradation.

Maharashtra Management of Irrigation Systems by Farmers Act, 2005 and Rules 2006 (GoM, 18 August 2004)

The Maharashtra Water and Irrigation Commission (1999) has recommended that statutory provisions may be made for management by farmers, of irrigation systems by providing water from Public Canal System to Water Users' Associations on volumetric basis it is decided by the State Government to bridge the gap between the irrigation potential created and its actual utilisation and to optimise the benefits by ensuring proper use of surface and groundwater by increased efficiency in distribution, delivery, application and drainage of irrigation systems and for achieving this objective to give statutory recognition to the constitution and operation of Water Users' Associations so as to enable the farmers to act collectively to improve the productivity of agriculture.

Hypotheses

When a prediction or hypothesized relationship is to be tested by scientific methods, it is term as research hypothesis (Dr. Priti R. Majhi and Dr. Praful K. Khatua, 2015). It is a predictive statement that relates and independent variable to a development variable. For the present research there are two hypotheses supposed to be tested as follows -

1. Irrigation management transfer helpful for equitable water distribution.
2. Socio-economic conditions of beneficiary farmers are improved due to irrigation water management by water users associations.

Research Methodology

Present research study is rely on secondary sources of data. The secondary data are collected from annual reports of irrigation projects, economic survey of Maharashtra as well as India, annual reports of Ozer Projects, research papers, research articles, research books, research journals, theses, magazines, news papers, various websites etc. The present research study is a descriptive in nature. Therefore for making interpretation of data/facts collected through secondary sources of information, appropriate statistical tools and techniques are used. Use of charts, graphs, tables and maps are followed to present numeric data collected from various sources.

Wahgad Project Level WUAs

One positive impacts of IMT is to introduction of volumetric supply and pricing of water to WUAs. There are some success stories of volumetric supply in Maharashtra State. The state has made it mandatory to allocate water to WUAs on volumetric basis. In Waghad project of Maharashtra, a Project Level Water Users Association (PLWUA) was established in 2003 and state government transferred the O & M of the entire project to PLWUA in 2005. The project has 24 WUAs covering 9642 ha command area, 2523 wells, and about 16000 farmers. The irrigated area both under canal and well has increased from 7377 ha in 2003 to 10,400 ha in 2008, 100 % recovery of water charges and an average farm income of Rs, 60,000 per ha (Panish Sinha, 2014)

Waghad project level WUAs consist of 24 water users associations. The presidents / directors of all (i. e. 24) WUAs are the member of Waghad project level WUA. This project is located in Palkhed Pathbandhare department Nashik as a sub-divisional Waghad medium project. The proper guidance to built concrete structure formulation, implementation and evolution by Samaj Parivartan Kendra, Ozar district Nashik. The banking facilities to the Waghad project level WUAs are provided by Nashik District Central Cooperative Bank Ltd. Mohadi and Bank of Maharashtra Mohadi. Waghad project having irrigation capacity of 10570 ha area covered 18926 total farmers' families of 30 villages in command area with storage capacity 2550 Million Cubic Meter (R. K. Wable, 2015).

Table No 1 : Waghad Project Level WUAs

Sr. No.	Name of Member	Irrigated Area ha
1	Kolwan Water User Association, Hatnore	183
2	Kanifnath Water User Association, Nilwandi	223
3	Mohalban Water User Association, Dindori	99
4	Ganesh Water User Association, Dindori	294
5	Balasaheb Raje Water User Association, Dindori	79
6	Popatrao Jadhav Water User Association, Dindori	75
7	Manki Parisar Water User Association, Dindori	61
8	Dr. Babasaheb Ambedkar Water User Association, Dindori	602
9	Jay Janardhan Water User Association, Korhate	198
10	Shri. Samarth Water User Association, Mohadi	599
11	Saptashrungi Water User Association, Mohadi	200
12	Navnath Water User Association, Mohadi	726
13	Banganga Water User Association, Ozer	137
14	Baliraja Water User Association, Janori	161
15	Jay Laxmimata Water User Association, Ambe	165
16	Baneshwar Water User Association, Ambe	230
17	Jay Bajrang Water User Association, Janori	262
18	Jagdmba Water User Association, Janori	197
19	Mahatma Phule Water User Association, Ozar	176
20	Jay Yogeshwar Water User Association, Ozar	390
21	Maha Laxmi Water User Association, Nigdol	278
22	Shri Krishna Water User Association, Pade	419
23	Mauli Adivasi Water User Association, Kadwa Mhalungi	185
24	Rangnath Gopal Patil Water User Association, Valkhed	668

Source : https://www.waghdproject.org

Waghad Project level water user association is a controlling body of these listed WUAs of Waghad project.

Table No 2 : Irrigation Water Rate Collected of WPLWUA

Year	Project Level Associations Rate	Project Level Associations Rate Collected	Collected in Percentage
2010-11	1774930	1774930	100 %
2011-12	2308558	2262386	98 %
2012-12	1896915	734563	95 %
2013-14	1967937	639931	95 %
2014-15	2081905	1956990	94 %

Source: 12th Yearly Report of Waghad Project Level WUAs 2014-15

From the above table it clearly indicates that the project level associations rates and the project level associations rate collected both are increasing but the percentage of collection of rates are decreasing continuously for the financial year 2010-11 to 2014-15 respectively. Project level associations rate increased from 1774930 in 2010-11 to 2081905 in 2014-15 and the project level association rates also increase from 1774930 in 2010-11 to 1956990 in 2014-15 respectively.

Table No 3 : Supervision and Maintenance Cost of WPLWUA

Year	Maintenances on Dam cost	Supervision cost	Total cost
2010-11	130144	34780	164924
2011-	117924	80500	198425

12			
2012-13	128240	147690	275930
2013-14	556620	150900	707520
2014-15	230530	142170	372700

Source: 12th Yearly Report of Waghad Project Level WUAs 2014-15

Supervision and maintenance cost amounts are shown in above table from the financial year 2010-11 to 2014-15 respectively. The cost of supervision and the cost of maintenance both are increasing rapidly in subsequent years and therefore total cost.

Up gradation of agriculture produce

The works of WUA Is not only distribute water but up gradations of Agri-produce also. In Waghad command an agriculture producer company is formed. Along with agricultural department small group of farmers are formed through which different agricultural schemes launched. (Kulkarni, 2014)

Food Security, Employment Security and Revenue Security

Secured food to every stomach is the main base of food security. If irrigation potential increased with PIM, definitely food security can be obtained. We have to obtain food security not only in quantity but quality also. Due to climatic changes cropping patterns are affected by various insects and diseases and due to misguidance over use of agrochemical the climate and agri-produce are affected leading to adverse effect on health level of society. Regarding it, these WUAs can do a very effective work along with food security, employment security and revenue security as shown below in the table.

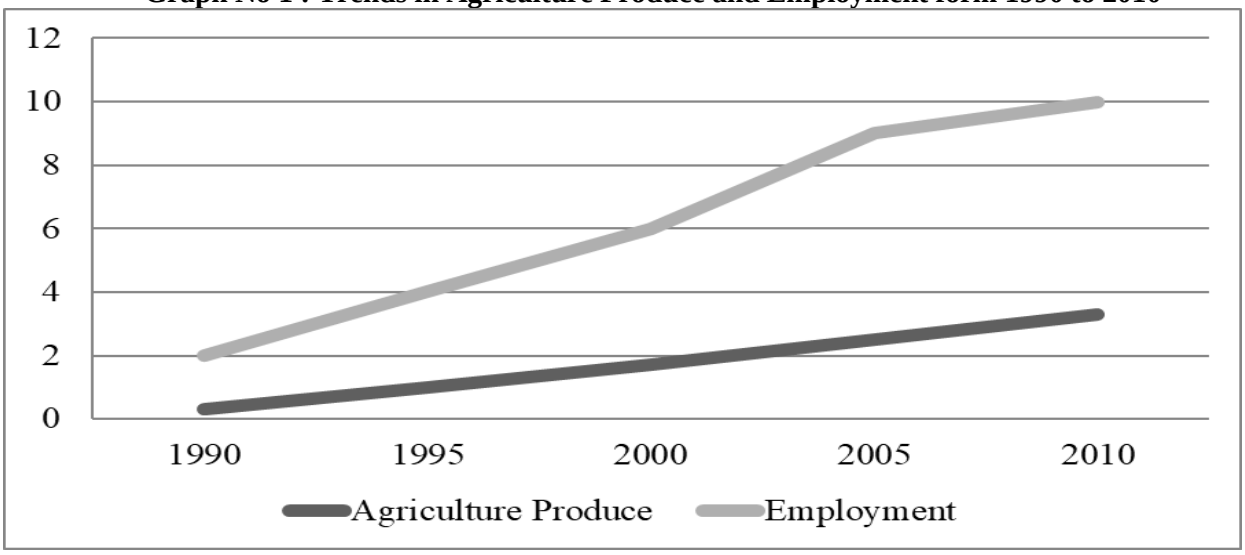
Table No 4 : The trend of irrigated area, agric-produce, employment and revenue on Ozer WUA

Sr. No	Year	Irrigated Area Ha	Number of Rotations	Agruculture Produce (t/Ha)	Employment Year	Paid Water Tax
1	1990	35.00	1-2	0.3	2	Negiligible
2	1995	531.88	4	1.0	4	50,125.00
3	2000	713.00	5	1.7	6	92,803.00
4	2005	723.00	5	2.5	9	2,35,000.00
5	2010	728.00	5	3.3	10	2,38,000.00

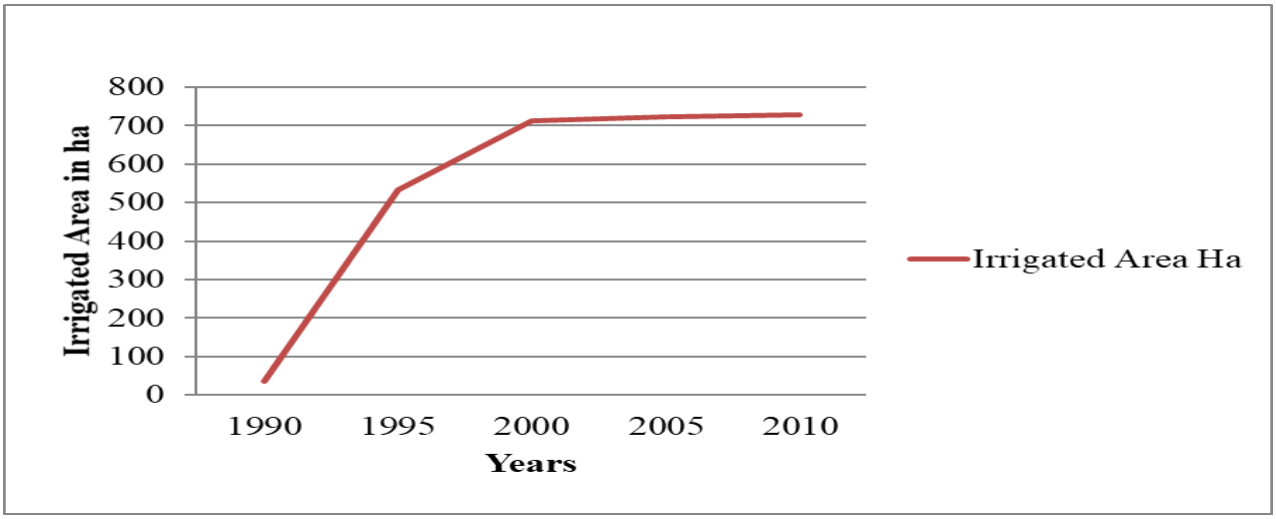
Source : G. R. Kulkarni, Conference Procedings, National Convention of Precidents of WUAs organized by MoWRRD and G R India, New Deli Nov, 2014. (Kulkarni, 2014)

As stated in the above table irrigated area, numbers of rotations, the agriculture produce in thousand hector and employment generation are increasing over the time period with increase in revenue and collection of taxes.

Graph No 1 : Trends in Agriculture Produce and Employment form 1990 to 2010



Graph No 2 : Trends in Irrigated Area (in ha)



From above tables and figure it is found that there is 11 time increase in average food grain production, 20 times increase in irrigation, 3 times increase in rotation, 29 times increase in farmers income, 10 time increase in government revenue, 5 times increase in employment generation.

Basic Information about the Banganga, Mahatma Fule and Jay Yogeshwar WUAs

Table No 5 : Basic Information about WUAs of Ozer

Particular	**Banganga WUA**	**Mahatma Fule WUA**	**Yogeshwar WUA**
Project Name	WPLWUA	WPLWUA	WPLWUA
Canal	Right Canal	Right Canal	Right Canal
Total Member	549	357	1008
WUAs Area 1. Cultivation able area 2. Irrigation able area	 CCA 277 194 ha ICA	 CCA251 ICA 176	 CCA 562 ICA 390
Minor Length	6.0 km	3.4 km	4.5 km
Quantity of wells in area	150	113	203
Dams in area of territory	4	11	18

Source : Annual reports of the Banganga, Mahatma Fule and Jay Yogeshwar WUAs Ozer 2014-15.

In the above table basic information about the three WUAs of Ozer are given i.e. Banganga, Mahatma Fule and Jay Yogeshwar WUAs. All the three WUAs are comes under WPLWUAs at right canal side of the Waghad Medium Level Irrigation Project.

Banganga WUAs has 549 member, 277 ha cultivable are and 149 irrigation able followed by 6.0 length of minor with 4 dams and 150 wells. The Mahatma Fule WUAs has 357 members which are the lowest than other two as well as the cultivable area and the irrigation able area also the lowest followed by 3.4 km minor leanth and 113 wells located in their area. Jay Yogeshwar WUAs of Ozer has greater membership i.e. 1008 member, cultivable area 562 ha and irrigation able are 390 ha respectively, and 18 dams with 203 quantity of wells in the pre determined territory.

Table No 6 : Supervision and Maintenance cost of Ozer WUAs

Year	**Banganga**	**Mahatma Fule**	**Jay Yogeshwar**
2010-11	NA	64398	13065
2011-12	NA	88480	146941
2012-13	126469	88497	126112
2013-14	140493	122000	223120
2014-15	120737	123088	161508

Source: Annual reports of the Banganga, Mahatma Fule and Jay Yogeshwar WUAs Ozer 2014-15.

In the above table supervision and maintenance cost of Ozer WUAs are tabulated. It should be noted here that the sum of the supervision and maintenance cost are obtain from the financial year 2010-11 to 2014-15 respectively by given sources of data collection. The data for the financial year 2010-11 and 2011-12 of Banganga WUAs are not published in their annual report therefore NA in the table is the Not Available. The Jay yogeshwar WUAs of Ozer has highest expenses on supervision and maintenance than the other two.

Table No 7 : Water Rates Levied and Collected by Ozer WUAs

	Banganga		**Mahatma Fule**		**Jay Yogshewar**	
Year	Water rates levied	Recovered	Water rates levied	Recovered	Water rates levied	Recovered
2010-11	113700	111850	199630	184035	86000	83485
2011-12	260000	201925	285000	273040	140000	127460
2012-13	197250	41965	172420	164870	107000	91965
2013-14	229500	42362	238000	166200	184000	63880
2014-15	138000	18975	235000	96800	130000	27142
Average	187690	83415.4	226010	176989	129400	787864

Source: Annual reports of the Banganga, Mahatma Fule and Jay Yogeshwar WUAs Ozer 2014-15.

Water rates levied and recovered by Ozer WUAs are shown in the above table respectively from the financial year 2010-11 to 2014-15. It clearly shows that the rate of water charges levied and recovery are increasing of all three WUAs. It is quite clear from the table that for all three WUAs there is problems of non- recovered water charges. On an average Banganga, Mahatma Fule and Jay Yogeshwar WUAs has last 5 years water rate or charges levied respectively 187690, 226010 and 129400; as well as water charges collected are 83415.4, 179689 and 787864 accordingly.

Table No 8 : Quantity of Membership of Ozer WUAs

year	**Banganga**	**Mahatma Fule**	**Jay Yogeshwar**	**Total**
2010-11	561	354	1005	1920
2011-12	601	354	1005	1960
2012-13	NA	357	1008	1365
2013-14	549	357	1008	1914
2014-15	549	357	1008	1914

Source: Annual reports of the Banganga, Mahatma Fule and Jay Yogeshwar WUAs Ozer 2014-15.

Quantities of membership of Ozer WUAs are increasing day by day except Banganga WUA. There is fluctuations in the membership of the Banganga WUAs, for the financial year 2012-13 NA indicates that the data are not available. If we see the last column of the table it will be seen that the total membership of the all three WUAs are increasing.

Table No 9 : Land under Major Crops, Production and Income in the year 2014-15 of Ozer WUAs

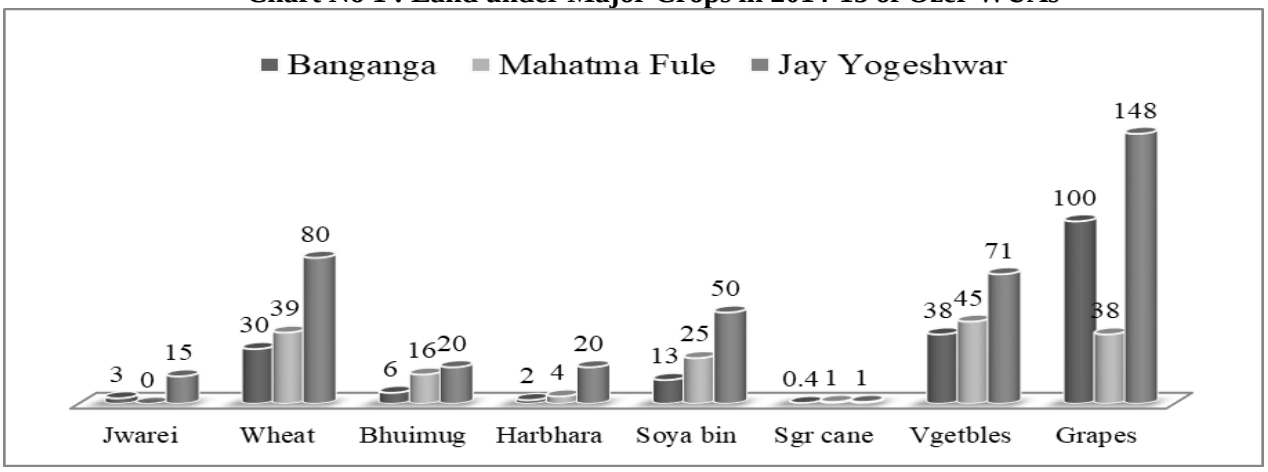
WUAs -	**Banganga**			**Mahatma Fule**			**Jay Yogeshwar**		
Major Crops in Area	Land in ha	Production per ha	Income per ha	Land in ha	Production per ha	Income per ha	Land in ha	Production	Income per ha
Jwarei	3	25	37500	-	-	-	15	25	37500
Wheat	30	25	55000	39	25	55000	80	25	55000
Groundnut	6	16	36800	16	16	36800	20	16	46000
Harbhara	2	12	32400	4	12	32400	20	12	32400
Soya bin	13	10	24000	25	10	24000	50	10	24000
Sgr cane	.40	60	36000	1	60	90000	1	60	90000
Vgetbles	38	310	186000	45	310	186000	71	310	186000
Grapes	100	250	500000	38	250	500000	148	250	500000
other	-	-	-	-	-	-	-	-	-
total	192.4	708	907700	168	683	924200	405	708	970900

Source: Annual reports of the Banganga, Mahatma Fule and Jay Yogeshwar WUAs Ozer 2014-15.

In the above table land under major crops, production per ha, and income per ha in 2014-15 of Ozer WUAs are given. In total accordingly Banganga WUAs has 192.4 ha land in use with respective crops having income of rupee 907700, the Mahatma Fule WUA has 168 ha land in use with their respective crops having of rupee 924200 and Jay Yogeshwar WUA has 405 ha land in use with respective major crops having income of rupee 970900. There is a similarity in production of major crops of Banganga and Jay Yogeshwar WUAs clearly shown in the table it is quite different in land use per ha in income in Indian National Rupees (INR) accordingly.

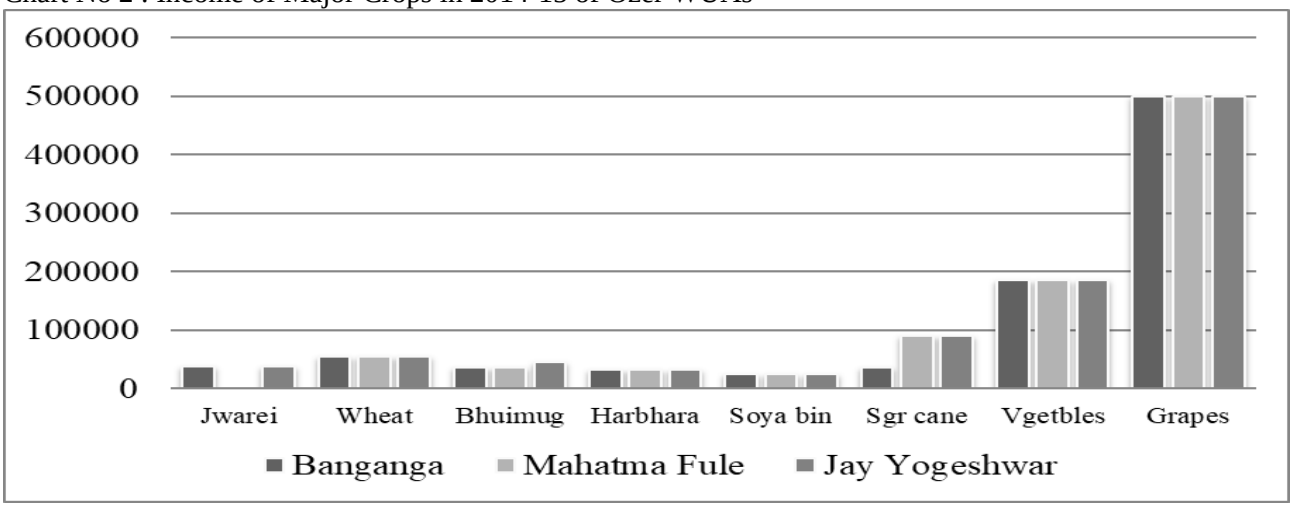
The same information is presented in charts of land in ha and income per ha with respective their major crops as follows.

Chart No 1 : Land under Major Crops in 2014-15 of Ozer WUAs



It will clear from the above chart that with the context of all three WUAs grown the same crops in last year only Jawar crops are not sown by the Mahatma Fule WUA hence there is no production and income of that crop. A wondering fact comes from the data that is, if we see the land in use of Banganga WUA and Jay Yogeshwar WUAs with respect to Jawar crops i.e. 3 and 15 but the production and income per ha are the same. It means that the Jay Yogeshwar WUA does not have a comparative advantage to grow the Jawar crops because with compare to the Banganga WUAs it has very law production per ha yield with respect to Jawar crops in the last year.

Chart No 2 : Income of Major Crops in 2014-15 of Ozer WUAs



In the context of the Wheat, Groundnut, Harbara, Soyabin, Vegitables, etc only Banganga WUA has comparative advantage but in the context of Grapes only Mahatma Fule WUA has comparatively advantage per ha yield of both production and income.

Conclussions

The equitable and optimal use of water from canal irrigation has been a matter of continuing concern. The traditional approach of pursuing these objectives through the field-level functionaries of irrigation department had its limitations. The participation of actual beneficiaries through PIM

and the maintenance of village-level distribution channels through WUAs have been found useful. There is broad consensus that this has been a step in the right direction. This needs to be pursued more vigorously with genuine empowerment of WUAs. The objective should be to cover the entire command of all major and medium projects with WUAs

This is a unique case in which complete control of the irrigation Project is handed over to the federation formed by 24 farmers' WUAs. This federation is the apex organization called WPLWUA. From the data available to us, it clearly shows that the recovery of water charges has considerably improved after the IMT. At the same time, it is found that the WUAs have been charging a much higher amount from their water users. This is a good sing because this will enable the associations to accumulate funds for the maintenance of micro structures relating to conveyance of water at the WUA level.

Irrigated area, numbers of rotations, the agriculture produce in thousand hector and employment generation are increasing over the time period with increase in revenue and collection of taxes. It is found that the Ozer WUAs i.e. Jay Yogeshwar WUA, Mahatma Fule WUA and Banganga WUA are tent to have more cash crops rather than the traditional crops because of having availability of sufficient water at affordable rate on time. Form the year 1990 to 2010 there are 11-time increase in average food grain production, 20 times increase in irrigation, 3 times increase in rotation, 29 times increase in farmers income, 10 time increase in government revenue and 5 times increase in employment generation. The provision of secure access to water is an important tool with which poverty can be alleviated, although its effectiveness depends on secure access to other productive resources such as land and training and capacity building. The Cluster of Ozer WUAs are supplying equitable, judicious, timely and assured water to farming community that results into innovative and sustainable irrigation management transfer.

Suggesstions

1. Training programs, programs introduces new technology, new innovation in the field, coming varieties of crops, etc for farmers should be arrange.
2. While studying the irrigation water management we found that the management of waste water is also most important. The around 32 % of total waste water comes from agriculture and allied sector. Therefore the management of waste water has same significance as the fresh water.
3. Modern technology should be used to water the farm. It will help to more and more grow crops with the les and les use of water.
4. The stakeholder of the WUAs should ask to the management of the authority about the maintenance of cannel, continuity of realizing water from resources, maintain account transparent in nature, cost benefit enquire and other related issues to the concern responsible office or person of the WUAs.
5. There is a need for exploring the possibility of integrating the Panchayati Raj Institutions (PRI) into the reforms process for sustaining the reforms in the long run. For these local bodies are totally bypassed by the new initiatives.
6. Transfer of powers and responsibilities to the WUAs at the local level should be done in an effective and phased manner.

Limitations and Future Research Directions

Many traditional small-scale and small holder irrigation systems worldwide employ water masters to manage and distribute water between farmers. The formation of a WUA provides the mechanism by which service fees can be charged and collected to pay water master. Employing a water master full-time during the irrigation season provides several benefits: (i) farmers are given a schedule of when they will receive water and can plan their irrigations, (ii) water is more equitably distributed, (iii) water is used more efficiently, (iv) field channels are better maintained, reducing conveyance time and losses, (v) conflicts over water reduced. By acting together through the WUA individual farmers can apply more pressure to the ID/WRD to ensure that they get a better level of service from the ID/ WRD. Better levels of service form the main system will result in improved water use efficiency and agriculture productivity. The basic management principle is, if you cannot measure, you cannot manage. Encouraging volumetric water deliveries and volume based charging from WUAs will motivate WUAs / farmer to use appropriate water and avoid wastage. It will also establish an appreciation for economic value of water. A large part of wastage on canal systems, particularly at minor and distributaries level occurs due to deteriorated, irregular and unmaintained hydraulic section and growth of weeds / bushes on canal banks. Timely maintenance and repair of canal can minimize wastage of water as well as economies on cost. It will be possible when a local institution like WUA

is enabled to carry out need based repair and local maintenance. It is known that maximum water losses occur below outlet level largely due to non-existence or poor maintenance of field distribution network. The social engineering skill which is required for conflict resolution on alignment of water courses and sharing of water is scarce among ID/WRD/CADA. If WUAs are enabled to take up role of water distribution and conflict resolution below outlet level can be reduced to a large extent. Once a regime for volumetric deliveries is established, it will be in the interest of the department to construct / rehabilitate the control structures and WUAs will be keen to monitor and curb unauthorized withdrawal. Wherever a mismatch between crop demand at field level and water supplied from canal occurs and supplied water is in excess of demand, the excess water is wasted. This situation can be corrected with WUA making water demand based on crop requirement and department effects it through operational plan and roster schedule. Farmers avoid risk and rarely deviate from traditional practices unless they are exposed to 'learning by doing' or 'learning by peers'. The success of Farmer Field Schools and Farmers Water Schools in developing a culture in which water saving technologies can work largely depends on functional WUAs. It has been well established that the conjunctive water uses offers more efficient irrigation water use and agriculture productivity. Due to compartmental structure of government departments, it implementation at field level is not possible by their intervention. WUAs are better placed to implement conjunctive water use in their command area. Evaporation, rainfall and ground water level data presently available to planners are inadequate, unreliable and not properly geo-referenced. The data collected by WUAs. As during course of their activities of water audit, water budgeting and implementing conjunctive use of water will be reliable and give fillip to micro planning at the sub basin level where maximum water wastage is prevalent.

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