



ROLE OF REGIONAL INNOVATION SYSTEM IN THE IRRIGATION SECTOR IN MAHARASHTRA

Waghmare Vikas Meghraj¹ and Dr. Kunal Sinha²

Abstracts

The Regional Innovation System (RIS) has been used in order to understand and analyse the structure of irrigation innovation of Maharashtra in which universities, industrial enterprises, public research institutes and various organisations playing crucial role. For writing this paper authors have done a primary survey of the four agriculture universities, one industry/company, four organization and corporation and two research institutes and for evaluating impact on agriculture production in Maharashtra.

Keywords: Regional Innovation System, Adoption, Diffusion and Irrigation Technology.

Introduction

In India, there are noteworthy achievements in the irrigation sphere such as magnificent dams across rivers with their vast network of canals, shallow and deep tube wells, in the plains and bore wells in hard rock areas (Swaminathan, 2007). In the pre-colonial era, the main irrigation systems were river diversion works, tanks and dug wells that were managed by local communities. Along with this, the colonial government expanded the canal irrigation in India in the 19th century. Over the last five decades, the net irrigated area has more than doubled and this expansion underlies the significant improvement in agricultural productivity and production in the country. Surface irrigation involves a whole range of technologies, such as hydrological studies for design of dams and canals, surveying and construction technology. In case of groundwater irrigation, the boom in tube wells and bore wells since the mid-1960s had been possible with the advent of high speed drilling technology. The irrigation system distribution is now commonly adopted by almost all the countries (Sampath, 1990). India had been facing the problem of water scarcity in the period from 1960 to 1980; 70% of the population was dependent on agriculture in India (Muruganatham, 2009). Now a day, especially Maharashtra is facing problem of water scarcity. The main reason of poor performance of irrigation systems was because the farmers utilised conventional methods of irrigation as well as they were unaware about new technological methods (Mitra, 1996).

In case of Maharashtra, the new technology of irrigation systems is playing a crucial role and increasing productivity in agriculture. There are many agriculture based industries such as sugarcane, cotton, tobacco and oilseed. Since last six decades, there has been a considerable increase in the irrigated area in Maharashtra. But irrigation sector in the state has been facing many problems related to water. The irrigation potential of the state is on the lower side in relation to its size of the rural population and gross cropped areas.

Regional Innovation System

In this research paper, Regional Innovation System (RIS) has been applied to analyse the irrigation innovation system of Maharashtra. The concept of a regional innovation system (RIS) is relatively a new one, having first appeared in the early 1990s (Asheim 1995; Isaksen

¹Ph.D. Research Student Centre for Studies and Research in Science, Technology and Innovation Policy, School of Social Sciences, Central University of Gujarat, Gandhinagar, India. Email: vikaswaghmarecug@gmail.com

²Assistant Professor, Centre for Studies and Research in Science, Technology and Innovation Policy, School of Social Sciences, Central University of Gujarat, Gandhinagar, India. Email: Kunalsinhajnu@gmail.com

1997; Cooke 1992). It is focused on the geographical configuration of economic actors –firms, workers, associations, organization and government agencies is fundamentally important in shaping the innovative capabilities of firms and industries. The concept of regional innovation system was inspired by the national innovation system and it is based on a similar rationale that emphasizes territorially based innovation systems. One such rationale stems from the existence of technological trajectories that are based on sticky knowledge and localized learning within the region. These can become more innovative and competitive by promoting stronger systemic relationship between firms and the region's knowledge infrastructure. A second rationale stems from the presence of knowledge creation organizations whose output can be exploited for economically useful purposes by supporting newly emerging economic activity. The emergence of the concept of a regional innovation system coincides with the success of regional clusters and industrial districts in the post-Fordist era (Asheim et al., 2000), and the elaboration of the concept represents an attempt by students of the geographical economy to understand better the central role of institutions and organizations in promoting innovation-based regional growth (Asheim et al. 2003; Gertler and wolfe, 2004).

In RIS it has been argued that the geographical configuration of actors- firms, organization and government agencies is fundamentally important in shaping the innovative capabilities of firms. A growing body of thought argues that in a competition in which success depends increasingly upon the ability to produce new or improved processes, tacit knowledge constitutes the most important basis for innovation based value creation (Pavitt, 2002). As Maskell and Malmberg (1999), have put it, when everyone has relatively easy access to explicit/codified knowledge, the creation of unique capabilities and products depends on the production and use of tacit knowledge.

Tacit knowledge is a key determinant of the geography of innovative activity. There are two closely related elements of this argument. First, because it defies easy articulation or codification (Polanyi 1958, 1966), tacit knowledge is difficult to exchange over long distances. The second is related to the changing nature of the innovation process itself and, in particular, the growing importance of socially organized learning processes. It means that innovation has come to be based increasingly on the interactions and knowledge flows between economic entities such as firms (customers, suppliers, and competitors), research organization (universities, other public and private research institutions) and public agencies (technology transfer centers, development agencies) (Lundva, 2005).

Types of RIS

In order to reflect the conceptual variety and empirical richness of the relationship linking the production structure to the “institutional set-up” in a region (Asheim, 1998) some academic literature distinguishes among three types of RIS. Such as territorially embedded regional innovation systems, regionally networked innovation system and regionalized national innovation system.

The Main Components of Regional Innovation System

- Universities
- R&D functions of, public and private research institutes
- Organizations and corporations
- Industries/companies/firms
- Collaboration between industry and academia

Regional Innovation Systems and irrigation Sector

There are three main types of innovation systems: National Innovation System (NIS), Regional Innovation System (RIS), and Sectoral Innovation System (SIS). We have selected Regional Innovation System (RIS) for writing this paper. The RIS has been applied to the

problem of irrigation within the limitation of the state boundaries. In other words, the proposed project works with the approach that the state and its institutional infrastructure become important for using the theoretical framework of regional innovation systems. Therefore, writing this paper has selected four agriculture universities, one industry/company, four organization and corporation and two research institutes in Maharashtra.

Components of Regional Innovation System in Irrigation System

It is necessary to mention some empirical specifications of this study at first. The objective is to trace the innovations that have taken place in the irrigation sector and the role played by the actors to bring about the innovations. In this order, a region needs to be selected within which empirical observations can be located so that the RIS can be utilized. However, nine districts have been selected to study RIS because the study includes the visits during fieldwork to 4 universities, 1 company, four organization and corporation and two research institutes bodies which are located in these districts. The irrigation scenario was aimed to understand during fieldwork which made it essential to include the various universities, industries, organisations, institutes and research centres within the survey.

Table 1: Components of Irrigation Innovation System in Maharashtra and their Activities

Components	Names	Activities
Universities	Marathwada Agricultural University, Parbhani. Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. Mahatma Phule Krishi Vidyapeeth, Rahuri. Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli.	These Universities have been doing Research & Development related to Agricultural (Irrigation) sectors.
Company	Jain Irrigation Industry, Jalgaon.	Irrigation Related Production. Research & Development.
Institution	Water Resource Ministry Government of Maharashtra	Roles and Norms
Organization and Corporation	Water and Land Management Institute, Aurangabad (WALMI) Maharashtra Krishna Valley Development Corporation, Pune. Godawari Marathwada Irrigation Development Corporation, Aurangabad. Vidarbha Irrigation Development Corporation, Nagpur. Tapi Irrigation Development Corporation, Jalgaon.	These organizations and corporations are doing Water and Irrigation related activities.
Research and Development	Directorate of Irrigation Research & Development, Pune (DIRD) Water and Land Management Institute, Aurangabad. (WALMI)	Research & Development (Requirements of the farmers)

Source: Own Compilation 2014

Table 1 provides the empirical equivalents of the theoretical concepts of regional innovation system. In this paper, regional innovation system has been used to help analyse the structure of irrigation innovation in Maharashtra. In the regional innovation system the main actors are university, industrial enterprise, public research institutes and various organisations. So, using this, it provides an idea how the irrigation system is getting

consolidated by these actor's roles in Maharashtra. There are agricultural universities, R&D centres, industries and organizations has selected in the state. These components have been playing an important role in the development irrigation system in Maharashtra. This paper analysed the relation between regional innovation system and irrigation system in Maharashtra.

Role of Universities in Irrigation Sector

There are five agriculture universities in Maharashtra namely Marathwada agricultural University, Parbhani, Dr Panjabrao Deshmukh Krishi Vidyapeeth, Krishi Nagar, Akola, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dr Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli and Maharashtra Animal and Fishery Sciences University. But in which four universities are doing research in the area of irrigation and its development. Maharashtra Animal and Fishery Sciences University is a recognized agriculture university but it does not function in the area of irrigation sector. So the overall assessment is that four universities have played crucial role in the area of irrigation research and development and training programmes for farmers.

Table 2: Universities Indicators for Irrigation Sector in Maharashtra 2014

Sr. No	Universities	Patent	Completed Research projects	Ongoing Research projects	Ph. D. Holders	Number of Collaboration (Name of Collaborator)	Expenditure
1	Marathwada Agricultural University, Parbhani	No	9	7	-	1 (Central Institute of Bhopal)	15000* 5000**
2	Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola	No	7	-	2	1 (Jain Irrigation Industry)	60,000
3	Mahatma Phule Krishi Vidyapeeth, Rahuri	2	16	-	-	-	-
4	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli	-	-	-	-	-	-
5	Total	2	32	7	2	2	80,000

Source: Own Compilation, 2014: Note: Big project*, Small project** and No comment-

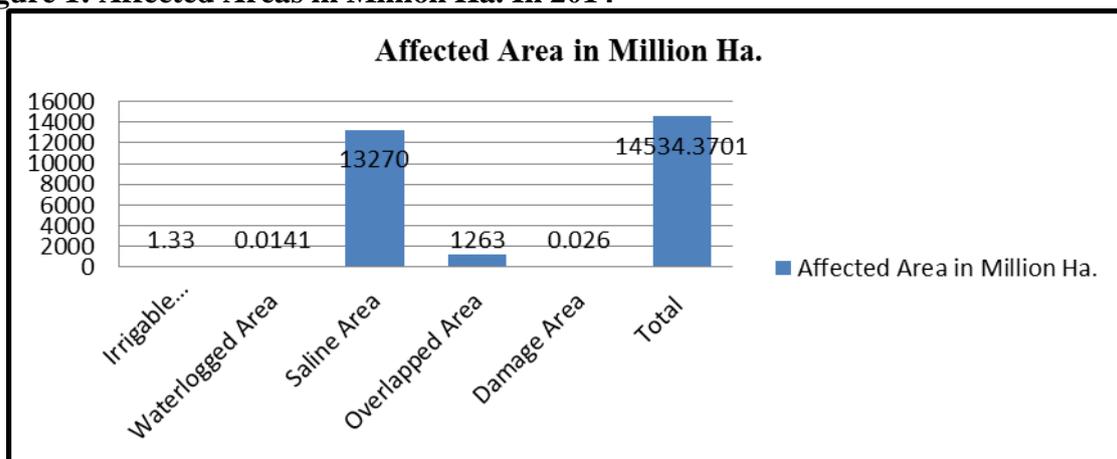
Table 2 shows clearly, that the universities play a major role in the irrigation system. The condition of the irrigation sector is understood better as per the data which was found from these universities. However, the objective is not satisfied with the available data. The table helps explain the status of irrigation in Maharashtra in relation to research centre. This research has collected the views of government authorities through primary survey and the details are given below.

Directorate of Irrigation Research & Development, Pune (DIRD)

The DIRD was started in the year 1916 as a special organization of Government of Maharashtra (GoM) that focused on the rehabilitation of waterlogged and saline areas in Pune. The functions of this organization are to execute and maintain surface and sub-surface drainage schemes for reclamation of waterlogged. In order to make an effective organization,

the government of Maharashtra has provided constitutional framework.³ This research paper has collected the views of government authorities about the patent. They responded that DIRD never tried to apply for patents of any research done in their laboratories, but DIRD conducts research about the current problems and issues which are raised by the farmers. There is no any candidate who completed Ph.D. but several candidates came from engineering background i.e. B. Tech. & M. Tech who conduct research. This institute does not have any kind of collaboration with other institutes, organizations within or outside India. This institute is engaged in conducting research with the objective of developing such techniques that will provide more agricultural yield and at the same time requiring less use of water. They plan to proceed in the same research direction in the future⁴.

Figure 1: Affected Areas in Million Ha. In 2014



Source: Own Compiled 2014

Figure 1: indicates how much affected area is under the Directorate of Irrigation Research & Development, Pune (DIRD). The total affected area is 14534.3701 million ha. This area has been divided in five part, the damage area is 0.026 million ha, overlapped area is 1263 million hector, saline area is 13270 million hector, waterlogged area is 0.0141million hector and irrigable area is 1.33 million hector.

Role of Organization and Corporation in Irrigation System

The organization and corporation plays a crucial role in the irrigation systems. The main objective of these organizations and corporations is the development of irrigation systems. This study has selected five organizations and corporations namely Water and Land Management Institute, Aurangabad (WALMI), Maharashtra Krishna Valley Development Corporation, Pune, Godawari Marathwada Irrigation Development Corporation, Aurangabad, Vidarbha Irrigation Development Corporation, Nagpur and Tapi Irrigation Development Corporation, Jalgaon. These organization and corporations are engaging in irrigation related activities.

Water and Land Management Institute, Aurangabad (WALMI)

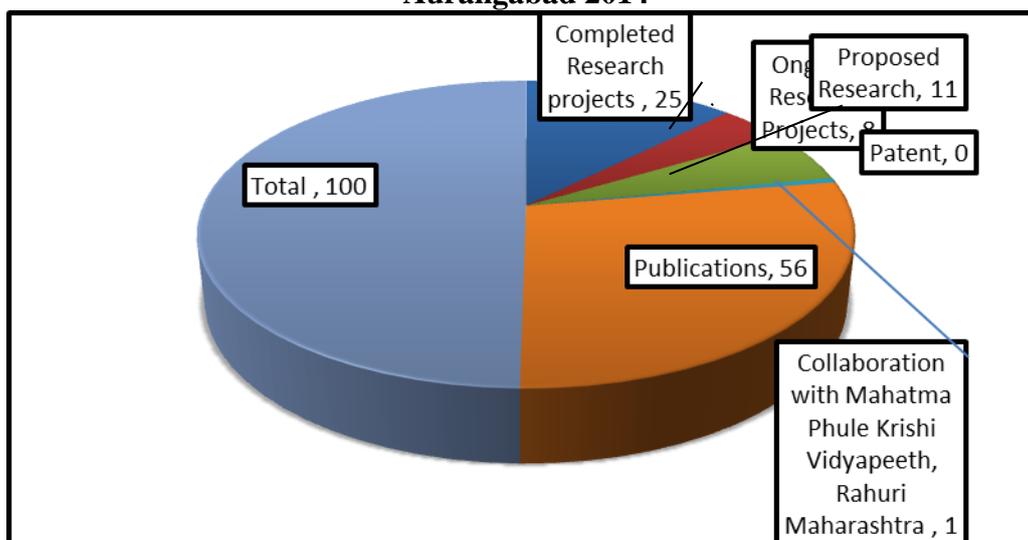
This is the first institute in India established for water management⁵. Water and Land Management Institute (WALMI) had been established on the 1st Oct.1980 in Maharashtra. This institute is totally autonomous and is registered society under the water resources department, government of Maharashtra. The main objective of this institute is to provide training service of the interdisciplinary, research and development related to the irrigation sector, consultancy services and training through seminars, workshops etc.

³Available at: <http://www.dird-pune.gov.in/> Accessed on date: 11 Nov.2014.

⁴Source: Primary survey; 25 Oct. 2014.

⁵Available at: Water and Land Management Institute; Kanchanwadi, Aurangabad, Maharashtra: Available at: <http://www.walmi.org/index.htm>: Accessed on date: 02 Sept. 2014.

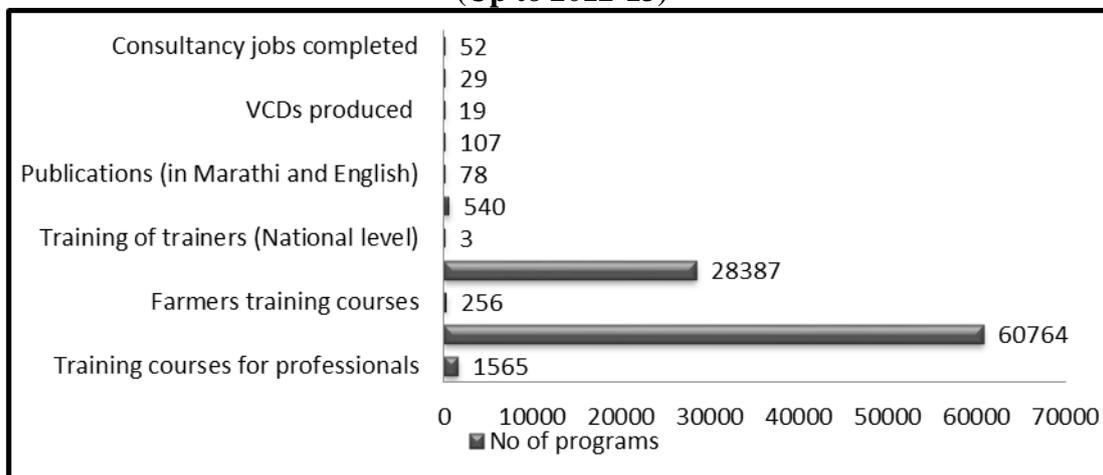
Figure 2: Research Activities of water and Land Management Institute (WALMI) Aurangabad 2014



Source: Own compilation, 2014

Figure 2 indicates research activities of Water and Land Management Institute, Aurangabad (WALMI). Through the primary survey the authorities given information that there are 25 completed research project, 8 ongoing research projects and 11 proposed research projects in the (WALMI). This institute is in collaboration with Mahatma Phule Krishi Vidyapeeth, Rahuri Maharashtra. Along with this, the institute has 56 publications to its name but no patent on its name.

Figure 3: Achievements of Water and Land Management Institute (WALMI) (Up to 2012-13)



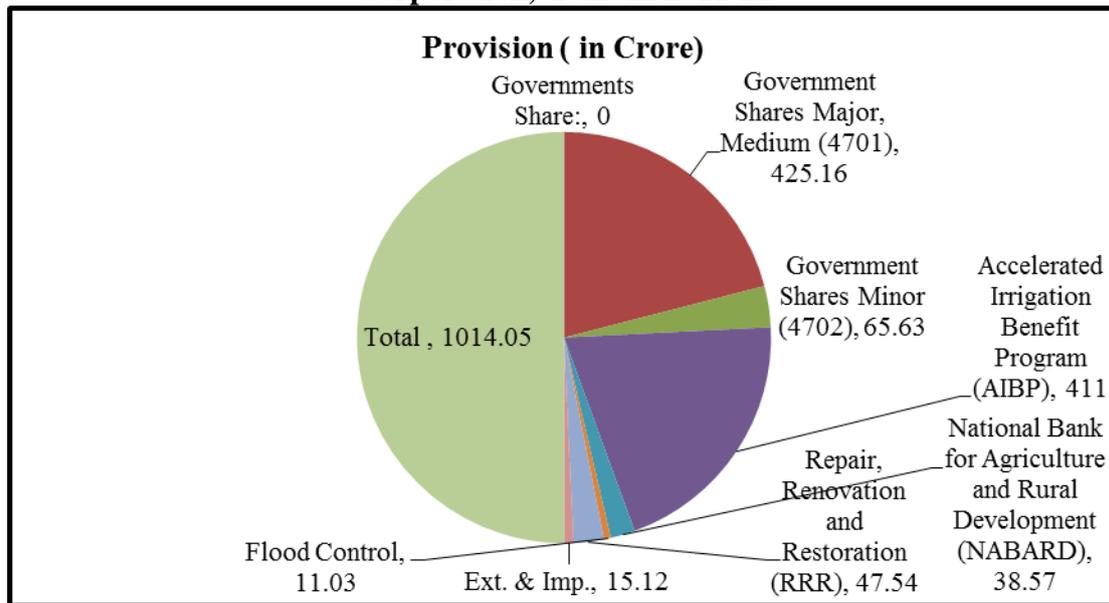
Source: Own compilation, 2014

Figure 3: mentions the achievement of the water and land management institute (WALMI) in the year 2013. Through this figure it can be seen that there are different types of the programs of (WALMI) for the development of irrigation system. This institute facilitates 1265 professional’s courses (WALMI) and 60764 officers and other staff courses. Another achievement of this institute is that, 28387 farmers have been trained here. There were 256 farmers training courses going on in the institute. Along with, in this institute 3 farmers have been given national level training while 540 seminars and workshop have been organised in this institute. The institute has 78 publications. It also provides the facility of videos, VCDs files and computer software’s to farmers because through this they can easily to understand how to utilise technology and other activities.

Maharashtra Krishna Valley Development Corporation, Pune

The Maharashtra Krishna Valley Development Corporation was established in the year 1996, with its headquarters in Pune working started independently from 1st April 1966. The total irrigation projects were 1058 and at present a total of 111 irrigation projects are under construction which comprises of 16 major, 20 medium and 55 minor irrigation projects. The following data has been collected through the booklet of directorate of irrigation research and development, Pune 2012-13.

Figure 4: Budgetary provision of Finance of Maharashtra Krishna Valley Development Corporation, Pune in 2011-12



Source: Own Compilation 2014

Figure 4: indicates the budgetary provision of Finance in 2011-12 of irrigation development. The Maharashtra Krishna Valley Development Corporation Pune has taken funds from various sources such as the government, Accelerated Irrigation Benefit Program (AIBP), National Bank for Agriculture and Rural Development (NABARD), Flood Control, Repair, Renovation and Restoration (RRR) & Export & Import Bank etc. For the purpose of development of corporate services, this corporation has been given funds from the government.

Godawari Marathwada Irrigation Development Corporation, Aurangabad

Godawari Marathwada Irrigation Development Corporation was established on the 17th of Aug 1998 in Aurangabad, Maharashtra but actually it started working from 1st Oct 1998. The main objective of this corporation is speedy utilization of sanctioned water use of Godavari River in Maharashtra state in Godavari basin. The corporation has undertaken construction of 14 major irrigation projects, 12 medium projects and 158 minor projects. In addition 215 more projects are to be constructed in near future. This research has taken into consideration Godawari Marathwada Irrigation Development Corporation. The authorities of this corporation didn't give any answer.

Table 3: Achievements during the last five years of Godawari Marathwada Irrigation Development Corporation, Aurangabad

Sr. No.	Particulars	Achievements
1	Commencement of new projects	300
2	Administrative Approval for new projects	302
3	Revised Administrative Approval to new projects	415
4	Major Irrigation Project	1
	Medium Irrigation Projects	15

	Minor Irrigation Projects	179
5	Additional Irrigation Potential created	0.331 M ha.
6	Completed Gorge filling projects	247
7	From completed projects water supplies to the population	2.5 Crore
8	From completed projects water is supplied to Industries	100
9	Barrages projects completed	10

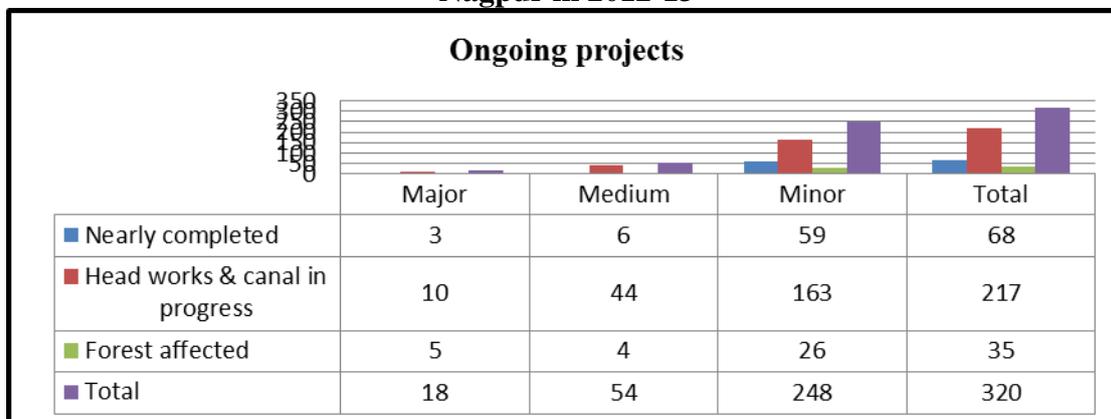
Source: Own Compilation, 2014

Table 3 indicates the achievements of Godawari Marathwada Irrigation Development Corporation. The corporation has approved 302 projects but implemented 300 new projects. The corporation has also revised administrative approval to 415 new projects. The overall assessment is that under this corporation 295 major, medium, minor irrigation projects and 10 barrages projects have also completed. Despite this additional irrigation potential also irrigated 0.331 M ha. The data indicates that during last five years, the corporation has spent 2.5 Crore for the water supplies.

Vidarbha Irrigation Development Corporation, Nagpur

This corporation was established in the year 1997 in Nagpur⁶. The main purpose of this corporation is the development of irrigation systems. The complete some irrigation projects in the Vidarbha region, Government of Maharashtra has formed the Vidarbha Irrigation Development Corporation, Nagpur. Initially 96 ongoing irrigation projects in the Vidarbha region, major projects were 14, medium projects were 27 and minor projects were 55. At present, there are total 1089 projects in Vidarbha, out of which 767 projects are completed, 320 projects are under the construction and 2 projects are in the process of administrative approval. The update cost of 320 ongoing projects is 57062 crore. Along with this, the expenditure incurred in March, 2012 is 21813 crore.

Figure 5: Ongoing projects in Vidarbha Irrigation Development Corporation, Nagpur in 2012-13



Source: Own Compilation, 2014

Figure 5 indicates the status of the Vidarbha Irrigation Development Corporation, Nagpur. During the primary survey, the author got the information that this corporation has 320 ongoing irrigation projects. These projects are divided in three parts. The completed irrigation projects are 68, 217 projects are under the construction and 35 projects is forest affect.

Tapi Irrigation Development Corporation, Jalgaon

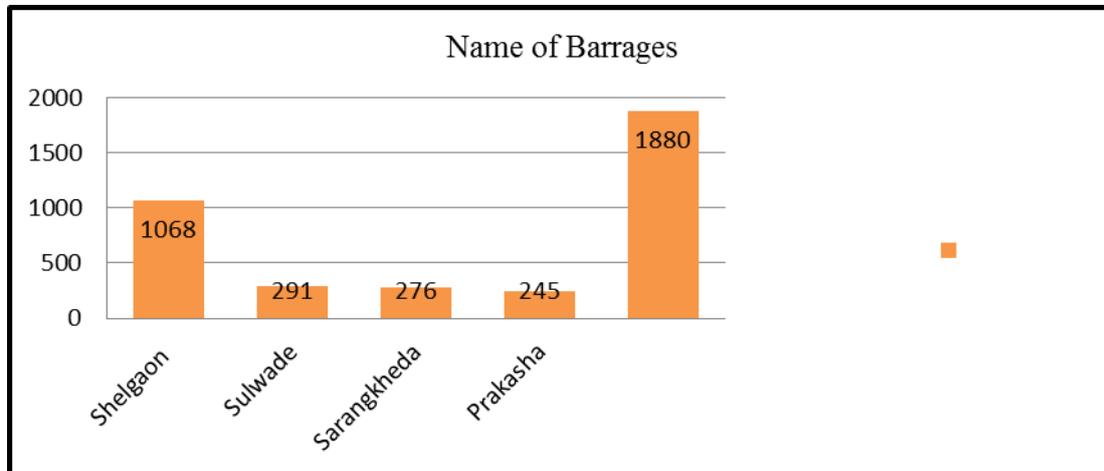
The Tapi Irrigation Development Corporation was established in the year 1998 in Jalgaon⁷. The objective of this corporation was to provide irrigation water. The Tapi

⁶ Available at <http://www.vidc.in/> Accessed on date 26 Oct. 2014

⁷ Available at: As per the information available in the document brought out during the India Water Week 2013-14, based on the theme “Efficient Water Management Challenges and Opportunities”; published by Directorate of Irrigation Research and Development under the Water Resources Department, Government of Maharashtra.

Irrigation Development Corporation has 280 irrigation projects viz. major irrigation projects 3, medium irrigation projects 19, minor irrigation projects 257 and one lift irrigation scheme is completed at present, condition of the Tapi Irrigation Development Corporation is that 144 total irrigation projects viz. major irrigation projects are 5, medium irrigation projects are 21 and minor irrigation projects 81.

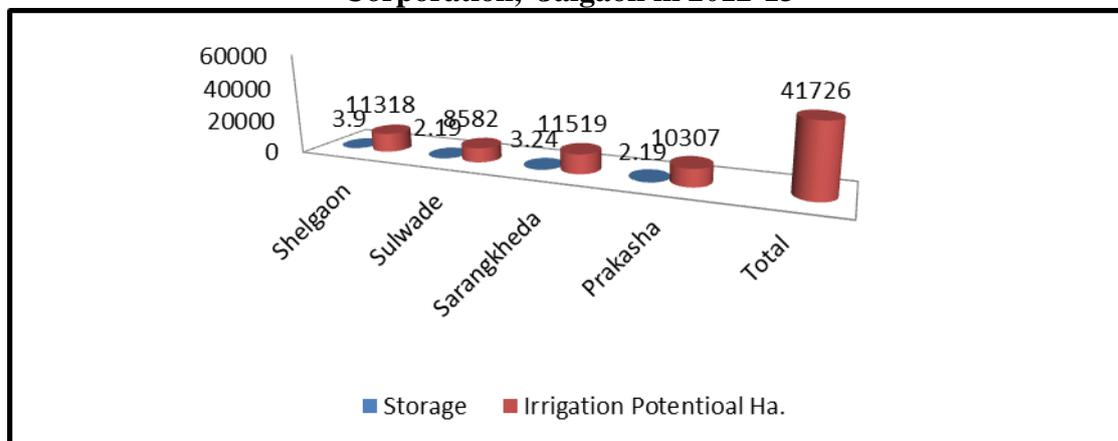
Figure 6: the Barrages of Tapi Irrigation Development Corporation, Jalgaon in 2012-13



Source: Own Compiled 2014

Figure 6 indicates the estimated proposal of four barrages by the Tapi Irrigation Development Corporation. 1068 crore estimated for Shelgaon barrage, 291 crore Sulwade, 276 crore Sarangkgheda and 245 crore Prakasha barrage. It indicates that highest money is proposed for Shelgaon barrage and lowest for the Prakasha barrage.

Figure 7: Storages and Irrigation Potential of Barrages of Tapi Irrigation Development Corporation, Jalgaon in 2012-13



Source: Own Compiled 2014

The figure 7 indicates the capacity of storages and irrigation potential barrages in hectares. The Shelgaon barrage capacity is 3.9, Sulwade barrage capacity 2.19, Sarangkgheda barrage capacity 3.24 and Prakasha barrage capacity 2.19. The Shelgaon 11318 hectares potential irrigation, Sulwade 8582 hectares potential irrigation, Sarangkgheda 11519 hectares potential irrigation and Prakasha 10307 hectares potential irrigation.

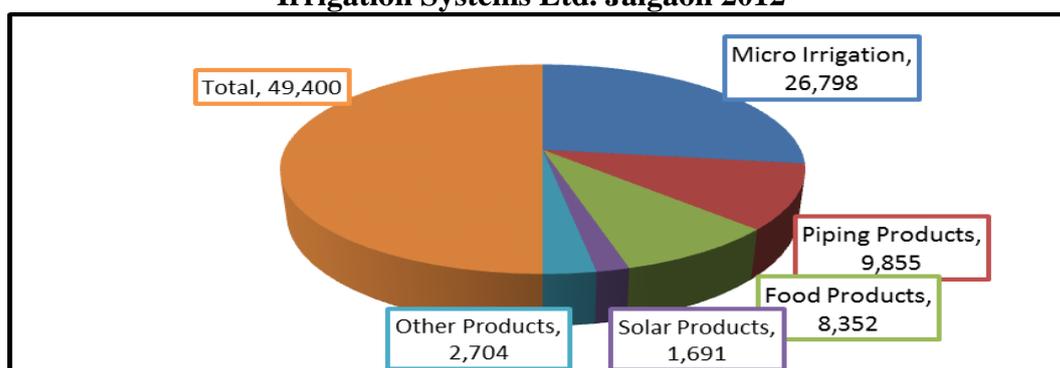
Irrigation Company/ Industry in Maharashtra

This paper has selected one company for the work of paper. Researchers visited this company - Jain Irrigation Industry Jalgaon.

Jain Irrigation Systems Ltd. Jalgaon, Maharashtra

This industry was started in the year 1989 in Jalgaon Maharashtra. Jain Irrigation had struggled to pioneer water management through micro irrigation in India. This company has emerged as a big company after merging with various Jain groups of companies, such as the Jain Plastic & Chemicals Ltd., Jain Kemira Fertilizers Ltd., Jain Rahan Biotech Ltd, Jain Brothers Industries, and Jain Pipe⁸. This company is a multinational organization in Jalgaon, Maharashtra, India. The company offers the widest range of cost effective and customized technologies across more than 100 countries worldwide⁹. This industry is playing a vital role in irrigation systems Maharashtra and has been doing development in the irrigation system. The following has been mentioned about the current status of Jain irrigation industry.

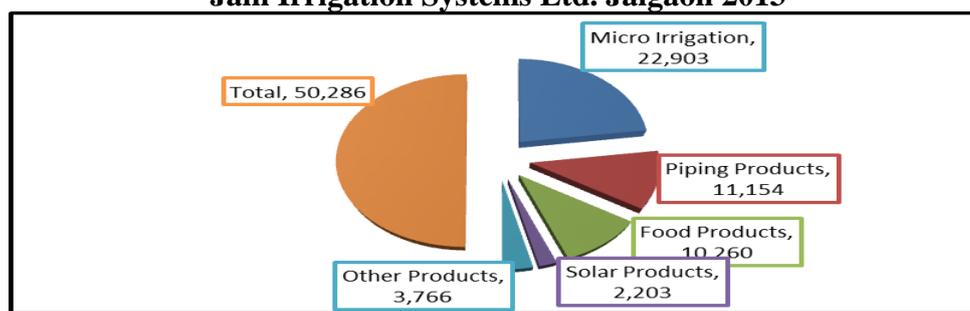
Figure 8: Consolidated Revenue Segmentation in Million: By Business Verticals of Jain Irrigation Systems Ltd. Jalgaon 2012¹⁰



Source: Own Compilation, based on Jain Irrigation System Ltd. Annual Report 2012-13.

Figure 8 indicates the consolidated revenue segmentation of Jain irrigation system Ltd. Jalgaon. The total revenue was 49,400 million in the 2012. This diagram shows the distributed revenue in the business verticals. Such as the vertical of micro irrigation revenue is 26,798 million. The vertical of piping production is 9,855 million. Along with, the vertical of food products revenue is 8,352 million. The vertical of solar production revenue is 1,691 million and the other production revenue is 2,704 million in the year 2012.

Figure 9: Consolidated Revenue Segmentation` in Million: By Business Verticals of Jain Irrigation Systems Ltd. Jalgaon 2013



Source: Own Compilation, based on Jain Irrigation System Ltd. Annual Report 2012-13

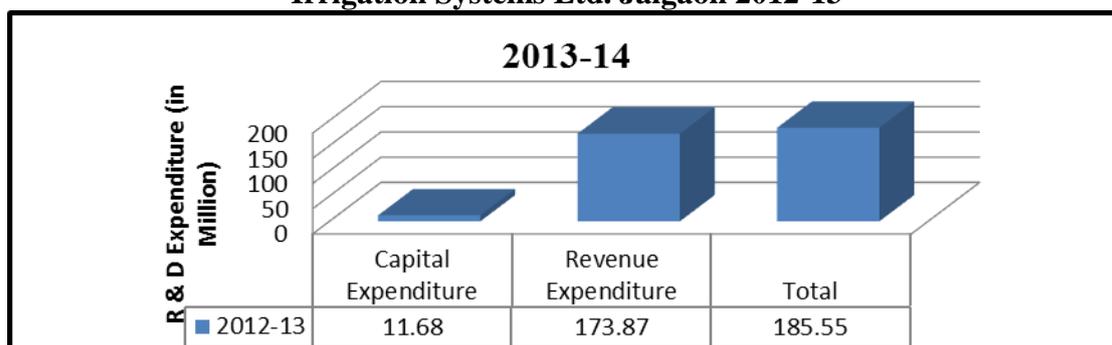
Figure 9 indicates revenue in business verticals. In 2013, the total revenue is 50, 286 million which was collected from several areas such as micro irrigation 22,903, piping products 11,154, food products 10,260, solar products, 2,203 and other products 3,766.

⁸Available at: http://en.wikipedia.org/wiki/Jain_Irrigation_Systems: Accessed on date: 21 Nov. 2014.

⁹Available at: <http://www.naandanjain.com/>: accessed on date: 22 Nov. 2014.

¹⁰Available at: <http://jisl.co.in/Company/financial/PDF/13/JAIN%20IRRIGATION%20-%20ANNUAL%20REPORT%202012-13.pdf>: Accessed on date: 22 Nov. 2014.

Figure 10: Research and development (R&D) Expenditure (in Millions) of Jain Irrigation Systems Ltd. Jalgaon 2012-13



Source: Own Compilation, based on Jain Irrigation System Ltd. Annual Report 2012-13

The figure 10 indicates the expenditure of Jain Irrigation System Ltd. Jalgaon on the research and development (R&D) during 2012-13. The total expenditure is 185.55 million; it is divided into two types of expenditure, first, capital expenditure which amounts to 11.68 million and second revenue expenditure which amounts to 173.87 million. This industry has conducted research related to irrigation.

Table 4: Year Wise Sprinkler and Drip Sets Distributed and Expenditure (Rs. in crore)

Year	Sprinkler		Drip		Expenditure incurred Rs. in Crore
	No. of sets	Area (ha.)	No. of sets	Area (ha.)	
2007-08	35,288	37,719	63,298	63,548	167.28
2008-09	34,701	41,851	58,014	74,782	197.55
2009-10	36,329	37,552	91,058	81,660	192.11
2010-11	38,030	38,029	1,40,764	1,27,967	407.88
2011-12	38,959	37,904	1,77,150	1,50,995	448.04

Source: Economic Survey of Maharashtra 2012-13

Table 4 shows year wise sprinkler and drip sets distribution and expenditure. It examines the distribution and expenditure of sprinkler and drip 2007-08 to 2011-12. In 2008-09, the increment sprinkler and drip sets are seen but the lessening of both too can be observed. In 2007-08, the irrigated area of sprinkler was 37, 719 whereas the same area decreased by 167 hecter in 2009-10. In 2011-12, this area increased by 352 hectare again. Thus, year wise increment in the irrigated area under the drip can be observed but with the increased expenditure. Sprinkler and drip irrigation involves the target with intelligent application of water, fertilizer, and chemicals. Maharashtra state encourages cultivators to adopt these irrigation systems by giving 60% subsidy to small groups of farmer and 50% subsidy to the main farmers for purchasing sprinkler and drip irrigation equipments.

Summary

The regional innovation system has used for understand and analyse the structure of irrigation innovation in Maharashtra which universities, industrial enterprises, public research institutes and various organisations play crucial role. This study finds out how the four agriculture universities, four industries, five corporations are helpful for development of irrigation sector of Maharashtra.

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