Final Report

Irrigation and Entrepreneurship: Status and Lessons for Improvement and Expansion

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Executive Summary

Introduction

Agriculture today suffers from multiple crises and one of the worst crises is pertaining irrigation and water resources. It is a crisis of poor management of water resources leading to deeper crisis in terms of both availability as well as quality of water. Enhancing water availability and making it amenable for use and managing the distribution are challenges of a tall order due to dynamic nature of the resource and its distribution. The water situation has changed drastically over the past 4-5 decades. The last 20-40 years have witnessed massive increases in the use of groundwater for irrigation in the arid regions and in areas that have extended dry seasons and/or regular droughts.

At the same time the provision of irrigation services has been hampered by inefficient implementation. Despite huge progress the irrigation services provided by government authorities seem to fall short of the expectations of the farmers. The inability of reforms to really catapult the situation has led to lacunae in providing irrigation services. Private entrepreneurs claim to have come in to fill these voids. This study is an attempt to figure out how these entrepreneurs are faring, what are their characteristics and what can policy makers do or focus on to enhance the situation towards better provision of irrigation services.

Research Issue

The provision of irrigation as a service and input to agriculture is attaining critical proportions for the nation as it seeks to enhance productivity of agriculture to feed its billions of people. Irrigation has also seen more and more large irrigation schemes based on large dams on rivers being favored as the mode of development by successive governments and this has raised its own set of issues. The cost of providing irrigation keeps increasing for the government every day and is becoming prohibitive, energy subsidies to agriculture are on the rise leading to extreme stress on the energy sector and the economy as a whole. At the same time the users of irrigation continue to be unhappy with the services provided to them almost free of cost resulting in widespread dissatisfaction with the services and also a huge subsidy burden on the government treasury.

A fresh breed of irrigation entrepreneurs is coming up trying to innovate and try their fortunes by starting up businesses in the domain of providing irrigation and allied services. The lack of a directed policy for private participation in irrigation has hampered their development is a claim oft made by them.

There is a need to study this further and also make a beginning to understanding the existence and status of these enterprises (promoted by entrepreneurs) for providing improved and better irrigation services (to the farmers). Since the resources of the government are limited and the government is increasingly trying to withdraw from operations where it has been less effective or efficient and allow the market to take over, it makes sense to study whether irrigation entrepreneurs can pave the way ahead and substitute the efforts of the government in providing irrigation services to the farmers.

Thus the lacunae of looking at the role of entrepreneurs in the domain of public goods and services delivery and implementation is the theoretical prompt for this study and the lack of literature on the same has prompted an exploratory methodology and a largely descriptive output from this report. The literature gaps lead to the research questions and the methodology chosen for the study.

Research Objectives

The study is an attempt to figure out the role of entrepreneurs in the irrigation space and if it has potential in the future. The study seeks to provide certain pointers towards policy formation and reforms to aid the sector and entrepreneurs. The study is aimed at the following research objectives and questions:

1) *To ascertain the status of irrigation related entrepreneurship in India*
2) *To arrive at the future scope for entrepreneurship in the irrigation and allied sectors in India*
3) *To arrive at policy recommendations to facilitate greater entrepreneurship for the benefit of the irrigation sector*
4) *To arrive at lessons from the existing ventures for expansion and improvement of entrepreneurship in Irrigation and allied sectors in India*

Methodology

The study has followed a mthodology that starts with exploratory research and follows it with investigative research. This study was not amenable to a true quantitative analysis using econometrics. This study therefore followed a methodology generating a lot of descriptive data and a survey to collect responses of the users.

The exploratory research focussed on developing a list of entrepreneurship typology for irrigation and allied sectors and discovering dimensions of their existence and status for enabling the investigative study. The second step was to select case studies of irrigation and related entrepreneurial ventures. The third step entailed conducting case studies of the selected ventures.

A survey was conducted, as part of methodology, across a total of 445 respondents with about 50 beneficiary respondents from each case. A stratified random sampling frame was used to select respondents from each case. The survey included enquiries about the profiles of farmers and their farms, The expereince with the irrigation service and its impact. The survey also sought suggestions on the specific role of the entrepreneur and the institutional aspects of the enterprise. The chosen case studies were from the states of Gujarat, Maharashtra, Bihar, Jharkhand and Odisha.

Major Findings

Within technology adoption also there are multiple segments. Thus the policy has to be careful in avoiding drawing to the old conclusions that only young gentleman farmers are technology adopters. The general proportion of educated farmers is higher in the sample signifying that more educated farmers avail irrigation services from entrepreneurs than the illiterate ones. However, adoption is not limited to educated farmers only and even illiterate farmers have availed the irrigation services from the entrepreneurs.

Entrepreneurs are not entering the irrigation space for making money alone. They are targetting larger objectives such amelioration of agricultural distress and resolution of the energy-irrigation nexus as well. There is room for more generous but directed support from the government and the state at promoting such efforts by entrepreneurs.

A large proportion of famer-respondents had availbility of non-agricultural sources of income but this cannot be treated as a prerequisite for adoption as about one-third of the respondents were limited to agriculture as a source of livelihood. Other factors such as consolidation of landholdings, farm terrain, location in the command areas, sources of irrigation and the general water situation on the farm do not seem to have a major impact on farmers availing the services from irrigation entrepreneurs. In other words entrepreneurs seem to have overcome these limitations.

Farmers' needs for irrigation are changing due to changes in rainfall pattern, shortage of labour, poor soil quality and due to new irrigation practices. Most of the farmers are actually availing new and innovative services to cope up with a situation that they are faced with rather than for seeking growth alone.

A large majority of the sample believed that trainings are needed for better adoption and economics from the irrigation services but the content and delivery of available trainings need to be modified to make more sense for the farmers.

Farmers treat irrigation as a competing and exclusive good rather than a public good increasing the chances of tragedy of the commons.

Overall the stisfiaction levels with the irrigaiton services are high. Thiere is scope for more transparency that entrepreneurs have to bring in their dealings with farmers.

The respondents were very appreciative of the role of entrepreneurs in planning and implementation of the irrigation services. These are deifnitely areas where the entry of irrigation entrepreneurs seems to have made a significant impact. The impact of entrepreneurs on ease of acquiring irrigation services , enhancing participation in trainings, after sales service, fairness perception about the service and the overall managemnet of irrigation service is appreciated.

There is a need to take a fresh look at the complementarity of activities of the entrpereneurs and the government officials and institutions rather than treat them as substitutes or competitors in a market.

Suggestions for improvement of services from the respondents included the need for discussing more technical issues and economic issues with the farmers, the involvement of more technical personnel and special focus is needed on better coordination between private entrepreneur institutions and those of the government in delivering good services.

The enterprises were seen as very sucessful in making the irrgiation services and the local institutional mechanisms for the delivery fo the same more democractic, efficient and compliance oriented. The respondents also rated them as better on water measurement and distrbution compared to the earlier and traditional institutions.

The impact of entrepreneur led private enterprises was very positive on aspects such as timeliness of irrigation, followed in magnitude of impact in terms of adequate irrigation, facilitating expansion of irrigated area, equitable distribution of water, and adptiveness of the agricutlure using this irrigation service.

Overall the response was very positive that the irrigation services had enabled farmers to achieve their goals from agriculture as an occupation and livelihoood for them.

The strongest results in favour of irrigation services provided by entrepreneurs where they were successful in enabling agricutlure despite limited power,labour and / or financial availability and to some extent even shortage of water itself. A lesser proportion of farmer reposndents reported a positive imapct on increased income or assured income. The incresae in savings and investments coupled with these results signifies that the overall impact of entrepreneurs is even more positive in such resource constrained scenarios enabling farmers to think more from a long term perspective and sustainability of farming as an occupation and livelihood.

Recommendations

The following policy recommendations are arrived at and suggested based on the results obtained from analysing the data collected through the survey.

1. *It must be taken note by the policy makers that there is urgent need to support entrepreneurs with policies that promote them rather than allowing them to function in the absence of any policy.*
2. *The success of private entrepreneur led irrigatoin services is significant and thus there is a strong logic that the government and policy makers need to consider in favor of the participation of entrepreneurs in irrigation service provisions.*
3. *Special policy incentives seem desirable in case of resolving the energy-irrigation nexus, it appears to be difficult for entrepreneurs to take up innovations and services that impact the energy irrigation nexus wihtout subsidy.*
4. *Policy makers need to pay special attention to the assignment of property rights or other usufructus rights to irrigation services for private entrepreneurs to be successful. This emerges as an enabling condition that helps the entrepreneurs to deliver what is expected of them thereby taking the load off the government functionaries.*
5. *Policy makers need to regulate in a manner such that it is conveyed that entrepreneurs need to devise better innovative ways to establsih transparency and their processes & procedures are understood by the farmers.*
6. *A traditional regulatory role may not be able to achieve much and policy makers have to be innovative in enhancing the user expereince with respect to ease of acquiring*

irrigation service , enhancing participation in trainings, after sales service, fairness perception about the service and the overall managemnet of irrigation service.

7. *It is required to draft policies that allow entrepreneurs to take up larger and more diverse roles as they seem to have developed a fair amount of expertise in the delivery of public goods at the planning and implementation of services stages.*

8. *Policy makers need to ensure that procedural justice and fairness are the cornerstones of irrigation services delivery to farmers.*

9. *Policy makers need a radical shift in looking at private entrepreneurs' vis-à-vis govenrment functionaries and instituions as the survey clearly shows that there is a need to treat entrepreneurs and government officials and instiutions are complementary to each other and then devise policies for reforming the sector.*

10. *There is a need for discussing more technical issues and economic issues with the farmers and also the involvement of more technical personnel and special focus is needed on better coordination between private entrepreneur institutions and those of the government.*

11. *Aspects such as autonomy of the mangement committee and primacy to farmers' opinions are the critical aspects on which the government and the entrepreneurs need to come together and work in partnership and a policy push is required for the same.*

12. *Policy makers need to consider many additional reasons apart from those present in current literature in favour of participation of entrepreneurs in providing irrigation services to farmers. Some of these reasons could be the postiive impact on timeliness of irrigation, followed in magnitude of impact in terms of adequate irrigation, faciliating expansion of irrigated area, equitable distribution of water, and adaptiveness of the agriculture using this irrigation service.*

13. *Entprenreurs have been particularly good at developing innovations and business models that enable farmers to cope up with the major challenges. This directly means that after two succssive bad monsoons it is imperative that a great push be given to entpreneurs to ensure the long term sustainabilty and success of agriculture. It also implies that irrigation entreprenurs should not be rattled and hassled by taxation and other issues right now. They situation demands they be seen as an essential organizational format in an otherwise gloomy situation of resoruce crises, nature's apathy and dwindling resources of the farmers esepcially the factors of production.*

14. *Overall impact of entrepreneurs is even more positive in resource constrained scenarios enabling farmers to think more from a long term perspective and sustainability of farming as an occupation and livelihood.*

15. *Entrepreneurs in irrigation are still catering only the explicit and expressed demand only the actual scope is much wider leaving a lot of room for improvements within the enterprises and also from the policy support and regulator.*

16. *There is no single dominating benefit across the enterprises and as such policy makers need to take into consideration the specificity of each innovation and enterprise category in formulating supportive policies and government regualtions and orders to achieve desired results. The results of this study are very useful in understanding the same.*

17. *There is still a segment that needs requires subsidy support as an incentive for adoption but the subsidies need to be smart and targeted at the right segment for the right benefits.*

18. *The biggest benefit reported by farmers is that of increased adaptiveness of agriculture and this can be very useful in dealing with the direct and indirect threats of climate change and sustainability concerns around agriculture. Entrepreneurship in irrigation can deliver significant improvments on these counts.*

19. *The entrepreneur may need to be involved in implementation herself and this will have serious implications on achieving scale of operations and therefore policy has to enable replicability of innovation and enterprises in irrigation.*

20. *The irrigation entrepreneurs are working on business models based on either irrigation as a leading input or as a productivity enhancer based on the theory of constraints (ToC). However both of these are theoretically old and will only result in incremental benefits overtime whereas disruptive improvements are needed in the times to come. Policies are needed to promote entrepreneurs and enterprises that are disruptive and their innovation can propel growth of a farm, the farmer as well as farming as a sector and an occupation too. Policy can go a long way in enabling the desired change.*

Acknowledgements

This study bears a deep acknowledgement to the farmers of India and their entrepreneur friends in the sector who relentlessly work to benefit each other. This study was conducted with an underlying objective of collating and creating knowledge to be useful for the policy makers and hence the farmers as well. The author bears a deep sense of gratitude to them for experimenting with irrigation services and also providing time generously to share their experiences and opinions.

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Vaibhav Bhamoriya

Chapter 1

Introduction

1.1 Introduction

Irrigation in India is at a crossroads today. Irrigation is a particularly expensive public service to provide and yet it is one of the most important given the concerns around food security. According to an ICAR report (2001) India had made an investment of Rs. 88,100 crores in creating and providing to the masses major, medium and minor irrigation infrastructure. At this cost a total irrigation potential of 91 Mha was created. The India Water Vision 2025 estimates for irrigation demand in 2025 warranted investments needs of Rs. 20,000 crores per year. The current out lay on expansion of irrigation potential is to the tune of Rs. 7000 crores per annum and this is expected to create a potential of 1.8 Mha every year. Time and cost overruns often significantly reduce the gains from such hefty investments. The required growth rates for achieving required irrigation and agricultural growth in 2025 is 5% for irrigated areas and 1% for the rainfed areas. It is next to impossible to achieve these and keep up the current expenditure of creating, operating and maintaining the irrigation infrastructure by funding out of government subsidy alone.

Given the rising cost of providing irrigation coupled with the fast changing needs of the Indian farmer who has to keep abreast with the changing agriculture in India, it is imperative that innovations are needed for cost-effective and efficient irrigation service delivery to the increased satisfaction of the farmers. Often the government bureaucracy is blamed for inefficiencies and in order to cut costs there is a greater demand to partner with private parties to increase efficiency of irrigation service provision. There are also increased calls for greater innovation in irrigation provision to help the farmers survive and prosper in agriculture. The government on the other hand is searching new ideas to enable better recovery rates from irrigation projects towards reducing the subsidy burden while ensuring that irrigation provision and food security of the nation are not compromised with.

An argument in this regards is that it is imperative that entrepreneurs be allowed an increasing role in the irrigation sector to be able to achieve the national objectives of poverty alleviation and agricultural growth and sustainability. The right innovations can make a

difference to the lives of millions of farmers and rural households who are dependent or benefitted by irrigation. Entrepreneurs can also help in reducing the time and cost overruns of irrigation projects. Maharashtra state alone requires Rs. 75,366 crores to complete the ongoing irrigation projects in the state. (Indian Express, April 15,2013). This equals to an investment of Rs. 2.27 lakhs per ha. of created irrigation potential. This amount is large enough to attract private and social entrepreneurs to participate in making this a reality. It is in this context that it is believed that entrepreneurship can have a significant role to play in the irrigation sector. This study tries to tackle this question from the bottom up. We study the enterprises in the irrigation domain at the grassroots and collect the experience and impact of the same towards informing policy recommendations for expanding irrigation and the role of entrepreneurs in the same as also bringing about massive improvements in irrigation service provision.

1.2 Literature Review

The irrigation sector has a very important place for India but currently it is besotted with a number of problems that are a cause of concern. Irrigation is a huge sector in India and generates enormous amount of employment directly and indirectly in India. This includes agricultural labour opportunities, irrigation equipment manufacturing and distribution, irrigation management and even in the education domain for educating and training skilled technical workforce for the sector.

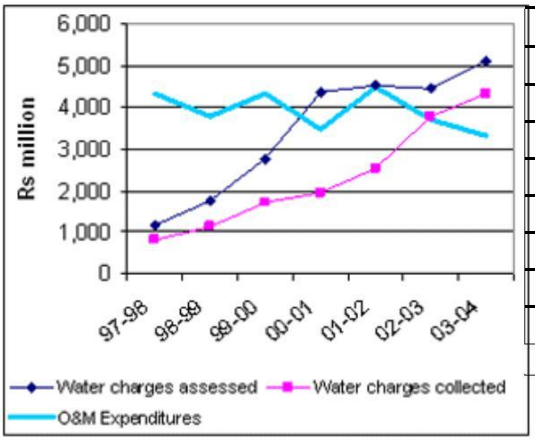
Responding to the need of dealing with water as an economic resource / good in addition to being a natural resource requires lots of innovation and new ventures to depart from business as usual. This sets up the need for entrepreneurship in the irrigation and its allied sectors. The rising prominence of social entrepreneurship is attracting entrepreneurs to social issues like irrigation management improvements. Impact investors looking for investing in projects to achieve desired social impact are also promoting new ventures in domains including water management and the energy-water nexus.

The irrigation sector is plagued by manifold problems relating to status and availability of the resource, its use, management including that of run-off and wastewater flows. There are fiscal crises in many states (Sur and Deininger, 2003). It is often claimed that irrigation subsidies are a

major reason for this. Subsidies are in turn said to be high due to no or low recovery of O&M fees from the users (as shown by the table and graph below). This in turn is attributed

to the lack of proper institutional environment (Bhamoriya, 2010). One of the main functions of entrepreneurship is expected to be institutional innovation.

Figure 1.1 Water fee revenues and collection, Maharashtra



Source: ID, State Government of Maharashtra

Particulars	Unit	Orissa	AP
Potential created	Lakh ha	25	48
Gross irrigated area	Lakh ha	16	22
Avg. Annual plan outlay	Crore Rs	619	893
Avg. O& M Expenditure	Crore Rs	60	265
Weighted Water rate	Rs/ha	104	398
Current water rate demand	Crore Rs	19	116
Receipts, Current account	Crore Rs	15	69
Cost recovery, Current account	Per Cent	25	26

Source: ICAR Policy Brief 15, Sustaining India's Irrigation Infrastructure

Some researchers out of which Edwards (2009) is foremost point out to the need to shed state enterprises those are operating at a loss and draining the government's coffers. This logic could prove to be very powerful for the irrigation domain as well. One of the strongest reasons in favour of privatization has been the need to run the enterprises more efficiently and delivering better services than the state by infusing the enterprises with new capital, improved management practices and better technologies.

One of the reasons that has been pointed out in literature as to why public authorities or government bodies are unable to deliver public goods and services is that they are free from any monitoring either through electoral checks of politics being autonomous organizations nor are they subject to monitoring for the profit-maximising interests of shareholders as in a pure private organization (Saylor Academy,2012). It is also argued that public authorities also are more prone to free-rider problems as compared to private firms in the delivery of public goods and services. Such free-rider problems are a major cause for reduction in monitoring ability of a firm or entity and as such reduce the ability of the public authorities to monitor the delivery and as such often create scope for ineffectiveness, inefficiency and at times even corruption.

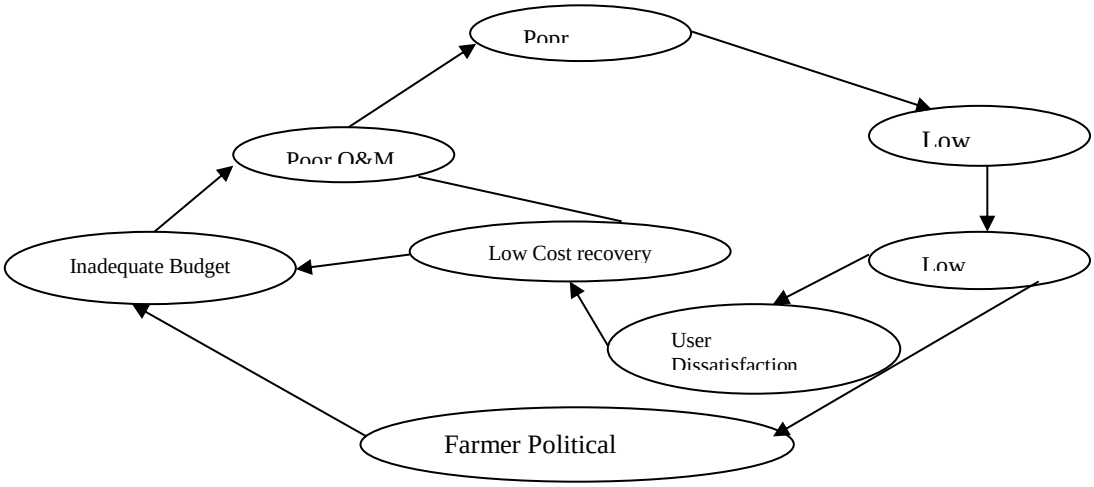
One of the most promising ways of breaking through the vicious circle of poor quality of India's Irrigation sector is to improve the recovery rates of O& M charges as proposed by this World Bank publication below. This also sets up the context in which entrepreneurs can be engaged to bring such improvements to the irrigation sector thereby creating a strategic need for entrepreneurship in irrigation and its allied sectors.

Scenario	Actual	B.E.	Projected				
I. 8% water rate increase per year	**2003/04**	**2004/05**	**2005/06**	**2006/07**	**2007/08**	**2008/09**	**2009/10**
1. 100% collection	1,804	1,558	1,551	1,554	1,572	1,602	1,675
2. 50. % irrig./93% all other uses	1,042	677	600	**527**	**463**	**404**	**381**
3. 80% irrig./93% all other uses	1,323	1,001	950	906	871	845	857
4. 90% irrig./93% all other uses	1,419	1,111	1,069	1,034	1,010	995	1,019
II. 5% water rate increase per year							
1.100% collection	1,804	1,558	1,374	1,176	968	744	532
2. 50.% irrig./93% all other uses	1,042	677	449	**206**	**-51**	**-327**	**-592**
3. 80% irrig./93% all other uses	1,323	1,001	789	563	324	68	-178
4. 90% irrig./93% all other uses	1,419	1,111	905	684	451	201	-37

Source: Sourcebook : Agriculture Investment, Module 1- India Using a public Expenditure review of the irrigation sector to assess the fiscal impact of the Maharashtra Water sector Improvement Project (http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTARD/EXTAGISOU/0,,contentMDK:20925700~pagePK:64168445~piPK:64168309~theSitePK:2502781,00.html)

Some successful examples of Irrigation Management Transfer (IMT) / Participatory Irrigation Management (PIM) exist in India e.g. Waghad Project level Water Users Association. In Ozar the irrigation cooperatives have been able to achieve water management reforms in obtaining the rights of the whole project and also charging the farmers on volumetric basis which has resulted in multiple benefits to individual farming households, the institutions and the villages in the command area as a whole (Bhamoriya et. al. 2009). There are many private entrepreneurial ventures as well that have met with success in resolving this and many other common isolated problems of the sector.

Figure 2: Vicious Circle of Indian Irrigation



The huge surge in Groundwater irrigation and meteoric rise in the number of irrigation pumpsets has changed the face and conduct of pump manufacturing and distribution as well as the tubewell drilling industries. Now many ventures are looking at Solar energy based pumping to effect energy savings.

Various projects like DRUM and WENEXA, funded by international development agencies, have explored new ideas on the ground aimed at amelioration of the Energy-Water nexus.

Various other equipment and technologies like Micro Irrigation Systems (MIS) and piping have gained popularity and is still expanding the market size allowing greater participation of entrepreneurs in the same along with PPP projects.

In order to assess the potential of entrepreneurship in improving the irrigation sector and removing its inefficiencies and improving the situation, it is essential that we develop greater understanding of existing entrepreneurship in the irrigation and allied sectors. It is also essential that we understand the nature of various types of entrepreneurship in the sectors. If we can study the existing examples of entrepreneurship, we can cull out the principles of entrepreneurship that create a positive impact on the sector. Based on these principles policy recommendations can be formulated which can help aid the development of private participation in irrigation sector through entrepreneurship. This research study seeks to do a part of this and explore key principles of doing this to enable the improvement and expansion of the irrigation sector.

It is argued by Gillette (1994) that private firms and entrepreneurs providing public goods facilities tend to have much stronger and better economic incentives for efficiency.

The private sector has resources and capabilities that the public sector does not and, potentially, a substantial business interest in seeing the public sector succeed. (Gerderman, Dina, Private Sector, Public Good, HBR Working Knowledge, 12th February, 2014). This is counter intuitive for most traditional economists who believe that private entrepreneurs find no role in the delivery of public goods. However, for a variety of reasons private

entrepreneurs have felt the thrust towards public goods delivery and history serves as evidence for the same. Prof. Vikram Sarabhai is one such shining legend who inherited a private business was always more active and in pursuit of better and more effective public goods delivery in India.

One of the advantages of private enterprises is that they do not suffer from institutional disadvantages of the public authorities and hence they perform public functions better at times (Gillette, 1994). However the exact conditions under which this happens are not known. There are multiple examples of toll roads, private airports, wastewater treatment plants and even electric and water utilities across the globe. However these are often the cases of PPPs and the private capture of the profits happens by assigning legal property rights to the private party. In PPPs often the innovation is limited as the contract is developed by the Public authorities. Entrepreneurs can also bring in a lot of innovation into the same as they are not functioning as PPPs but are free to draft their own mandate within the laws of the land and directed by the policies in place.

Henderson noted that there are opportunities for firms to address public goods problems and make money at the same time. (Henderson, Rebecca as given in Gerderman, Dina, Private Sector, Public Good, HBR Working Knowledge, 12th February, 2014). Many new organizational and contracting formats are also being tried out for the same. The Public-Private Partnerships (PPPs) are only one of the many that exist in the world today. Edwards (2009) points out in support of privatization that private entrepreneurs can innovate where government workers cannot and they can more easily cut down on unneeded and failed activities.

In addition to this in the private firm the promoters or shareholders or even the owners have a substantial part of the wealth tied up in the firm and as such they have an incentive to monitor closely and ensure that not only efficiency is achieved but that there is no let down on effectiveness towards fulfilment of mandates such that their investments are protected (Gillette, 1994). Entrepreneurial firms are even more poised with better alignment with entrepreneurs as fitting in all roles -owners, promoters and also employees as well as shareholders. This enables positing that entrepreneurial organizations or start-ups may be better suited for private involvement in the provision of public goods and services such as the irrigation space.

The arguments pile up on multiple dimensions as illustrated by many examples wherein public authority activities appear out of sync with social utilities or value addition. A strong case here is about expansions of services taken up by the public authorities in rolling out public goods services. Private entities will instead rationalise their spread and prefer not to roll out services where the margins are really thin or negative. Taking up such activities is therefore not possible for traditional private entities but new form of entities are needed back by innovation on such dimensions. This is the basic need for entrepreneurs to step in the domain of public services and public goods delivery to fill in the void left by either of public authorities as well as the traditional private organizations.

It is also commonly postulated that private entities are defined by the single objective of profit maximization which is very narrow compared to the multiple, at times vague and yet at the same time competing objectives that public officials are forced to attempt to fulfil in the delivery of services (World Resources Institute, 2003). This again goes to prove that either of public authorities or traditional private authorities will find it difficult to fulfil the multiple objectives of public goods and services delivery. This also entails that PPPs or partnerships between public and private entities are also doomed to failure in delivery of public goods or services with multiple objectives as none of the constituent partners is suitable to overcome this shortcoming. This is another very strong reason why entrepreneurs are needed in this domain to overcome these lacunae.

1.3 Literature Gaps and Areas of Interest

The literature on the subject of participation of entrepreneurs in irrigation is at best characterised by the term non-existent. There are hardly any direct reference to the same and whatever exist are confined to either traditional private participation in irrigation structure maintenance or delivery, Public-Private Partnerships or to the much larger but largely futile participatory irrigation management literature.

The irrigation literature has focused mainly on the shortcomings of the centralised irrigation system management and argued in favour of decentralization and participatory irrigation management. (Gandhi et.al. 2009) The debate is then mostly about the pros and cons of participatory irrigation management. The solutions provided are institutional and while

almost every solution talks of adaptiveness there are few real solutions provided for the same (Bhamoriya, 2010).

The public goods literature has focused on the shortcomings of the public authorities and their inability to monitor the actions and their alignment with the objectives. It stops too short of any real solution by suggesting privatisation but fails to discuss ahead of this as a conceptual suggestion. The limits to privatisation have been discussed earlier in the literature review section and thus this literature is also very restricted.

The privatisation literature on public goods delivery largely talks of PPP efforts across the globe and gives many reasons as to why PPPs are suitable but stops short of a real criticism of the PPP regime and its recent failure in many domains especially in the developing countries like India where it is a relatively new concept and faces serious issues of financing and project completion as well as contracting.

Lastly but not the least the entrepreneurship literature has focused on the drivers for entrepreneurial leanings of individuals and the definitions and characteristics of entrepreneurs as well as start-ups. It also talks of stabilization and growth phases of the enterprises but squarely misses out on the role that entrepreneurs have played or can play in the public goods and services delivery phase.

Thus the lacunae of looking at the role of entrepreneurs in the domain of public goods and services delivery and implementation is the theoretical prompt for this study and the lack of literature on the same has prompted an exploratory methodology and a largely descriptive output from this report. The literature gaps lead to the research questions and the methodology chosen for the study.

1.4 Research Objectives and Questions

It is clear by now that the study was aimed to figure out the role of entrepreneurs in the irrigation space as of now and if the same has potential in the future or not and provide certain pointers if possible towards policy formation and reforms that can aid the sector and also the entrepreneurs if they have a role to play. Thus the objectives of the study were formulated and the methodology set up to fulfil the same.

The study is aimed at the following research objectives and questions:

1) To ascertain the status of Irrigation related Entrepreneurship in India
2) To arrive at the future scope for entrepreneurship in the irrigation and allied sectors in India
3) To arrive at policy recommendations to facilitate greater entrepreneurship for the benefit of the irrigation sector
4) To arrive at lessons from the existing ventures for expansion and improvement of entrepreneurship in irrigation and allied sectors in India

Chapter 2

Methodology and Data

2.1 Choice of Methodology

The study was based on a mthodology that coupled exploratory research followed by Investigative research. Since there are not many ventures of a similar kind, this study was not amenable to a true quantitative analysis using econometrics. This study therefore followed a largely qualitative research methodology despite generating a lot of descriptive data from the survey carried out to collect responses of the irrigation service users.

The exploratory research focussed on developing a list of entrepreneurship typology for the irrigation and allied sectors via secondary data collection and interviews with experts, concerned government officials and entrepreneurs.

The second step was to select case studies of irrigation and related entrepreneurial ventures based on the typology developed earlier. The list of cases and progress of each case study is given in a table in Annexure 1.

The third step entailed case studies of the selected ventures. The case studies comprise analyse both qualitative and quantitative data to build the case studies. The individual case studies were then analysed on various identified parameters to draw inferences towards the study objectives. A case protocol to be used for collecting information and preparing the case study is attached in Annexure 2.

The fourth step was to design a questionnaire instrument for collecting responses from individual farmers and farming households. The questions included questions about profile, experience of the irrigation service, impact on availing irrigation service and suggestions.
The fifth step was to conduct the survey as per methodology and plan given in the next section of this chapter. The sixth step was analyzing the data collected using the questionnaire and qualitative analysis to arrive as prescriptions for policy for entrepreneurship in irrigation.

The analysis was crried out on composite data compield from the case studies to give a global view of the domain. The study is not specific to any of the irrigation services or

enterprises. As this report seeks to make suggestions and policy recommendations for entrepreneurship in irrigation, it is imperative that focus be on entrepreneurship and the service of irrigation ratehr than the type of service being studied. Also the sampling (stratified randomized) takes care of the same and enabled the survey and analysis of the composite sample.

Policy in India is unitary for irrigatoin institutions and does not vary with the type of irrigation services and institutional format. This however does not warrant a separate irrigation policy for each irrigation service. Thus it is apt that a study of this type analyses the composite sample to advise policy makers on entrepreneurship in irrigaiton.

2.2. The Survey Methodology

A survey was conducted as part of methodology fourth step and entailed primary data collection from beneficiaries such that the total number of beneficiaries across the cases is a total of about 450 with about 50 beneficiary respondents from each case. Within each case the respondents for the survey were chosen by a stratified randomised sample so as to ensure representativeness of the variety of beneficiary types in the study from each case. The stratification was done based on different parameters for each case such that each strata was represented in the sub-sample giving the best possible spread in terms of diversity of views while the strata together compiled the total diversity of respondents and features for the service users and beneficiaries in the case specific. The stratification was attempted in terms of farmers of different land holding and cropping patterns as well as different parts of a village as well as keeping the diversity of levels of services needed.

The survey questions included those pertaining to the profile of the respondent as well as the general profile of the farm followed by the secular trends that affect agriculture. The survey instrument included detailed data on the experience of availing the irrigation service including questions pertaining to subsidies, fairness and justice, efficiency as well as technical and socio-economic considerations. The survey also entailed enquiries around the impacts of irrigation service on irrigation as well agricultural practices and economics. The survey also collected farmer responses on an extensive set of suggestions from the users as well as well their responses to the queries about the institutional aspects of the enterprise

ensuring the delivery of irrigation services to the respondents. There was a small section about the buying behaviour of the irrigation service users as well.

2.3 Choice of Cases / Ventures studied

The Study could have covered the whole of India but the entrepreneurial ventures suitable for study are few and far apart and hence the study was concentrated on few innovation / entrepreneurship centres in the irrigation and allied sectors. This means that there were no geographical boundaries within India for the study yet it was concentrated to few geogrpahical areas based on various selected ventures for the study.

The final cases chosen are from the states of Gujarat, Maharashtra, Bihar, Jharkhand and Odisha. A list of cases is given in Annexure 1. It represents a healthy spread geographically east to west of the nation as a whole. It also represents a very healthy spread in terms of the north to south spread in the nation in terms of agriculture. Despite leaving the southern states of Tamil Nadu, Karnataka and Andhra Pradesh the cases chosen do cover the type of initiatives that are taking place in these states as well. Thus the coverage is a close approximation to a pan-India Spread in terms of entrepreneurship in irrigation.

2.4 Reference Period for study

This was a one shot study but not restricted to a particular reference period. The very nature of entrepreneurship being innovative will restrict the study to not extend over too many years in the past. The case study method as well as the survey method limits the study to currency in terms of time spread. However the wastewater irrigation has been happening since almost four decades and the tubewell cooperatives have also existed for at least three decades. There are enough cases which have existed for two decades and at the same time there are cases that are as new as to have only one year’s balance sheet as in the case of the agricultural finance company or a couple of years in case of the solar pumping entity. It must be noted in the case of the latter that these are the only entities focusing primarily or only on irrigation solutions and are also the oldest in their class of entrepreneurs thereby justifying their choice and brining in rigour in terms of a generous spread in terms of time and life period of entrepreneurs as well as their irrigation service enterprises.

2.5 Limitations of the Study

The study has a few limitations and it is only correct to upfront state the same in this section. One of the minor limitations of the study has already been stated in terms of absence of the big three southern states in the sample. The same is however a minor limitation as conceptually and technologically the innovations are represented in the cases chosen.

The second limitation of the study is the literacy of farmers and their ability to respond to complex questions. To overcome these attempts were made through rigorous pre-testing of the instrument and development and use of a conversation method of interviewing the farmers such as to elicit the responses in a conversation rather than a point to point question. This enabled the counter questioning and triangulation with the respondent to ensure that the question was correctly understood and answered by the respondent.

One of the biggest limitations of the study is the non-existence of literature on the subject proper and hence a dearth of starters for a survey instrument to be used. As such an extension methodology was used and case studies were conducted at the locations prior to carrying out the instrument design and the survey design. Also the instrument was modified a little to cater to each case more specifically and reduce errors due to language and other location and innovation specific causes.

While most of the data may appear to be perception however user experience and satisfaction in the irrigation domain do not have standard scales and precise measurement of such psychological variables is not possible. To overcome this there were multiple triangulations points inbuilt in the survey instrument to monitor inconsistency in responses and even the ratings on a particular subject. The data collected as responses is closest to actual measurement possible and is the best possible measurement in its domain. Also it must be realised that the reasons for seeking entrepreneur based services in the irrigation domain is not only economic but much more and to figure out the same it was essential to move beyond the measurable economic data lest the study be measurement based but useless towards its objectives.

2.6 Data

The data appeared in two formats – qualitative data as part of the discussion and the quantitative data as part of survey responses collected through a structured survey

instrument. This report presents the qualitative data very briefly and is largely based on the survey data. The total sample data is a collection of 445 respondents spreading across the nine different case studies as given below.

Table 2.1: The sample spread across cases and Geography					
S. No.	**Case Study**	**No. of Respondents**	**Villages covered**	**Districts covered**	**States covered**
1	*Wastewater Irrigation*	50	1	1	1
2	*Tubewell Companies*	50	1	1	1
3	Expandable lift irrigation	50	1	1	1
4	*Fixed membership lift irrigation*	50	1	1	1
5	*Smallholder agri-financing*	54	14	2	1
6	*Solar Irrigation pumps*	50	5	2	1
7	*Treadle Pumps*	56	9	2	1
8	*Remote switches*	50	22	2	1
9	*Family Drip system*	35	4	2	1
10	**Total Sample**	**445**	**58**	**13**	**5**

The respondents were spread across the five states of Gujarat, Maharashtra, Bihar, Jharkhand and Odisha and within these states they were spread over 13 different districts and a total of 58 villages. This is due to the fact that some of the innovations are niche innovations and often a village had only one or two user farmers willing to participate in the survey. This also slowed down the survey work due to massive travel commitments but the cost was managed by locating for cost reduction and reduction of time in commutation.

The data was collected over 150 data points for each respondent out of which more than 60 major variables were considered and the rest are secular features and trends and other minor variables. The data presented in this report is a snapshot of the same and is not exhaustive to maintain the readership and parsimony for the report.

Given that such a study has been attempted for the very first time in India and the adjoining parts it was considered prudent to restrict to descriptive analysis of the data and the same is presented in this report in the form of more than 60 tabulations of the data in various aggregated and disaggregated forms. The descriptive analyses yield some very good pointers for policy conclusions presented in chapter five of the report.

Chapter 3

The Enterprises

This chapter presents a breif description of the entrepreneurial venture and their enterprises and is an attempt to describe the local context, the details of the institution and the innovation of the enterprises interlaced with qualitative information collected.

3.1 Wastewater Irrigation: a boon for the local farmer over generations

Initially, when the service of providing treated wastewater for irrigation was started, it supplied a very little area adjacent to the pumping station. As the city advanced farmers gave up the land adjacent to the pumping station and slowly shifted to the village of kapurai at a short distance. While this service had been provided for about two decades and a little more, In 1996 when Ms. Vilasini Ramchandran took over as the municipal commissioner of Vadodara, she ordered the service stopped citing environmental reasons. Before this incident VMC or the Vadodara Municipal Corporation had been managing the distribution to the farmers.

197 farmers formed the Kapurai Khedut Mandal or the Kapurai farmers association and made petitions to the municipal commissioner and also made a representation to the local representatives in the state legislative assembly as well as the parliament. They made a case that the service benefitted an area of over 400 bighas and was used to mainly grow fodder which was in turn an important input for milk production to provide milk to the city of Vadodara. After much agitation and many representations it was decided to continue the service but the farmers would have to pay for the service and also distribution of irrigation water among the farmers would be managed by the farmers association. The farmers readily agreed to the same.

A few conditions were placed to start the service such as

1. No water would be allowed to go out of the allocated fields to control he menace of mosquitoes.
2. NOC would be obtained by the farmers association from the farmers whose fields were on the way over the pipeline for conveying the wastewater.
3. The management of the operation of the valves from the pipeline would be the responsibility of the farmers.

The service came as a lifeline to the farmers as they were confined to growing Paddy, tuvar and cotton during kharif only earlier. Today some of them are able to grow 2 crops of paddy and another crop of wheat as well based on wastewater irrigation.

3.1.1 The Institution

Faced with the challenges of restarting the services, the institution took shape and Ravji Purshottam was made the in charge of the affairs. Slowly he built a team and as an association there is an executive board today and processes like collection of dues and issuing receipts which have been made regular. At the same time an operator has been hired to take care of the operation of the valves and other minor needs of the farmers. The institution is frugal and largely driven by the individual pursuit for service towards farmers exhibited by Ravji. Ravji is now old and may need to retire and at the same time the institution may become redundant as the city has now extended to just on the outskirts of the village and a new wastewater treatment plant has also come up on the other side of the village. At the same time many builders are searching land for development of residential schemes for the city dwellers threatening the continuity of farming itself on these lands.

In an average year the maintenance is limited and total expenses are capped at Rs. 5000-10000 per annum in a good year for the same. However the major task of the association is conflict resolution with non-members at certain points of time to ensure that the service continues and is available to the farmer members in a timely manner.

Last year the valve had some issue and the wastewater overflowed at the back of a residential society leading the boundary wall of the society to collapse. This instantly flared up into a big issue. The association had to promptly step in, to get the valve repaired and also get the wall of the residential society reconstructed to their satisfaction. The overall expenses in the same was very high and more importantly being the peak irrigation time, all activities of farmers had come to a standstill till the issue was resolved and the wall was reconstructed and the valve repaired. The NOC had been temporarily withdrawn by the society members but they later provided the same and the service was resumed after a gap of about a week.

3.1.2 The Entrepreneurial Angle

The institution is based and run on lines of frugality and lean organizations. There is a board but few members in the board take decisions and Ravji is himself at the helm of affairs. At

the same time only one operator is an employee of the association and the activities taken up are simply the valve management, conflict resolution in case of conflict and repair and maintenance of the pipeline when needed.

The service fee is fixed at Rs. 120/bigha per annum. The total collections are therefore capped at Rs 48000/- per annum (120X400). In a good year there is some surplus that remains whereas in a bad year the account has dip into reserves to take care of the maintenance and repairs. The operator is paid a partial salary as he also benefits from the service on his farms. The service is very useful for the farmers as the closest substitute would be tubewell water which despite being saline is priced at Rs. 100 per hour and it usually takes 8-10 hours to irrigate one bigha of land. Thus the wastewater irrigation service is far more cheaper for the farmers.

At the other end of the village lands, the Kapurai Narmada minor carries some Narmada river water for irrigation in certain seasons. However, it has been observed that farmers prefer the wastewater as they have figured out the practices in a manner such that they are able to save on costly fertilizers by using the wastewater instead. Thus the economics is highly tilted in favour of using wastewater for irrigation.

The association also has tried to educate farmers much more about how to alter their irrigation and agricultural practices to tackle the increased number of mosquitoes in the fields due to the use of wastewater for irrigation.

Wastewater as an irrigation source represents a unique dilemma. In the absence of a policy on either wastewater or entrepreneurs such efforts can be made and such examples can be more numerous but in case of a conflict especially with nature or environmental issues at hand or in the current scenario of dengue epidemics, there is more concerted and science based action and decision making that is needed. Entrepreneurs are used to working in grey areas and the purpose of this case study is to highlight that such grey areas exist even in the irrigation domain and the government and policy makers must take cognizance of the same and have some guidelines for the same after thorough studies rather than knee-jerk reactions.

3.2 Tubewell Companies: A dying innovation for the future to come?

These are probably the oldest form or entrepreneurial institutions in the irrigation space. Tubewell companies have been known to exist for almost five decades now since the

inception of green revolution in India. Tubewell companies have particularly flourished in North Gujarat and even more so in the district of Mehsana. The district had been a hot bed of cooperative movement in the 1960s and 70s. The same had resulted in setting up of Dudhsagar Dairy at mehsana, which is India's largest dairy today. The fast receding water table in mehasana coupled with the proximity of good markets at Unjha, Visnagar, Chhapi, Mehsana, Palanpur, Himmatnagar, Gandhinagar and Ahmedabad to name a few have led to this development.

There are parts of Mehsana district especially the taluka of Chanasma where the groundwater table has receded so much that farmers have drilled tubewells to 1500 feet depth for irrigation water. The technology to drill such a tubewell necessitates drilling of large diameter tubewells and the costs of such drilling are prohibitive for individual farmers including the largest of individual farmers. The water yields of such tubewells have been high enough to allow many farmers to come together and dig one such tubewell leading the formation of an informal company. The membership of such companies can vary from 7 to as high as 51 farmers coming together. Many such companies also sell water to non-members to increase revenue and maximize profits.

Tubewell companies have been extensively and best covered by Navroz Dubash in his book Tubewell capitalism (2002). It is a very fascinating form of institutional and business innovation that has come up to deal with the extant conditions of geography , hydrology in order to fulfil the needs of agriculture and economy of a region that has clocked high growth rates and has been one of the solid pillars of the so called Gujarat Model of development.

3.2.1 The Institution

The tubewell companies are best seen as an informal associations of farmers who come together to share costs as well as benefits for the common purpose of irrigation. The membership is therefore pre-decided by those willing to share costs of drilling a tubewell and setting up the infrastructure including the electricity connection, transformers etc.

The institutional structure is simple and there are only two office bearers in company one secretary and one president. The president works as the appellate authority in case there are grievances against the functioning of the secretary. The secretary or operator is the main functionary and is selected by the members based on an auction process as explained in the next sub-section. The president is usually selected based on his social standing and ability to

bring order to the house when needed. Fairness in his judgement is often an important criterion for selection.

The members / shareholders of the tubewell company meet once in a year whereby the account of activities of the complete year is given along with the financial accounts by the secretary. The accounts are ratified in this meeting and the records are then destroyed. The secretary for the next year is chosen after the president informs of the expectations of activities in the coming year.

3.2.2 The Entrepreneurial Angle

The tubewell has always been seen as an individual's personal asset. Various government efforts at establishing and running community tubewells have met varying degrees of success. The varying needs of different members and spiraling costs have often led to the failure of these community tubewells unless they are backed by a strong promoting institution or committed individuals who work tirelessly to make it successful. Where these community tubewells have stagnated the tubewell companies have prospered by innovating management solutions to continue to make sense to the members and deliver irrigation to them at an affordable cost and with least effort.

The tubewell companies have relied on lean structures with just the president and the secretary managing the people and the activities respectively. The president is an honorary member thereby cutting costs. The secretary is also chosen or selected through an innovative mechanism to further cut costs and efficiency into the management. There is an auction and suitors for the post of secretary bid at an assigned payment that they want to receive in return for a year's service. The lowest bid is sought but the selection is not purely on the lowest bid and members also assess the ability of the individual to service the activities at the stated cost. In case the costs for a year are going above the bid the secretary makes a representation to the president who then asks the members to pay the extra amount as per their shareholding in the company. In case of profits in a particular year it is distributed in the proportion of shareholding.

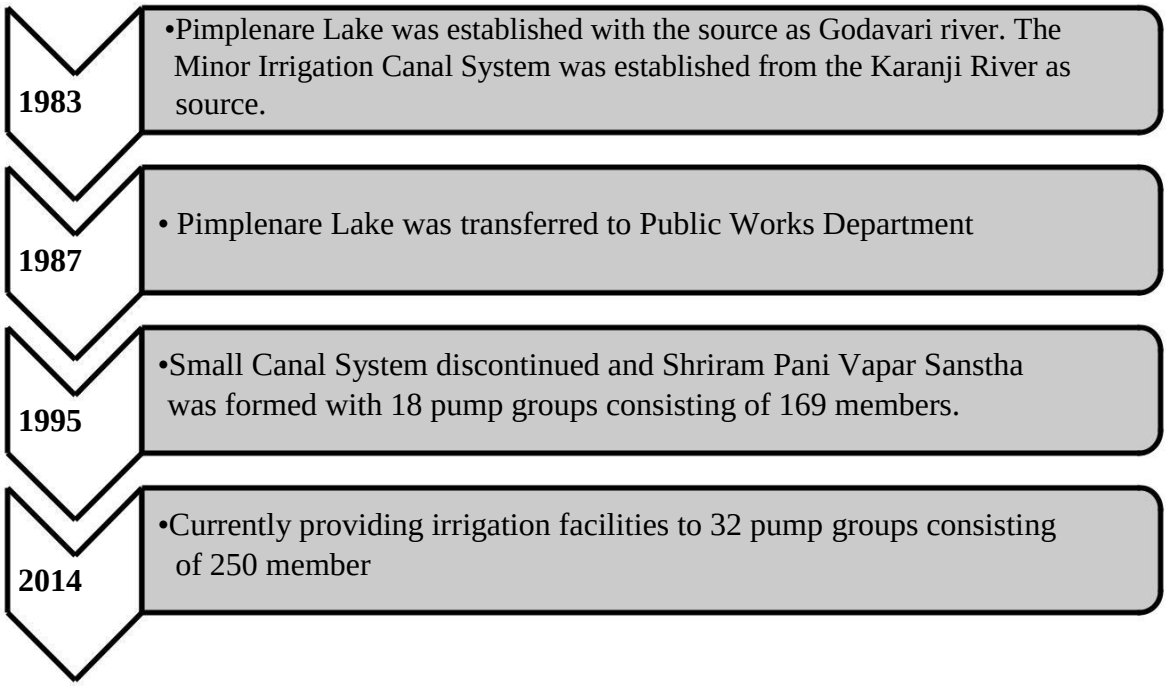
3.3 Expandable Lift Irrigation Model based on power: Pimpalnare

3.3.1 Village Background

Pimplenare is a village situated at the distance of 15km from Nashik in Maharashtra. It is well known for Pimplenare Lake which is nearby Ramshej Fort, to the west of Pimplenare

village over to Karanji Nalla. The village has an estimated population of approximately 3000 people across varied communities and religions. Basic government infrastructures in the village include a hospital dispensary and a primary school. The village has been classified as a drought area for many years. Though the Pimplenare lake has a capacity of around 79.40 million cubic feet, the last time the lake filled up was in the 1994. The lake was connected to a canal of approximately 6 km length running across the village. But this canal was discontinued by the joint effort of the cooperative enterprise as the canal was situated on barren land and due to inefficiency in water distribution; the farmers were able to cultivate only Wheat and Gram with the one or two water rotations in the Rabi season.

3.3.2 Timeline



3.3.3.The Institution:

Before the formation of the cooperative enterprise, farmers used to individually pump water according to their need from the dam. This led to massive wastage of water and misuse too. Also, due to erratic water use and management, the water level of dam was solely determined by the monsoons. Soon the native farmers realized that a collective institution would function more efficiently than a government system. An introductory advice was taken from Mr. Vasant Rao Upadhayay (Bapusaheb Upadhyay), the founder of Water Management Systems in the nearby village of Ozar and also the MLA of Ozar at that time. The idea was rooted in the notion that the farmers would be individual stakeholders in a pumping group. This would ensure that each unit of water being provided could be monitored and thereby reduce the number of individual pumps at the dam source. In short a spider net of pipelines from the dam would guarantee a fair share of water to all the members throughout the year at a reasonable price. With this aim, the ***Sriram Pani Vapar Sahkari Sanstha*** was formed on 29th April, 1995 under the leadership of Shri Y G Khandve.

Y G Khandve had worked as the contractor for the public works department in creating the canal system as per the contract from the department. When the rule changed he decided to retire as a contractor and returned to his village to take up farming. On his return to Pimpalnare he found that hardly 20-25 farmers were benefitting from the canal that he had constructed as a contractor. It was not designed to help the farmers and there was no maintenance either. His own need for irrigation as a farmer and his emotional connect to his own village and the canal system that he had constructed were driving forces for him to take up the onus of finding a solution for himself and his vilage farmers on himself. That is when he got in touch in Bapu Upadhayay.

With the formation of the Cooperative enterprise, around 250 farmers are directly and indirectly being benefitted in Pimplenare. The Cooperative enterprise has been successful in not only establishing two electric supply transformers for the water management and distribution systems, but also ensuring that the dam is recharged in every monsoon.

3.3.4 The Entrepreneurial Angle:

Today the enterprise boasts of a membership of upwards of 300 farmers and has installed 21 pumps to service these farmers with irrigation water from the small dam. The pumps are in

turn fed power from four transformers that have been established next to the reservoir such that there is no shortage of power and hence irrigation water in the irrigating season.

The enterprise is registered as a cooperative under the Maharashtra government irrigation rules and functions as a water user association. It elects a 11 member board for managing the executive functions and has a secretary of the society and two watchmen cum operators as its employees.

Unofficially it is an entrepreneurial enterprise as it has taken up on its own to establish transformers, get the electricity connections, manages the power situation, the irrigation water allocations, and the maintenance of the system upwards of the pump. The pump and downstream expenditures on maintenance are borne by the respective user groups. Each pump is assigned to a sub-user group which has to manage its own allocation and issues and in cases of escalating conflict it can go to the cooperative enterprise for aiding conflict resolution.

The enterprise is responsible for ensuring timely and adequate irrigation to all member farmers and takes up multiple activities which go way beyond a normal cooperative's domain to qualify as an enterprise. In years of low rainfall the water in the dam is not sufficient to fulfil the needs of the farmers. The enterprise has therefore constructed recharge pipelines and channels from other nearby sources at the foot of the ramshej hill neighbouring the village to enhance water collection. The same channels and pipelines are used in reverse direction for promoting water recharge into the ground and natural aquifers at times of high rainfall thereby making the water management more sustainable overall.

The enterprise also collects a token amount from each farmer without issuing a receipt but the complete accounts are shared to one and all. The fund thus generated is used to highlight the achievements of the cooperative to the concerned departments and keep them in the know of the farmers need for prompt and proper irrigation such that there is an implicit pressure on the departments to ensure proper electricity and water supply to the village. Sometimes this fund is also used to take up repairs beyond the capacity of the cooperative budget.

There are certain rules and regulations in the Cooperative enterprise which set it apart from other Water User Associations in the area.

1) Each pumping group should have a minimum of 10 members to be a part of the Cooperative enterprise.

2) The beneficiaries will be responsible for all the repair and maintenance of their respective pipelines from the source.
3) All other expenses, mainly water taxes of government, electricity bills and the salaries of the watchmen are borne by all the members in the Cooperative enterprise equally.
4) If a member sells his agricultural land to a non-native of the village, the membership expires with the sale. The new owner has to arrange his own means of irrigation water. This has ensured low attrition and migration the natives and ensures that the water is specifically used only for agricultural purposes.
5) The government transformer at the dam used to be defunct for 6 months during the monsoons, but still the farmers were forced to pay the minimum charge. Also the existing transformer used to require constant repair and maintenance. To handle these issues, a 160 KV transformer was installed by the Cooperative enterprise for power supply to the dam for water distribution. The Cooperative enterprise is also able to terminate the supply in time of low water availability and also can monitor the water supply in a proportionate manner by congrolling the transformers.
6) The lake has a storage capacity of approximately 80 million cu. ft. The natural rainwater was calculated approximately to be around 15 million cu. ft. The rest of the 65 million cu. ft. of the water level goal could not be achieved because of lack of river flow and insufficient power supply. Hence, the Cooperative enterprise arranged for "T" joint pipelines to recharge the dam from the canal and the lake. The rainwater flows into the dam with the help of an individual transformer of 100 KV power supply.
7) During the Kharif season, motor pumps are timed based on the area of land (in Acres) and during the Rabi season, the motor pumps are timed according to the number of members. If during the rotation, a member misses his share due to valid reasons like power cut or maintenance in the pipeline, then the pumping hours are extended according to the rule.
8) If the motor pump group fails to pay the taxes even after the bailout duration, the motor starter is dismantled by the watchman or the director members of the Cooperative enterprise. The bailout period is counted as per power units consumed.
9) The farmers cultivating year long crops like Grapes are encouraged to adopt water saving drip irrigation technologies and assisted with construction of recharge wells near their farms. This ensures that even if the water allotted is in excess of what the farmer needs, the water can be stored in his individual well and used later on for his

other uses like cattle rearing, domestic uses etc. or shared among his neighbours. The Cooperative enterprise also ensures that the water shared is not sold by the farmer for monetary gains. This reduces the unfair hoarding tendencies of the members.

3.3.5 Pump Allotment Details

Sr. No.	Name of Motor Pump Group	Electric Motor being used (HP)	No. of members
1.	Shri Swami Samarth - A	11	15
2.	Shri Swami Samarth - B	10	11
3.	Jay Bhavani	10	13
4.	Jay Gajanan	7.5	6
5.	Jay Mahakali	7.5	6
6.	Shree Dutta	5	7
7.	Jay Saptashrungi	0	8
8.	Ramshej	10	8
9.	Shree Sainath	7.5	9
10.	Jay Bajrang	7.5	10
11.	Jay Yogeshwar	7.5	10
12.	Jay Shivshankar	7.5	13
13.	Jay Mariaai	12.5	12
14.	Shree Ganesh	10	8
15.	Jay Bholenath	5	5
16.	Jay Janardan	9	5
17.	Jay Kisan	7.5	10
18.	Jay Hanuman	5	6
19.	Jay Navnath	5	7
20.	Om Sai	7.5	*10.5**
21.	Gangajal	7.5	*10.5**
22.	Gadage + Bolkar	7.5	*8**
23.	Y. G. Tatya	7.5	*10**
24.	Fouji	5	*8**
25.	Agasti	7.5	*8**
26.	Indur Matha	5	*11**
27.	Gurukrupa	11.5	*10**
28.	Jay Mata Di	7.5	*7**
29.	Fire	5	*7. *5*
30.	Sai Ram	10.5	*10**
31.	Kuriy	7.5	*9.5*
32.	Jay Shiram	7.5	*9**
**No. of days/stages*			

3.4 Fixed membership Lift Irrigation model based on gravity flow: Indore

3.4.1 Village background

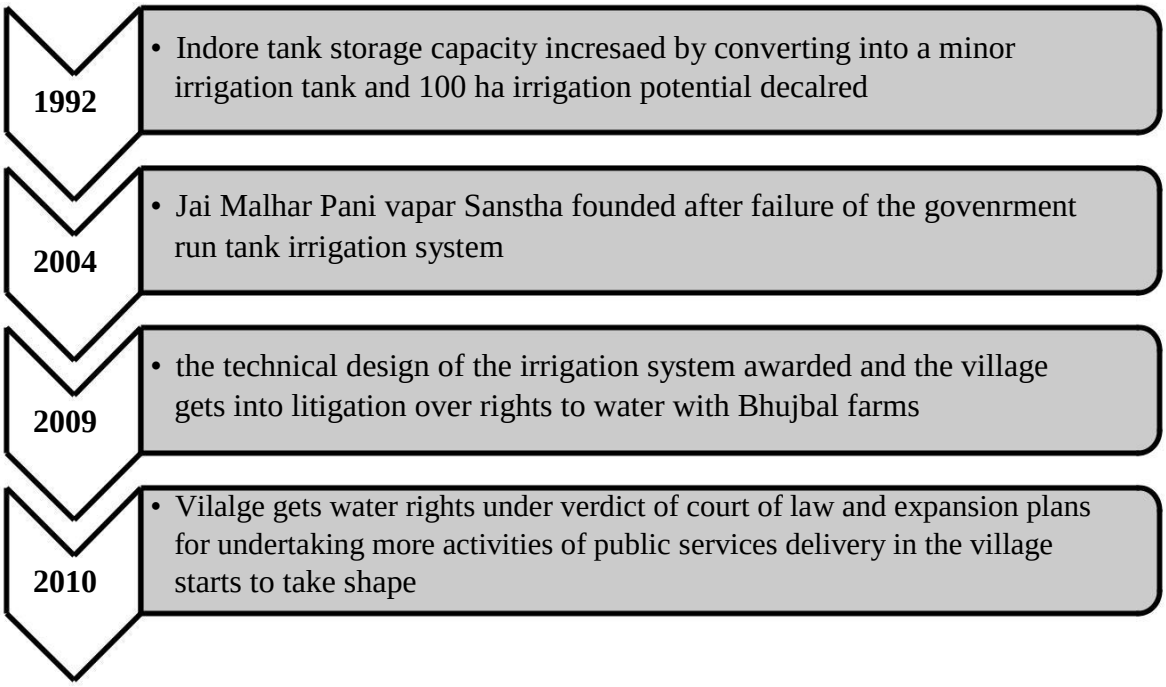
Indore is a village situated at the distance of 25 kms. from Nashik in Maharashtra. It is well known for a picturesque view of the waghad dam from the outskirts of the village and the neighbouring Pimpalnare Lake which is nearby Ramshej Fort, to the west of Pimpalnare. Just across the Indore water tank there is a large expanse of Bhujbal farms which is a privately managed and has huge operations by Indian standards.

The village has an estimated population of approximately 2000 people across varied communities and religions comprising about 400 families. Basic government infrastructure in the village is largely absent due to the proximity with the taluka headquarters of Dindori. However, the communication is skewed as the shared autos reach the village only 4 to five times a day. Most of the commutation is by private vehicles or on foot a minimum of 8 kms from either of two roads passing by near the village.

The village has been classified as a drought area for many years. Though the Indore tank has a storage capacity of around 0.89 Mm^3 , the last time the lake filled up was in the year 1992. The lake has two irrigation sluices and it is said to achieve an irrigation potential of 100 ha. One of sluices serves the neighbouring village of Madakejamb and thus only a limited supply reaches Indore. However, the tank was never filled up with water and thus the so called potential was never achieved. Inspired by the success of the neighbouring Pimpalnare village, the farmers of Indore village decided to take matters in their own hands and do something to ameliorate their situation and thus the Jai Malhar water user association was founded in 2004.

The work for the formation of the water user association was initiated by a freedom fighter who used to reside in the village. He went to the nearby dindori market and staged a dharna outside the shop of a relative who was educated and whom he considered capable of taking up the activities of the water user association as the secretary. This is how Mr. Ghughre was inducted as secretary of the association. He continues enjoying popular support and is stll the functionary of the association. The association in 2009 set up an indepdent dairy collection unit in the village as well to help the poor farmers who had so far not benefitted from the irrigation work.

3.4.2 Timeline



3.4.3. The Institution:

Before the formation of the cooperative enterprise, farmers used to individually pump water according to their need from the dam. This led to massive wastage of water and misuse too. Also the government irrigation system was proving to be a massive failure leaving most of the farmers in the village and even in the command area parched for irrigation water. Soon the native farmers realized that a collective institution would function more efficiently than a government system.

The farmers studied the functioning of the existing water user groups and figured out that conflict resolution was a major draught of resources for them. Thus they contacted a consultant Shri. Kulkarni at Nashik to design a system that worked on gravity as the reservoir was situated at a height from the farms of the village and such that the water delivery to each outlet was same leaving no scope for any conflict. Shri Kulkarni, a qualified civil engineer, specialised in such designs and soon designed the water tank and distribution system based on pipelines to reduce wastage of water in conveyance and distribution as well. The system had only one drawback. Once designed it did not allow an increase of membership into the system. The farmers agreed to live with this and 115 farmers came together into the system and formed the water user association.

3.4.4 The Entrepreneurial Angle:

The enterprise continues with a membership of 114 farmers and the water from the minor irrigation reservoir is lifted on to the storage tank with the help of two pumps pf 25 HP each with a discharge capacity of 50 lps.the discharge openings from the storage tank are situated at the same height and are of exactly the same diameter to ensure that the same amount of water flows through each of the 31 pipelines from the tank to the distribution chambers. The distribution chambers have the same mechanism of equal sized openings at the same height for equal discharge to each of the members.

The enterprise is registered as a cooperative under the Maharashtra government irrigation rules and functions as a water user association. It elects a 11 member board for managing the executive functions and has a secretary of the society and one watchmen cum operators as its employees. The salaries of only the watchman are borne by the society. The secretary has decided to work on an honorary basis. The maintenance of the rising main and pumps is the responsibility of the society as are the collection of water charges and payment to the government its dues towards water and electricity charges. An electric transformer has been purchased by the society and it is maintained in conjunction with the

The enterprise is responsible for ensuring timely and adequate irrigation to all member farmers and takes up multiple activities which go way beyond a normal cooperative's domain to qualify as an enterprise. In years of low rainfall the water in the dam is not sufficient to fulfil the needs of the farmers. During such years the society takes the help of government officials like every year in ascertaining the water level in the reservoir and calculating the water allocation and water charges for the year. Currently about 105 farmer members are active.

The neighbouring Bhujbal farms laid a claim to the water in the reservoir and the society decided to contest the claim. The matter went to courts and the farmers were able to display their cooperation and rightful ownership by precedence and were given rights to the water in the reservoir. This has proved to be a major shot in the arm for the society and it is now trying to set up other service delivery entities in the village as well. A dairy is functional since 2009 and soon a chemist shop or an agri-input centre may become functional if their plans see fruition.

A discussion on the dispute with Bhujbal farms led to the villagers expressing their concern that the right organizational format and larger participation by the farmers are essential to act as a deterrent for the entrepreneurs from cheating the farmers.

There are certain rules and regulations in the Cooperative enterprise which set it apart from other Water User Associations in the area.

1) To reduce conveyance losses, they decided to adopt piped distribution service.
2) Groups of 3 to 7 members were formed with adjacent fields to be serviced by a common pipeline from the water tank at the reservoir.
3) The beneficiaries will be responsible for all the repair and maintenance of their respective pipelines from the source.
4) All other expenses, mainly water taxes of government, electricity bills and the salaries of the watchman cum operator are borne by all the members in the Cooperative enterprise equally.
5) A 160 KV transformer was installed by the Cooperative enterprise for power supply to the dam for water distribution.
6) The user charges were stagnant at Rs. 3000 per annum till 2013 when they were increased to Rs. 5000 p.a.
7) The watchman is paid a salary of Rs. 4000 per month,
8) The total project construction cost was Rs. 80 lakhs in 2004.

The rough calculations of financial functioning of the cooperative is as follows for the year 2013-14.

Table 3.1 : Financial details of Lift Irigation Cooperative			
Expenditures		**Income**	
Items	***Value (Lakhs)***	***Item***	***Value (lakhs)***
Electricity charges	1.25	Collections 100X5000	5
Water Charges	0.60		
Watchman salary	0.48		
Repair charges	1.25		
Total expenditure	**3.58**	**Total income**	**5**
		Net addition to reserves	***1.52***

3.5 Agricultural Financing for Irrigation by smallholders: Sustainable Agri-commerical Finance Limited (SAFL)

SAFL, as it is better known as, is a unique and interesting case to consider as it is the first financing entity of its type that has been able to record a positive balance at the end of the first year itself and also has a ticket size of less than one lakh for each credit unit and is yet not part of the Priority Sector Lending (PSL) of any bank. Financing has often been considered as the stumbling block to asset creation in irrigation. In India the best results of asset creation in irrigation have been based on government subsidies such as the Million Wells Scheme (MWS). Thus it is very heartening at one end to see SAFL enter the irrigation domain as almost ninety percent of their lending in the first year was in the irrigation sub-sector of agriculture. It must also be noted that in less than two years of its inception it already has competition from another similar NBFC floated by the competitor of its parent company.

The origin of SAFL lay in the financial status of Jain Irrigation Systems limited (JISL) and the subsidy regime for drip irrigation that existed and continues to exist today. The drip irrigation sales in India were driven by subsidies and there was considerable delay in the release of subsidies for any financial year and also there was considerable delay in settlement of bills. Irrespective of the reasons of the same JISL was faced with the situation that time taken for the release of subsidy and

settlement of bills had increased from 6 months earlier to 2.5 years in Maharashtra by 2013-14. This had put the business model of JISL under great stress as they had embarked on an interest free credit subsidy based model for effecting sales.

The international investors led by IFC necessitated that JISL hive off the credit component off their balance sheet. It was also seen as an opportunity to float a new business in the line of credit if synergies could be built with the huge distribution network of JISL. Thus with farmer finance as focus IFC (as anchor investors) , JISL and Jain family came together to launch SAFL as a non-banking finance company. It was decided to start from the familiar turf of Maharashtra and then expand both geographically as well as to a wide array of agricultural loans for farmers with time. It was also decided to make the new entity completely independent as soon as possible and JISL would move out of the management and ownership of the organization by raising capital from other sources.

3.5.1 The Institution

The operations of SAFL are divided into 4 zones within Maharashtra namely Pune, jalgoan, Aurangabad and Amravati. The NBFC functions through 50 branch offices today, including one in Karnataka which is the latest expansion of the company as well. They offer more than eight credit lines of differing durations.

The operations are simple and the business is attained through channels – the JISL dealers, the business development managers of SAFL and through holding outreach events such as local festivals and camps. The Business is based on sound credentials that last mile delivery of credit or any other service is prohibitively costly and hence the operations are very frugal and cost effective at the client end and most of the decisions are standardised but decision making decentralised based on a standardised credit manual. The application development takes place through all the three channels mentioned earlier and the application development and processing is completed at the branch office itself. The decision to issue credit or not is taken at the branch and head office level following collateral based lending model. However the system is flexible and due diligence tries to work with the farmers in developing the applications rather than face rejections later on. The system saves on costs by failing fast applications and putting them through the development route.

In the first year of operations the lending amount totalled over Rs. 100 crores and the number of beneficiary farmers was more than 10000 arriving at an average ticket size of less than Rs 1 lakh per credit unit. This is remarkable because even drip irrigation (a large chunk of their business is

loans for micro irrigation systems) for 1 ha costs more than this. This means that the beneficiaries may be a chunk of small and marginal farmers.

The organization had a total employee strength of 136 people in mid-2014. It has since raised capital from Mandala capital (VC funding) and the Jain family has moved out as promoters. This also resolves the conflict of interest for them between JISL and SAFL.

3.5.2 The Entrepreneurial Angle

This case study has a very strong entrepreneur story to it in terms of two things – the business and the main person behind it all. In terms of business it is a domain that has been desired to be triggered for a long time in Indian agriculture. Finally SAFL has been able to do the same. The mid duration and mid-sized segment of credit has traditionally been the worst ignored segment. This makes this innovation very special. It also does a yeoman's service to the irrigation sector by promoting the use of conservation technology as micro irrigation amongst farmers who most need it. It has enabled the push of subsidy on such a technology to be converted into the pull of the market led demand and financing.

Mr. Arvind Sonmale, the CEO of SAFL, had been a banker for more than 30 years when he retired. Having worked closely with the Jain group as a banker on the other side of the table evaluating their credit requests he understood their business well as well as the business of the banks. He was the ideal choice to head SAFL when it was formed and he took up the challenge. His experience played a very strong role in setting up the processes and overcoming the issues of last mile delivery vis a vis cost effectiveness of the whole entity. He has also been able to bring in the JISL relationship aspects into the business model for servicing the credit needs of the farmer.

Once the credit space for irrigation is opened up , many more entrepreneurs can dare to come in on their own rather than wait for signals from the government or for the government resources to kick in to start and establish a business. The crux of doing this boiled down to innovating and standardising the processes for ease of execution while retaining the discretion to enable the correct due diligence and reduce NPAs to minimum.

3.6 The Promise of Solar Pumping for energy starved Farmers: Rise of the end of the energy-irrigation nexus: Claro Energy

Claro Energy Founded by Kartik Wahi, a kellog alumni, is the first solar company that was present only in the solar pumping space. This qualified it as a solar pump specialist outfit and also the

pioneer in irrigation applications of solar pumps with a service component. As a fresh graduate Kartik visited his senior and friend Soumitra Mishra for three weeks and decided to take a closer look at the waste management business opportunities in India. This brought him to another three weeks in India where he figured out opportunity in the energy starved and yet energy guzzling irrigation domain of India. His fascination in cleantech got him to combine this need with solar power and hence the idea of solar power irrigation services was born.

Claro is a 100% assembler and does not produce any component that it is selling to the farmers. Surprisingly maximum success has been achieved by Claro energy in the fields of Bihar and has now expanded to over eight states with more than 200-300 pumps installed on ground at the time of the study and another 800 in the pipeline. The numbers may seem small but at a ball-park price to the consumer at Rs. 1 lakh per HP this turns into staggering numbers for a start up. This also is a great indication of the scope for solar pumping that the irrigation sector opens in India with approximately 40 million pumps installed for irrigation across India and out of this 25% are starved for energy or dependent on diesel based power. This calculates into 10 million pumps that have a potential to be replaced by solar pumps not counting the new pumps that will also be installed in the duration of this transformation.

3.6.1 The Institution

Claro is headquartered in Delhi amidst art studios, which is almost symbolic of its own art like situation amidst irrigation and pump sellers in Indian rural markets. While the market is dominated by manufacturers with outdated models and technologies still holding forte, Claro is like disruptive modern art with no manufacturing of its own and a service based futuristic models being worked out in the most traditional of all markets– Bihar. At the headquarters, Kartik wahi is the fund raiser and the external interface of Claro energy whereas Gaurav Kumar is the internal interface and execution in-charge for Claro or the operations in-charge. They are backed by a team of accounts and financial servicing professionals, some marketing professionals and proposal developers.

It has a strong field presence with a big team in Bihar with the regional office in Patna. The whole of Bihar is serviced from Patna itself. Similar field offices are coming up in each of the eight states where Claro is present and eyeing a share of the solar water pumps market. The team in Patna is divided into business development and the execution and servicing side. The former tries to market the services offered and get new clients and tie up with the state government for the subsidy reimbursement. The latter division takes up the logistics of shipment , installation and helping the

farmers with after sales maintenance and handholding in teaching good operations practices. Therefore the critical operations are figuring out a farmer who is faced with either an adverse energy scenario or an adverse energy cost scenario but progressive farming.

3.6.2 The Entrepreneurial angle

Given that the business was started as a subsidy based business but very soon it was obvious that government help was not as forthcoming as promised as the subsidy release was delayed and the need of farmers was much higher. The organization quickly decided to use the situation to its advantage and sought to degovernmentalize its business or to reduce its dependence on government subsidies. Thus Claro got its team back to the drawing board and they have come up with seven different probable services that will allow different type of water and pumping needs to be fulfilled with the use of solar power.

Solar water pumps alike micro irrigation have been capital expenditure or capex intensive. Thus one of the constant efforts of Claro has been to create tie-ups with financing institutions to provide various financial products such as to convert the capex into recurring expenses. Leasing is one such method. Bridge financing by banks is another such effort. The financing solution has to be customized for the institution that they are dealing with either at the back end or at the front end in case of subsidy based installments.

In their efforts to give better services to farmers they have even tried to set up partnerships with micro irrigation providers such as NETAFIM, Drip Tech etc. In a state like Bihar in order to effect sales they had to ensure that the product was theft proof and they were able to do this using innovation such as anti-theft screws. They are currently faced with different challenges. Insurance could come in very handy in placating the fears of the farmer about the safety of his asset for the financial loss. However the insurance companies are at a loss as they do not have the requisite understanding of the asset nor do they have huge databases comparable to actuarial database as this is a new innovation in India. Thereby insurance cover of the asset is next to impossible under the current scenario or prohibitively costly for the farmers.

Claro is also investing a lot in setting up the right type of training for farmers and the local populace as one of the major hurdles faced in scaling up sales is the absence of local knowledge base about the solar water pumps. Once this is set up there are fewer concerns about repairs and maintenance from the consumer and sales are easier and less costly to make.

The biggest challenge the Claro faces is about financing its working capital requirements. Enterprise level debts are few and far apart and due diligence is not geared up to provide traditional finance to new and innovative ventures such as Claro. Thereby leaving no other option but the costly ones such as venture funding and angel investments left for the organization. This is probably the biggest ticket item where the government and policy can kick in a big way and create a positive environment for delivery of public goods and services by entrepreneurs.

3.7 Pedalling Irrigation and a full value chain intervention: KB Treadle pump, IDE India ltd.

International Development Enterprises or IDE has always been a pioneer at working with the poorest people and has always had business models based on principles of Paul Polacks research that have sought to create full value chains to benefit the intended populations. IDE (India) carries on a similar agenda and the method of working also has been same. In India IDE has found success that has been unparalleled for it globally with the popularity of pedal or treadle pumps. In the eastern parts of India and even Bangladesh KB or Krishak Bandhu (Farmer brother) is a brand to reckon with in the poorest segments of the market with a reach that is deeper than probably any other distribution system.

The work of IDE (India) with smallholders had made it clear that they needed a very successful entry point activity to gain salience in the segment. The treadle pump was innovated and made as a result of the search for the entry point activity. The treadle pump enables the farmer to increase the number of crops every year and also to shift from staples to more valuable crops as well such as vegetables which help with the nutrition as well as income to the family. In case of either of this not happening the assured irrigation allows the farmer to get a increase in productivity which results in higher incomes. The general experience has been that from treadle pump based irrigation the income from 1 acre of farmland increases by upto Rs. 20000 per year for the adopting family.

Treadle pumps have been a very successful innovation globally and are mssivle popular in Bangaldesh. More than million treadle pumps had been seold by 2003 in India and Bangaldesh. It was initially considered an innovation that would fail as it required human effort like cycling but impact studies very soon showed the reverse that it was very popular in subsitutting the age old *Tenda* in places like kandhmahal. Soon after its launch it gined massive popularity as women of the farming household would go to the fields and pedal water for irrigation close to sunset making use of their free time and thereby reducing dependence on both rain and labour availbaility. This adoption by women was the major change that propelled this innovation to be redomified for

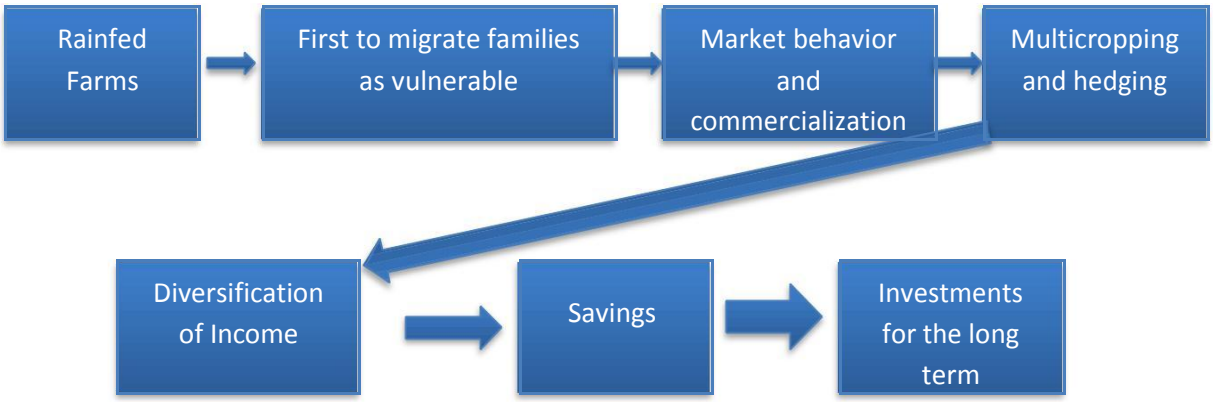
suitability to women and once this was done it was a rage in the market. Around 2004 IDE controlled more than 85% of the market of treadle pumps across the globe and today there are more than 30 competitors in India itself.

3.7.1 The Institution

Work was initiated in Kandhmahal in 2004 and today IDE has been abel to establish the whole value chian from manufacturing through distirbution through dealer through offices to the farmers. takign into account the financial vaiability of each actor in the value chain and also their commercial viabiliyt has been important but difficult as the product and service are innovative and no benchmarks exists to make forecasts easily.

The organization follows an annual licensiing system to maintain quality and put pressure on the manufacturers and dealers to sustain quality of activities and services.

The working Philiosophy of IDE is to intiate a change as given in the flow chart below



The operations so far in kandhmahal have benefiitted close to 20000 families whoa re pedlaling out of pvoerty as the famous report by Jack keller and Tushaar Shah is titled on this innovation and publsiehd in 2003.

3.7.2 The Entrepreneurial Angle

IDE works with the complete value chain right from the drawing board. They first did local research and testing and created a customised solution for kandhmahal in Odisha. Once the produt had been customised and the proto type was ready , the next step was to convince a local entrepreneur to set up shop as a part time manufacutere or fabricator of the pumps thereby taking the most critical link of rampling up supply in times fo suddent surge as close to the people as possible. Currently a fabricator has been ocnvinced to turn manufacturer of KB treadle pumps and

this is his breadwinner for more than six months of the year. The fabricator is also into its second generation now and the business is stable and the commitment to the cause of KB and also the cause of business and sustainability of their own business are both present.

IDE (India) as an NGO has officials working as Quality assurance officers for product quality to be maintained without vested interests to curb quality and increase pay-offs. The other stream of officials are the business development managers who take care of the critical function of not only marketing and promotion of the treadle pump but also end up providing economic advisory and other handholding support for the farmers including agronomic support at times. The BDMs also function in close conjunction with the dealers as well as retailers in the market for the promotion of the projduct and also keep collecting socio-economic data for further innovating with the product.

The BDMs at times also provide inputs for marketing opportunities such that the farmers are able to get a better price for their produce. Thus the treadle pump service is actually a irrigation plus service and not just a pure irrigaiton service or product selling.

IDE has also secured carbon credits for the treadle pump thereby being able to pass on certain benefits to customers either in the form of lower prices or more services there by making the business model more sustainable. IDE being registered as a Non-Governmental Organization or NGO has carried out studies on impact to facilitate showcasing its work to the prospective donors and the numbers are impressive. There is a marked difference on the halth expenditure between the user and non-user households being RS. 3104 and Rs. 1941 respectively for a year. The increase is considered a development as the tribal population in kandhmahal needs more halth care but has issues of being abel to afford the same. With the use of treadle pump the same seems to be better on affordability for the poor farmers. The expenditure on childrens education is also differenetiated at Rs. 1199 and Rs. 861 respectively between users and non-users. A similar difference is observed in the spending on vegetable, fuits and milk as Rs. 1328 for the users while the non-users spend Rs. 1090 on these items.

3.8 Smart solutions for the smart farmers: remote operators from Ossian AgriTech

Ossian Agro Automation was started as a proprietary holding company by Shri.Santosh Ostwal, along with his wife, in 1996. He had seen his grandfather and his fellow villagers' face serious problems in irrigating their fields at odd hours and situations. He had vivid memories of some deaths due to snake bites due to the same irrigation story. He started thinking of innovating to reduce the drudgery and find a solution to the problems faced by farmers in starting and switching

off their pumpsets. Little did he know that the desire was going to redefine his life! Ossian Agro Automation was a loss making enterprise till most of 2008 and the earnings from the non-agri applications developed by Santosh were always ploughed back to do research and trials on the agro solutions that he was pursuing.

He was quick to zero down on remote switching of pump sets as the ideal solution to the problems of the farmers. However he was faced with challenges of colossal proportions. The problem is actually very complex technologically to solve and the policies of the Government with respect to wavelengths for remote usage and transmitting were very restricted for most of his journey. For a major portion of his research and efforts duration he was trying to deal with the administrative red tape for permissions to conduct trials as any remote switching device over the range of 50 meters needed government permission and could be used only by defence forces. Even the government permission was determined by security concerns of the defence forces. This slowed him down and burnt a lot of his cash and capital and also the time of his team and slowed his ability to learn from his trials and develop the final product.

It was only in 2003 that when the mobile revolution took up and the mobile broadbands were freed that he really could embark on a commercial application that he was developing so long. Once this happened the rate of development of models was faster and also the adoption and penetrations was faster and within 4 years the breakeven was achieved and the company started to make profits. Today they are able to sell close to 5000 units a year. as it is unlisted company the full and exact data is not available but the sales of agro automation has been profitable since 2008 onwards. Now his son has completed his engineering and is also going to join this family business.

3.8.1 The Institution

Ossian Agro is a very small institution and employs a team of about 30 employees for manufacturing and some of them are part time. The total marketing and office team comprises of another 6-7 people including Mr. Ostwal and his wife. His wife is in charge of the office whereas he takes care of the business development and product research. Thus there are three teams – the product development team, the manufacturing team and the office team which looks after business development and client relationships.

The equipment is sold through some shops that sell irrigation equipment and there is an elaborate arrangement for after sales service using local plumbers and pump repair personnel on a commission basis. These pump repair persons and motor rewinding shop owners and workers are

also a formidable marketing sales force. There are multiple points of relationship building with them on part of Ossian agro and this is one of the core strengths of the organization as well.

A farmer query gets transmitted to the core team which then contacts the farmer to assess the situation and explain the best possible solution. The local team then takes over in pursuing the sales lead till the sales happen. Once the sales have been made the local person keeps contact with the farmer to ensure that they are satisfied with the product and also to collect critical feedback for product development.

3.8.2 The Entrepreneurial Angle

The power of Ossian agro is not in its size or profitability but in the ability to find a niche segment in a basic irrigation service and fulfil the same. It is in the story of the entrepreneur who has had to endure penury to deliver a service so essential for agriculture to prepare for the modern times. It is in his ability to set up an example that it is possible to have so many cottage and small scale industries possible in India. His estimates are that there 10 million farmers in India alone who need his services and he is already getting into exports to Africa and some other countries in the south East Asia. There are already over 150 competitors in this space in India alone employing a total of close to 1000 people full time and about double that number part time or on commission basis. This is the reason for highlighting this story and case for policy makers.

3.9 Refuelling growth in the Naxal belt by promoting high value agriculture using subsidized low cost drip irrigation systems: Netafim India Pvt. Ltd.

Despite being a global leader in the drip irrigation industry NETAFIM is a late entrant into the low cost drip irrigation systems. NETAFIM being an Israeli business entity is shy of sharing the full details also with an eye of retaining and strengthening its position as the technology leader in micro-irrigation and India's largest seller of drip irrigation. NETAFIM had a good business in the major micro irrigation states of Maharashtra, Andhra Pradesh, Karnataka and Gujarat when it was looking to expand business and figured out that the eastern states of India were the future of Indian Agriculture. However they were plagued by very low productivity and the concept of precision irrigation could be useful in overcoming this limitation.

They decided to take their products to the farmers of East India to nurture the green revolution and productivity increase here. Very soon they realized that the real farmers who were progressive and needed their support very scattered tribal farmers who wanted to cultivate high value and short

duration crops such as vegetables. However their land holing was abysmally making it difficult for them to afford the drip irrigation products marketed by NETAFIM and also almost impossible for them to generate sufficient returns on the costs incurred to achieve breakeven at the farm level. Thus they took the domain of low cost drip irrigation systems which was already populated by competitors. NETAFIM came with an innovation that did away the need for pumps to pressurize irrigation for making the drip irrigation work. This enabled the drip irrigation for a very small parcel of land of 1000sq m. or 1/10 of a hectare possible at a very low cost of close to Rs. 8000. However it was an interesting innovation and the Jharkhand government decided to add subsidy component to bring the cost for the farmers even lower. This seemed to work wonders and low cost drip irrigation system caught up in many places. In fact it has enabled NETAFIM to effect sales of its standard drip irrigation systems as well.

3.9.1 The Institution

The NETAFIM team in Jharkhand consists of a regional manager and two teams. One team is called the business development team whereas the other is the small army of agronomists that help the business development managers and also the farmers in ensuring the drip is adopted successfully by the farmers. These agronomists are also at the helm of the success of Family Drip System. The family drip system is a low cost drip irrigation system meant for the backyard farm of a tribal household and covers an area of about 400 Sq. mts. with irrigation. The source is a simple storage of about 1000-2000 litres at a height of about 8 feet and above. This storage can be filled in either manually or using a very small 0.5 HP pump bringing down the total energy requirement for irrigation by as much as 85 to 95% percent compared to a standard groundwater based irrigation pumping scenario in similar locations.

The agronomists help the farmers consistently get a better yield and also pick up better practices thereby ensuring higher revenues in times to come such that the cost of the drip irrigation system is recovered in a very small period of time. It is also hoped that once there is adoption based on subsidy, the famers will be able to buy such low cost drip at their own costs out of their savings from subsidy based drip irrigation systems sales.

The trips of the agronomists to the farmers' fields are usually on need and on call basis that is charged beyond the service guarantee period of a drip irrigation system. In the case of the Family Drip System or FDS the agronomists' costs were paid for certain duration by the state government itself. This enabled NETAFIM to create a good team of agronomists that has been slowly up scaled

for even non-subsidy operations. Increasingly the work of agronomists is being conducted through mobile but face-to-face meetings and field visits seem to have no alternatives yet.

3.9.2 The Entrepreneurial Angle

NETAFIM has been entrepreneurial in its journey with Jharkhand and especially the FDS in the capacity that they decided to look at a totally different market segment and customize the products for it as well. The Family Drip System also made a first of its kind, as it is the only scheme for low cost drip systems to be subsidized. Under the normal conditions only BIS certified drip systems were eligible for government subsidy on the same. The subsidy was also extended to the agronomists' service associated with the sale of the FDS. This was critical and has become the stepping-stone to success of FDS enabling the farmers to prosper with the application.

FDS is thus a total Product + service sales amounting to an irrigation plus deal. By doing so NETAFIM has enabled itself to become household name across large parts of Jharkhand and its tribal populations which were otherwise considered to be a very costly market to penetrate. It is also claimed to impact the beneficiary families positively on their health and nutrition due the shift in crops grown in the backyard of the tribal farmers.

Chapter 4

Findings from the Survey

The results from the survey are presented in this chapter without any inferences. Despite being only a descriptive reporting of data, the tables represent a detailed scenario of entrepreneurship in irrigation. The tables also present compilations of strong results and user perceptions and assessment of entrepreneurs' promoting irrigation services. The tables present a vareity of information as given ahead.

4.1 Farmer and Farm Profile

Table 4.1.1 gives an overview of age profile of the farmer respondents' case wise as well as for the overall sample. The average age of respondents across the sample is a little over 46 years. A little over one third of the respondents fall in the age group of 51 or above and about 12.5 % farmer's less than the age of 30 years are respondents. A little over half of the sample falls in the age group of 31- 40 and 41-50 years. Respondents using the services of the tubewell-company and solar pumping systems have a markedly higher average age than from other sub-samples. A higher percentage of respondents who are younger farmers are from Irrigation financing service and family drip irrigation systems.

Younger than average farmers as respondents lead to the question whether innovations are preferred by younger farmers or are innovations making farming preferred by younger farmers?

Table 4.1.1 Age profile of farmer – respondents (all figures in %)

Age (years)	<=30	31 -40	41 – 50	>=51	Mean Age
Total Sample	12.5	25.9	27	34.6	46.66
1. Waste water irrigation service	8	28	26	38	47.64
2. Tubewell company	0	12	26	62	56.44
3. Lift irrigation company	6	30	28	36	46.88
4. Fixed membership irrigation company	6	22	28	44	48.66
5. Remote starter irrigation service	10	34	30	26	44.84
6. Irrigation financing service	31.5	25.9	22.2	20.4	38.94
7. Solar pumping systems	10	16	28	46	51.6
8. Drip irrigation systems	28.3	37	23.9	10.9	39.11
9. Surface Treadle pump service	12.5	28.6	30.4	28.6	45.89

Table 4.1.2 shows the education profile of farmer respondents from the overall sample and also for sub-samples of all cases. Out of overall sample respondents almost 40% of them were high school pass outs. However about 16% of them are certified or possess a graduation degree. Across the nine case studies only respondents from remote starter irrigation service possess higher percentage

of graduation degree and none were illiterate. Drip irrigation systems records maximum percentage of illiterate whereas remote starters and surface treadle pump service records lowest percentage of illiterates across all nine case studies. Overall about 9% of the total respondents were illiterate.

Table 4.1.2 Eduction profile of farmer-respondents (all figures in %)					
Education Level	**Illiterate**	**Primary School**	**High School**	**Diploma/Certificate**	**Graduation or higher degree**
Total Sample	9.2	34.2	39.7	4.6	12.3
1. Waste water irrigation	12	34	42	4	8
2. Tubewell company	2	42	42	2	12
3. Lift irrigation company	10	26	50	6	8
4. Fixed membership irrigation company	14	36	38	6	6
5. Remote starter irrigation service	0	8	36	10	46
6. Irrigation financing	11.1	25.9	46.3	3.7	13
7. Solar pumping	8	20	46	10	16
8. Drip irrigation systems	26.1	32.6	39.1	0	0
9. Surface Treadle pump service	1.8	78.6	19.6	0	0

Education seems to be not a very important variable in farmers preference behaviour for innovations and their adoption. The educational profile of respondents appears to be driven by geography rather than by the adoption of innovation.

Table 4.1.3 shows the tabulated caste profile of the survey respondents. Almost half of the respondents were from general category and about one third belongs to the OBC category which is also reflected across all individual case studies with two exceptions. Drip irrigation systems and surface treadle pump services recorded maximum number of respondents from scheduled caste and scheduled tribes which comprised of one fifth of the total sample. None of the users of the treadle pump service were from general category whereas the general category farmers comprised more than three-fourths of the respondents using remote starters or solar pumps.

Table 4.1.3 Caste-wise breakup of respondents (all figures in %)					
Caste	General	Other Backward Caste	Other Minority	Scheduled Caste	Scheduled Tribes
Total Sample	49.1	28.1	2.6	5.9	14.3
1. Waste water irrigation	64	32	4	0	0
2. Tubewell company	74	24	2	0	0
3. Lift irrigation company	64	34	2	0	0
4. Fixed membership irrigation	48	48	4	0	0
5. Remote starter irrigation service	78	22	0	0	0
6. Irrigation financing	38.9	48.1	11.1	0	1.9
7. Solar pumping	76	24	0	0	0
8. Drip irrigation systems	2.2	19.6	0	34.8	43.5
9. Surface Treadle pump service	0	1.8	0	19.6	78.6

The caste profile of respondents shows some skew as subsidies from the government are often linked to caste of the adopter. The profile is therefore linked to the policies of the government. At

the same time pure private initiatives devoid of government subsidy support have also been able to broadbase adoption across castes. Caste based incentives and policies need a relook and further research before being framed as much of the development is of the caste neutral enterprises/ services.

The presence and absence of non-agricultural sources of income has been shown in Table 4.1.4. Around three fourths of the overall sample has a non-agricultural source of income. All the respondents for the drip irrigation service had an income source other than agriculture. However around 80 percent of the respondents in Surface Treadle Pump Service were dependent on agriculture as the sole source of income. Respondents using the remote starters were split in exact halves of those with and without non-agricultural sources of income. the highest proposition of respondents with no non-agricultural sources of income was of the irrigation financing respondents.

Table 4.1.4 Non-agricultural sources of income (all figures in %)

Status	Available	Not Available
Total Sample	70.6	29.4
1. Waste water irrigation	80	20
2. Tube well company	70	30
3. Lift irrigation company	78	22
4. Fixed membership irrigation company	80	20
5. Remote starter irrigation service	50	50
6. Irrigation financing	88.9	11.1
7. Solar pumping	78	22
8. Drip irrigation systems	100	0
9. Surface Treadle pump service	17.9	82.1

Table 4.1.5 indicates the status of food scarcity experienced by the survey respondent households. The overall response shows that about 80% of respondents did not experience food scarcity at all. Most of the respondents never faced food scarcity however in the case of solar pumping, drip irrigation systems and surface treadle pump service food scarcity was observed. In solar pumps and drip irrigation systems, the respondents reported facing food scarcity for 3 months, generally during the summer months. In the surface treadle pump service all the respondents faced food scarcity for 6 months or upto the entire year.

There is a marked profile of respondents with respect to food security and it needs to be established which way the relationship works betwee adoption and food security.

Table 4.1.5 Duration of food scarcity (All figures in %)				
Duration	**Never**	**Up to 3 months**	**Up to 6 months**	**All year**
Total sample	80.7	7	3.1	9.2
1. Waste water irrigation	100	0	0	0
2. Tubewell company	100	0	0	0
3. Lift irrigation company	100	0	0	0
4. Fixed membership irrigation company	100	0	0	0
5. Remote starter irrigation service	100	0	0	0
6. Irrigation financing	100	0	0	0
7. Solar pumping	72	28	0	0
8. Drip irrigation systems	60.9	39.1	0	0
9. Surface Treadle pump service	0	0	25	75

Table 4.1.6 reflects the percentage of farm land consolidation across the sample. About 43% of the respondents reported their land to be consolidated while about one fourth of them reported their farm land to be fragmented. Maximum fragmentation was seen in the case of remote started irrigation service and surface treadle pumps.

The land consolidation profile clearly shows that time saving services are preferred by farmers with more fragmented lands.

Table 4.1.6 Farm land consolidation (all figures in %)			
Status	**Consolidated**	**Somewhat Consolidated**	**Fragmented**
Total Sample	43	32.2	24.8
1. Waste water irrigation	60	18	22
2. Tubewell company	56	38	6
3. Lift irrigation company	68	20	12
4. Fixed membership irrigation company	100	0	0
5. Remote starter irrigation service	10	22	68
6. Irrigation financing	64.8	35.2	0
7. Solar pumping	16	64	20
8. Drip irrigation systems	4.3	71.7	23.9
9. Surface Treadle pump service	7.1	25	67.9

Table 4.1.7 presents the farm terrain type across all the sample case studies. From the overall sample, more than half of the farm terrain type reported rocky areas amongst which lift Irrigation company and irrigation financing were fully covered with rocky terrain farmlands.

About one fifth of farmlands across the sample were of flat terrain and only about 3% of farmland understudy was gently slopingand 9% undulating.

The profile of the farm terrain is expected as difficult terrains need more innovation and such enterprises as have been studied.

Table 4.1.7 Farm terrain type (all figures in %)					
Status	**Rocky**	**Sloping**	**Undulating**	**Gently Sloping**	**Flat**
Total Sample	52.4	15.1	9	2.9	20.6
1. Waste water irrigation	80	0	2	0	18
2. Tubewell company	74	24	2	0	0
3. Lift irrigation company	100	0	0	0	0
4. Fixed membership irrigation company	0	96	4	0	0
5. Remote starter irrigation service	0	0	40	0	60
6. Irrigation finding	100	0	0	0	0
7. Solar pumping	0	0	12	22	66

Table 4.1.8 shows the irrigation command area across all sample case studies. Amongst the case studies studied, 6 cases were located in irrigation command areas in the overall sample around 65 percent had their land in the middle part of the command area and 8.6 percent had their land in the tail end.

Table 4.1.8 Location in the Irrigation command area (all figures in %)			
Status	Tail end	Middle land	Head end
Total Sample	8.6	65.4	26.1
1. Waste water irrigation	0	96	4
2. Tubewell company	28	68	4
3. Lift irrigation company	10	64	26
4. Fixed membership irrigation company	30	16	54
5. Remote starter irrigation service	10	90	0
6. Irrigation financing	0	64.8	35.2

Table 4.1.9 tabulates the sources for irrigation on the sampled farms. The common sources of irrigation for the respondents were open well, canal and tube well, as reported 60.3%, 36.6 %and 26.8 % respondents respectively. About 48 percent of the respondents had used other sources of irrigation like waste water. Majority of the farmers had more than one source for irrigation water.

Table 4.1.9 Sources for irrigation (all figures in)

Sources	Canal	Open Well	Tube well	Tanks / Water Storage	Lift from Canal/Stream/Pond/Tanks	Others
Total Sample	36.6	60.3	26.8	0.2	9.6	45.2
1. Waste water irrigation	100	0	0	0	4	100
2. Tubewell company	100	46	100	0	0	0
3. Lift irrigation company	0	100	16	0	100	0
4. Fixed membership irrigation company	100	10	0	0	100	0
5. Remote starter irrigation service	10	72	32	0	32	0
6. Irrigation financing	22.3	16.7	7.4	0	29.6	0
7. Solar pumping	0	100	72	0	0	0
8. Drip irrigation systems	0	95.7	17.4	2.2	4.3	0
9. Surface Treadle pump service	0	100	0	0	25	0

Table 4.1.10 collates the responses of different reasons for changing need for irrigation. About 90% of the respondents agreed that the major reason was due to change in the rainfall. Another 69% of the respondents pointed out that shortage of labour have caused a change in the need for irrigation water. Only about 8% were not sure about the reason for changing needs for irrigation water.

Table 4.1.10: Reasons for changing need for irrigation (all figures in %)

Reasons	Total Sample
Due to change in rainfall	90.10
Due to shortage of labour	68.90
Due to poor soil quality	55.30
Due to new irrigation practices	50.20
Due to poor water quality	35.10
Due to shortage of power availability	30.30
Due to agricultural practices	28.30
Due to change in varieties being grown for same crops	15.60
Due to change in cropping pattern	9.60
Due to change in livestock	9.60
Can’t stay	6.40
Due to other reasons	1.30

Table 4.1.11 shows the response about the reliability on the irrigation services. Two- third of the respondents dependent on the irrigation services considered that very reliable throughout the year. Almost all the respondents relied substantially or very substantially on the irrigation service from the entrepreneurs. The reliance was maximum and total in the case of respondents using irrigation financing, drip irrigation systems and treadle pump services. The reliance was least yet substantial in the case of fixed membership irrigation company (Indore).

A significant part of the respondents have a significant reliance on the institution. This signifies that enterprises in irrigation are still catering only to the explicit & expressed demand. The actual scope could be much wider and needs to be taped.

Table 4.1.11 Reliance on the Irrigation service (all figures in %)

Status	None	Very Little	Some	Substantial	Very Substantial
Total Sample	0	0	0.4	32.9	66.7
1. Waste water irrigation	0	0	0	4	96
2. Tubewell company	0	0	4	8	88
3. Lift irrigation company	0	0	0	0	100
4. Fixed membership irrigation company	0	0	0	98	2
5. Remote starter irrigation service	0	0	0	12	88
6. Irrigation financing	0	0	0	0	100
7. Solar pumping	0	0	0	66	34
8. Drip irrigation systems	0	0	0	0	100
9. Surface Treadle pump service	0	0	0	0	100

Table 4.1.12 collates the farmers' responses with regards to the general water situation prevalent on the farm. It could be observed from the table that 27% of the respondents reported facing no scarcity and almost one-fifth of the farmers reported facing excess water situation on the farms. At the same time about 50% of the farmer's respondents reported facing occasional to acute water scarcity on their farms.

Table 4.1.12: General water situation on farms

Status	**(%)**
Acute Scarcity	15.60
Scarcity	12.70
Occasional Scarcity	23.90
No Scarcity	27.20
Excess Water	20.60

Table 4.1.13 shows the responses towards the changes in availability of water over the years. While almost 50% of the sampled farmers responded that there had been some improvement 42%

or two-fifths of the sampled farmers reported no change in the availability of water over the years. At the same time, a little less than 10% reported a sharp fall or deterioration for the same.

Table 4.1.13: Change in availability of water over the years	
Status	**(%)**
Sharp Fall	4.80
Deterioration	3.90
No Change	41.90
Improvement	49.30
Large Improvement	0.00

Table 4.1.14 gives the cumulative responses to the perception of water quality available on the farm as perceived by the farmer-respondents. A little over 40% reported good or very good quality water being available to them. At the same time a little less than 50% of the sampled farmers perceived average water quality to be available on the farms.

The general water situation on farm is varied and well spread but a larger proportion of the respondents reported better water conditions, water quality with the services being availed.

Table 4.1.14: Wter quality as perceived by farmer	
Resopnse	**(%)**
Very Bad	3.70
Bad	9.60
Average	46.50
Good	26.30
Very Good	13.80

Table 4.1.15 presents the overall responses to the changes in water quality as observed by the farmers. About 40% respondents perceived an improvement or large improvement while a little less than 10 percent reported deterioration or a sharp fall in the water quality. Marginally over half of the farmer respondents reported no change in water quality over the past few years.

Table 4.1.15: Change in water quality over the past few years	
Status	**(%)**
Sharp Fall	5.30
Deterioration	3.70
No Change	50.90
Improvement	35.10
Large Improvement	5.00

Table 4.1.16 provides the survey responses for the impact of power availability on changing irrigation practices. About one-third of the respondents observed changes in the irrigation practices. However, a little over half of the respondents were unsure whether the change in availability of power had led to any variation in irrigation practices.

Table 4.1.16: Change in irrigation practices due to power availability variation	
Response	**(%)**
Strongly Disagree	7.00
Disagree	9.40
Undecided	50.40
Agree	33.10
Strongly Agree	0.00

Table 4.1.17 represents the impact of change in availability of labour on the irrigation practices. A little over 41% of the respondents agreed or strongly agreed that change in labour availability had led to change in the irrigation practices. However, almost 45% of the respondents were unsure whether there was any impact on the irrigation practices.

Table 4.1.17: Change in irrigation practices due to labour availability variations	
Response	**(%)**
Strongly Disagree	0.90
Disagree	13.20
Undecided	44.70
Agree	28.10
Strongly Agree	13.20

Table 4.1.18 shows the responses with regards to the change in the soil quality on the farm over the years. On one hand, half of the respondents perceived an improvement in the soil quality on the farm and on the other hand 40% of the surveyed farmers responded with no change in the soil quality on the farms over the past few years. Almost 11% respondents reported a sharp fall or deterioration of soil quality on the farm.

Table 4.1.18: The Soil quality on the farm has changed over the past few years	
Status	**(%)**
Sharp Fall	5.00
Deterioration	5.90
No Change	40.10
Improvement	46.30
Large Improvement	2.60

Table 4.1.19 shows the responses about the situation of the soil quality on the farms. Three-fifths of the respondents agreed that soil quality on the farm was very good. However a little over 20% of the respondents disagreed or strongly disagreed that the soil quality was very good.

Table 4.1.19: The soil quality on the farm is very good	
Response	**(%)**
Strongly Disagree	5.90
Disagree	15.40
Undecided	17.80
Agree	53.70
Strongly Agree	7.20

Table 4.1.20 shows the collection of responses towards the change in the availability of power over the years. About one-third of farmers observed an improvement or large improvement in the power availability over the years while almost half of the respondents did not observe any significant change. Almost one-fifth of the respondents reported deterioration or sharp fall in power availability over the past few years.

Table 4.1.20: The power availability has changed over the past few years	
Status	**(%)**
Sharp Fall	7.90
Deterioration	11.80
No Change	48.50
Improvement	29.20
Large Improvement	2.60

Table 4.1.21 collates the responses about the situation of power availability on the farms. Almost 40% of the respondents agreed or strongly agreed that power availability was very good whereas a little less than half of the respondents were undecided about the power availability on the farms and almost 15% of the farmer-respondents reported bad or very bad power availability on the farm.

Table 4.1.21: The power availability on the farm is very good	
Response	**(%)**
Strongly Disagree	5.00
Disagree	9.20
Undecided	46.70
Agree	32.20
Strongly Agree	6.80

Table 4.1.22 shows the responses from the overall sample to the change in labour availability over the past few years. Almost 39% reported an improvement or major improvement while a little less than one-fourth of the respondents reported a sharp fall or deterioration about the change in labour availability. A significant number of 37% of respondents did not observe any change.

Table 4.1.22: The Labour availability has changed over the past few years	
Status	**(%)**
Sharp Fall	12.70
Deterioration	11.40
No Change	37.10
Improvement	35.10
Large Improvement	3.70

Table 4.1.23 accumulates the responses about the labour availability on the farms. Almost 41% or two-fifth of the respondents agreed that the labour availability on the farm was good or very good. However, about 46% of the respondents were undecided in their response and a little over 13% disagreed or strongly disagreed that labour availability was good.

Table 4.1.23: The Labour availability on the farm is very good	
Response	**(%)**
Strongly Disagree	7.70
Disagree	5.70
Undecided	45.80
Agree	38.80
Strongly Agree	2.00

Table 4.1.24 shows the responses about progressiveness of agricultural practices in the village. Half of the sample respondents perceived that the agricultural practices had been progressive or innovative. However, about one-fourth of the respondents perceived the agricultural practices to be average and another one-fourth of the respondents perceived the same to be traditional or backward.

Table 4.1.24: Agriculture and Agricultural practices in the villages	
Status	**(%)**
Backward	7.50
Non Advanced	17.80
Okay	24.30
Advanced	43.00
Very Advanced	7.50

Table 4.1.25 presents the responses of farm advice available to the farmers. About 30% farmers perceived the advice available as good or very good and 47% of the respondents perceived the farm advice as average. Also, one-fifth of the sample respondents perceived the advice available as bad or very bad.

Table 4.1.25: Farm advice available to respondents	
Response	**(%)**
Very Bad	3.50
Bad	17.80
Okay	47.60
Good	26.50
Very Good	4.60

Table 4.1.26 presents the overall responses of surveyed respondents about the weather advice available to the farmer-respondents. 40% of the respondents perceived the advice available as good or very good whereas almost 44% of the respondents perceived the weather advice to be average.

Table 4.1.26 : Weather advice available	
Response	**(%)**
Very Bad	2.40
Bad	13.60
Okay	43.90
Good	32.70
Very Good	7.50

Table 4.1.27 shows the responses about the harmonious social relations among the farmer-respondents. Half of the respondent's agreed or strongly agreed with harmonious social relations in the village community amongst farmers. A little over two-fifth of the respondents were unsure about the harmony of the social relations in the village. Almost 7% disagreed with the existence of harmonious social relations in the village.

Table 4.1.27: Harmonious social relations in the village	
Responses	**(%)**
Strongly Disagree	0.00
Disagree	7.20
Undecided	42.80
Agree	42.50
Strongly Agree	7.50

Labour availability, soil quality and power availability are important issues faced by farmers but the respondents have reported significant improvements in all these with the adoption of services from entrepreneurs. This is a great benefit and opens the doors for the future of Indian Agriculture. The key to the future, it seems, rests in the hands of irrigation entrepreneurs and other such enterprises. There is al ot of scope for improvement with the right support os policy.

4.2 The Experience of Private Irrigation Service

Table 4.2.1 presents the responses to the changes in irrigation practices due to adoption of irrigation service. A little more than 70% of the survey respondents agreed or strongly agreed with a significant change. However, almost 23% of the respondents had disagreed or strongly disagreed with considerable changes in irrigation practices due to adoption of irrigation services.

Table 4.2.1: Irrigation practices changed significantly due to adoption of the irrigation service

Response	**(%)**
Strongly Disagree	14.90
Disagree	7.70
Undecided	4.80
Agree	53.10
Strongly Agree	19.50

Table 4.2.2 shows the responses collected for improvement in irrigation practices post adoption of irrigation services. 60% of the survey respondents agreed or strongly agreed that irrigation practices have improved since the adoption of irrigation service. However, almost 12% disagreed or strongly disagreed with any improvement having taken place. A Little less than 30% of the respondents were undecided about their response.

The utility entrepreneurial irrigation services, is borne by the fact that most ofhte changes in irrigation practices due to adoption have resulted in improvements.

Table 4.2.2: Irrigation practices have improved after adoption of the irrigation service

Response	**(%)**
Strongly Disagree	1.80
Disagree	9.60
Undecided	28.50
Agree	47.10
Strongly Agree	12.90

Table 4.2.3 gives the information regarding trainings organized for farmers for the irrigation service. Almost 54% of the respondents agreed that trainings had been arranged for farmers for the irrigation service.

Table 4.2.3: Trainings have been organized for farmers for irrigation service	
Response	**(%)**
No	46.70
Yes	53.60

Table 4.2.4 shows the responses whether trainings were helpful in getting more benefits from the irrigation service. A little over 36% of respondents agreed or strongly agreed that trainings had helped them reap more benefits out of the irrigation service and a little more than one-tenth of the respondents disagreed with the same. More than half of the respondents were unsure if trainings had enabled them to get more benefits from the irrigation services.

Table 4.2.4: The trainings help to get more benefits out of the irrigation service	
Response	**(%)**
Strongly Disagree	4.40
Disagree	7.00
Undecided	52.20
Agree	24.10
Strongly Agree	12.30

Table 4.2.5 collates the responses towards the need for special training to be provided to farmers to aid the adoption of the irrigation service. A little more than 50% of the survey respondents agreed or strongly agreed that the irrigation service needed special training to be given to the farmers to aid adoption. However almost 40% of the respondents were not sure, while less than 8% farmer respondents disagreed with the need for special trainings for aiding adoption.

The adoption of irrigation services needs to be supported with appropriate trainigs as respondents expressed the need for trainings. They also expressed the need to focus on appropriate & customised content. At times special trainings can be arranged as well.

Table 4.2.5: The irrigation service needs special training to be given to the farmers to aid adoption	
Responses	**(%)**
Strongly Disagree	1.80
Disagree	5.90
Undecided	39.50

Agree	36.60
Strongly Agree	16.20

Table 4.2.6 shows the responses towards change in the pumping hours for irrigation due to adoption of the irrigation services. A little over 4% respondents observed an increase or a sharp increase and whereas about one-fourth of the respondents observed a decrease or a sharp decrease in pumping hours for irrigation using irrigation service. However, a little more than 70% respondents reported no change in pumping hours due to irrigation services.

Table 4.2.6: Change in pumping hours for irrigation using the irrigation service

Status	**(%)**
Sharp Increase	2.60
Increase	2.00
Unchanged	71.90
Decrease	24.60
Sharp Decrease	0.70

Table 4.2.7 shows the responses for change in electricity consumption for irrigation due to adoption of irrigation services. A little over one-fifth of the respondents observed a decline or sharp decline in electricity consumption whereas about 77% of the farmers reported no change in electricity consumption.

Changes in electricity consumption were brought out by changes in pumping hourse rather than other efficiencies of innovations. There is therefore need for better practices to promote enterprises such as solar irrigation enterprises to impact the energy-irrigation nexus positively.

Table 4.2.7: Change in electricity in consumption for irrigation using the irrigation service

Status	**(%)**
Sharp Increase	0.40
Increase	0.40
Unchanged	77.40
Decrease	7.50
Sharp Decrease	14.30

Table 4.2.8 gives the responses to the query if the farmer could provide any specific suggestions in order to improve the procedure for availing subsidy related to irrigation service. Almost 70% of the respondents agreed that they could provide specific suggestions for the same whereas

about 30% of the respondents perceived that they may be able to give some suggestions but were not very sure.

Table 4.2.8: Specific suggestions for improving the procedure for availing the subsidy	
Response	**(%)**
Not at all	0.90
Somewhat	29.80
Yes, a lot	34.40
Very Much	34.90

Table 4.2.9 below collates the responses about irrigation service being used for purposes other than irrigation. About 37.10% or almost two-fifths of the respondents agreed to using irrigation services beyond the intended irrigation. Other purposes include uses for domestic water needs, domestic power needs, asset acquisition as a financial investment and are not limited to these.

Table 4.2.9: The irrigation service is being used for purposes other than irrigation	
Response	**(%)**
No	62.90
Yes	37.10

Table 4.2.10 presents the responses whether the irrigation service functioned at full capacity during extreme calamities like drought or flood. Almost 85% of the respondents agreed that the irrigation services functioned at full capacity even in extreme conditions such as drought or flood.

Table 4.2.10: The irrigation service functions at full capacity in drought/flood situations	
Response	**(%)**
No	15.60
Yes	84.40

Table 4.2.11 shows that none of the sampled respondents perceived the irrigation service to be the cause of any health hazard rendering the perception of irrigation services to be very safe.

Table 4.2.11: The irrigation service has been the cause of any health hazard	
Responses	**(%)**
No	100.00
Yes	0.00

From the table 4.2.12 it is observed that 90% of the farmer respondents agreed that the irrigation service provider could stop the supply of the service to the farmer if needed whereas other 10% did not agree to the same.

Table 4.2.12: The irrigation service provider can stop the supply of the service to farmer, if needed

Response	(%)
No	9.40
Yes	90.60

Table 4.2.13 shows the responses about the rush to avail the irrigation service before others could avail the benefit. Almost 89% of the respondents agreed that they wanted to avail the irrigation service before others, fearing it may not be available to them otherwise.

Almost every 9 out of 10 respondents agreed to have rushed to avail the services before other fearing it may not be available in the future. This indicates the perception of excludability in services provision despite irrigation a public good. Farmers view it as a rival good rather than as a non-rival good. Most entrepreneurial opportunities need to make use of this perception to survive and be successful under current circumstances. This helps to manage high recovery rates and timely receovery as well.

Table 4.2.13: People want to avail the irrigation service before others, fearing it may not be available otherwise

Response	(%)
No	11.40
Yes	88.60

Table 4.2.14 shows the responses of farmers for having an option of rejecting the irrigation service if needed. Almost 84% of the respondents agreed that they could reject the service if they wished to.

Table 4.2.14: The farmer can reject the service if they wish to

Response	(%)
No	16.40
Yes	83.60

Table 4.2.15 collates the responses for level of satisfaction with the benefits provided by the irrigation service. Almost 90% of the respondents were satisfied or highly satisfied with the benefits availed through the irrigation service. An additional one-tenth of the respondents were undecided about any such benefits.

Despite room for many improvements, the overall satisfaction leves of respondents shows that success is not the pursuit of perfection in all dimensions but in the right set of dimensions as prioritized by the farmers.

Table 4.2.15 The benefits provided by the irrigation service

Response	(%)
Highly dissatisfied	0.00
Dissatisfied	0.40
Undecided	9.90
Satisfied	64.50
Highly Satisfied	25.20

Table 4.2.16 gives the farmers responses about the influence of irrigation services on shifting to better irrigation practices. About 31% of the survey respondents agreed or strongly agreed whereas, almost 70% of the respondents were undecided that the irrigation service had helped them shift to better irrigation practices.

Table 4.2.16. Irrigation Service has helped you to shift to better irrigation practices

Response	(%)
Strongly disagree	0.00
Disagree	0.90
Undecided	68.00
Agree	27.20
Strongly agree	3.90

Table 4.2.17 shows the farmers responses with regards to fairness of the irrigation provider. About 40% of the respondents reported agreement or strong agreement that the irrigation provider was fair and just when dealing with them. Also, about a little less than two -third of the respondents were not sure about their response to the fairness of the irrigation service provider in dealing with them.

Table 4.2.17. The irrigation provider has been fair and just in dealings with you	
Response	**(%)**
Strongly disagree	0.00
Disagree	2.50
Undecided	58.60
Agree	31.40
Strongly agree	7.50

Table 4.2.18 exhibits the perception of respondents about the various aspects of farm-operations due to the adoption of the irrigation service. A little over 13% of the respondents agreed or strongly agreed that the operation was cumbersome as compared to three- fourth of the respondents who disagreed or strongly disagreed about the same indicating ease of operations as one of the features of the irrigation services.

These are best explained in the example of drip irrigation and solar pumping when the instllation and the system usage needs involvement of the farmers or labour in operations day to day making it cumbersome. Solar pumping is not cumbersome but drip irrigation is even to be an average performing adopter. The operations of both innovations are difficult to learn. However operations of both are difficult to master as they go much beyond irrigation and changes in agricultural practices and other extant conditions and adaptation by the farmers.

When responding to difficulty in learning the operations of the irrigation service on the farm a little more than one-tenth of the respondents agreed or strongly agreed whereas almost 55% disagreed or strongly disagreed to the same. At the same time about one thirds of the respondents were undecided about the same.

About 13% of the respondents perceived that the irrigation service operation was difficult to master whereas 35% of the survey respondents disagreed with the same. A little over half of the respondents were undecided for the same or perceived a medium level of difficulty.

Table 4.2.18: Perception about the operation of the irrigation service			
Response	**Operation is cumbersme (%)**	**Operation is difficult to learn (%)**	**Operation is difficult to master (%)**
Strongly agree	11.20	2.60	1.80
Agree	2.20	9.20	11.60
Undecided	11.40	33.30	51.50
Disagree	62.10	45.80	30.00
Strongly Disagree	13.20	9.00	5.00

Table 4.2.19 reports the responses about the maintenance of the equipment. Almost half of the respondents perceived that the equipment used for irrigation service was difficult or very difficult to maintain whereas a little less than 5% of them perceived it was easy to maintain. About 46% of them were undecided.

Table 4.2.19: Perception about the maintenance of the irrigation service	
Response	**The equipment is easy to maintain (%)**
Very easy	2.00
Easy	2.50
Undecided	46.00
Difficult	39.80
Very difficult	9.70

Table 4.2.20 presents the respondent's perception about the cost of the irrigation service and it's after sales service if any. Almost one-fifth of them perceived that irrigation services costs were high. However, only 3% of the respondents' perceived that the cost of irrigation service was very high. About one-third or a little less than 33% of the respondents believed that irrigation services were less costly and about 49% of them reported moderate costs for the same.

About 43% of the respondents believed that after sales services irrigation services were less costly whereas 55% of them reported moderate after sales costs. A negligible number (less than 2%) of respondents found after sales service costly. Entrepreneurial business models prefer collecting all costs upfront rather than recovering after sales service costs. This indicates a nee dfor behavioural change which is difficult under the current subsidy driven environment

Table 4.2.20: Perception about the cost of the irrigation service		
Response	**Irrigtion servce is very costly (%)**	**After sales service was very costly (%)**
Very high	2.90	1.20
High	16.70	0.50
No change	48.90	55.00
Low	27.00	39.60
Very Low	4.60	3.70

The business model seems to be to collect costs as cost of service rather than as after sales service csots. This can simply limit the total business opportunity from growth and prosperity.

Table 4.2.21 collates the responses about the effectiveness of the irrigation service. A little less than 50% of the respondents reported a perception that the irrigation service was highlyeffective

and only 3% of them considered it to be low on effectiveness. About 49% of them reported moderate effectiveness.

High effectiveness of irrigation services is reported alogn with higher costs. The farmers are evaluating the increased costs by balancing them against the gains from adoption of entrepreneurial irrigation services. No single benefit appears to propel adoption across the sample and multiple benefits such as effective irrigation services, benefits to the environment, reduction in power and labour availability, agronomic benefits and social benefits have been reported. Each entrepreneur has to either both select and deliver a range of benefits or a unique winning combination as per their context and user group preferences.

Table 4.2.21: Perception about the effectiveness of the irrigation service

Response	Effectiveness of irrigation service (%)
Very low	0.70
Low	2.00
No change	48.50
High	34.00
Very high	14.90

Table 4.2.22 shows the perception of the respondents about the benefits on environment due to adoption of the irrigation service. About one-third of the respondents agreed or strongly agreed that irrigation services were beneficial for environment as a whole whereas a little less than one-tenth of the respondents perceived it as less beneficial. Almost 60% of the respondents were undecided about the influence of the irrigation service on the environment as a whole. Additionally, almost 40% of the respondents agreed or strongly agreed that the irrigation service restored water balance in the environment while 5% disagreed on the same. About 55% of the respondents' farmers were undecided about the same.

Table 4.2.22: Perception about the benefits on environment

Response	Irrigtion service is benefical or environemnt (%)	Irrigation Service restores water balance in the environment (%)
Strongly disagree	0.70	2.50
Disagree	7.70	3.20
Undecided	59.20	54.70
Agree	31.10	37.80
Strongly agree	1.20	1.70

Table 4.2.23 collates the responses about the reduction in power and labour used for irrigation & farming. Half of the respondents perceived that there was high or very high reduction in power

used for irrigating the fields. Less than 4% of the respondents reported low reduction in power and about 47% of them reported no change in power reduction for irrigation. Almost 47% of the respondents perceived a high or very high reduction in labour used for farming whereas only about 6% reported low reduction in total labour used. A little less than half of the farmers perceived no change in the overall labour used for farming

Table 4.2.23: Perception about the reduction in power and labour		
Response	**Reduction in Power used for irrigation the fields (%)**	**Reduction in total labour used for farming (%)**
Very low	1.10	0.00
Low	2.20	5.90
No change	46.10	47.60
High	42.80	36.20
Very High	7.90	10.30

Table 4.2.24 shows the responses about crop specificity of the success of the irrigation service. Less than 2% of the respondents perceived that irrigation service was successful or very successful for only a few specific crops. Almost 65% were undecided about the crop specificity of the irrigation service. One-third of the respondents believed irrigation service was not crop specific and could be used for irrigating a wide variety of crops.

Table 4.2.24: Perception about the crops for the irrigation service	
Response	**Irrigation Service is successful for only few crops (%)**
Strongly agree	1.70
Agree	0.20
Undecided	64.90
Disagree	32.10
Strongly disagree	1.00

Table 4.2.25 shows the perception about parity among farmer users of the irrigation service. 30% of the respondents perceived that irrigation services led to a high to very high improvement of parity among the users. About two-thirds of the respondents observed no change in parity.

Table 4.2.25: Perception about parity among users of the irrigation service	
Response	**Irrigation service improves equality (%)**
Very low improvement	0.00
Low improvement	2.00
No change	65.40
High improvement	29.90
Very high improvement	2.70

Table 4.2.26 presents the perception of the overall sampled farmers about the productivity benefits with the adoption of irrigation service. About 44% of the respondents responded that using the irrigation service resulted in more yields. A little more than half of the respondents had a moderate response for the same.

Table 4.2.26 Perception about the benefits on yield

Response	Irrigation service gives more yields (%)
Very low	0.00
Low	4.20
Medium	52.20
High Very	34.40
high	9.20

Table 4.2.27 shows responses about quality and timeliness of after sales service. Almost half of the respondents considered that after sales service available were good and another 45 % considered them average. A little more than 40% of the respondents observed that after sales service was available on due time. However, almost 57% considered the on-time availability of after sales services as moderate.

Table 4.2.27: Perception about the after sales services for the irrigation service		
Response	**Good after sales service available (%)**	**Timely after sales service available (%)**
Very poor	0.00	1.50
Poor	6.40	1.00
Average	45.20	56.50
Good	42.80	38.60
Very good	5.70	2.50

Table 4.2.28 shows the responses about the benefits to overall farming. A little more than three-fifths of the respondents observed that the irrigation service was highly beneficial to farming. Apart from this more than one third of the respondents reported only moderate benefits to farming.

Table 4.2.28: Perception about the benefits on farming	
Response	**It is beneficial to farming (%)**
Very low	0.70
Low	0.00
Medium	36.40
High	52.40
Very high	10.50

Table 4.2.29 depicts the responses about various aspects of farming. A little more than one third of the respondents observed a high to very high reduction in weeds during farming with the irrigation service. Almost two third of the respondents observed a moderate reduction in weeds. A little over 36% of the respondents reported high to very high reduction in difficulties faced by farmers due to the adoption of the irrigation service. A little more than three-fifths of the respondents reported a moderate reduction in hassles in farming. Only about 2 % of the farmer-respondents reported against reduction in hassles in farming due to the adoption of irrigation service.

On being asked about fertilizer consumption in farming with the irrigation service, about 46% of the respondents observed high to very high reduction in the fertilizer usage. And a little less than half of the respondents responded a medium reduction. In response to the question on improvement in produce quality due to use of irrigation service, about 39% of the respondents observed high or very high improvement whereas 55% of the respondents reported a medium improvement in produce quality.

Table 4.2.29: Percption about the benefits on farming

Response	Reduction in weeds during faring (%)	Reduction in hassles in farming (%)	Reduction in the fertilizer used in farming	Improvement in produce quality (%)
Very low	0.00	0.70	0.70	1.80
Low	4.20	1.50	4.60	5.00
Medium	58.10	61.60	48.50	54.40
High	30.30	28.70	39.30	31.40
Very High	7.50	7.50	7.00	7.50

Table 4.2.30 depicts the responses about the benefits on land and soil by using the irrigation service. A little less than 50% of the respondents perceived that it was highly beneficial o beneficial for soil quality whereas another half of the respondents reported moderate benefits to soil quality.

Table 4.2.30: Perception about the benefits on land

Response	It is beneficial for soil quality (%)	Irrigation Service is suitable to all terrains (%)	Irrigation Service is successful in any soil quality (%)
Very low	0.00	0.50	2.70
Low	1.50	1.70	2.50
Medium	51.50	60.40	65.40
High	37.50	35.30	28.40
Very high	9.40	2.00	1.00

Farmers responded whether irrigation service was suitable to all terrains or not. About 37% of them reported the irrigation service to be highly suitable to all terrains. Almost 60% of the respondents perceived the suitability across terrains to be moderate.

A mere 3% considered irrigation services to be terrain specific. It is observed that a little less than one- third of the respondents' success of the irrigation service was not soil specific and almost two-third of the respondents considered moderate success across all soil types.

Table 4.2.31 shows the perception of farmers about the benefits on various aspects of water usage due to the adoption of the irrigation service. The farmers were enquired about the benefits in water availability due to the irrigation service. Almost 45% of the respondents observed it to be highly beneficial whereas half of the respondents reported moderate benefits in water availability

In response to an enquiry about the impact on water quality, one fourth or almost 25% of the respondents perceived that irrigation service was highly beneficial whereas about 73% recorded a moderate response for the same. A little less than 50% of the respondents observed a high reduction in water quantity used for irrigation service. About 48% of them perceived no change or moderate reduction. A little less than 5% of the respondents observed a low reduction or even an increase in water quantity used for irrigation.

Table 4.2.31: Perception about the benefits of water			
Response	**It is beneficial for water availability (%)**	**It is beneficial for water quality (%)**	**Reduction in water quantity used for irrigation (%)**
Very low	0.70	0.00	3.30
Low	2.60	1.70	1.50
Medium	50.90	73.40	47.80
High	43.00	22.90	39.70
Very High	2.90	2.00	7.70

There is no one benefit that overwhelmingly beenfits all adopting farmers or is perceived by farmers and there are multiple benefits arimed at either reducing cost or at increasing th prodcutivity by enabling better agricultural practices. Also it signifies that there is no single formula for success of entrepreneurs vis-à-vis benefits offered and they have to invest in market research to devise a combination of benefits that justifies the adoption to farmers. Policy therefore had to provide entrepreneurs some free hand in experimenting in order to discover this winning combination.

The irrigation entrepreneurs are working on business models based on either irrigation as a leading input or as a productivity enhancer based on the theory of constraints (ToC). However both of these are theoretically old and will only result in incremental benefits overtime whereas disruptive improvements are needed in the times to come. Policies are needed to promote entrepreneurs and enterprises that are disruptive and their innovation can propel growth of a farm, the farmer as well as farming as a sector and an occupation too. Policy can goa long way in enabling the desired change.

4.3 The Impact of the Private Irrigation Service

Table 4.3.1 presents responses about the impact of irrigation on water availability and its usage. It could be observed that about 85% of the responses were positive for timely accessibility of water whereas about 13% responses observed no impact. 60% of the respondents were positive or very positive about water availability being adequate for the farms post the adoption of the irrigation services whereas 36% of the respondents observed no effect. Moreover, a little less than 40% of the respondents were positive about the impact of the irrigation service on efficiency of water usage. However; about 61% of the respondents responded no impact for the same. The beenfits in water are timeliness and adequatenes and efficiency in order of perception by farmers.

Table 4.3.1: Impact of the irrigation service on the water situation			
Status	**Timely water availability (%)**	**Adequate water availability (%)**	**Efficiency of water use (%)**
Highly negative	0.00	0.00	0.00
Negative	0.50	3.00	0.00
No impact	13.40	36.10	61.20
Positive	84.30	59.20	35.30
Highly positive	1.70	1.70	3.50

Table 4.3.2 presents the responses about the impact of the irrigation service on the income and investments of the farmers. About 31% or almost one-third of the users observed a positive impact on income due to irrigation service whereas almost 70% of them did not report any impact on their income. Also, it was observed that 34% of the users responded positively or highly positively about the impact on assurance of income due to the adoption of irrigation service. However, two-third of the respondents responded to no impact on the same. While about 40% of the respondents responded positive or highly positive about the increase in their savings and investments post adoption of the irrigation service. At the same time about 57% of the farmers perceived no impact on savings and investment and a negligible 2.5% reported a negative impact.

Table 4.3.2: Impact of the irrigation service on the income and investments of the user			
Status	**Increased income (%)**	**Assured income (%)**	**Increase in savings and investment (%)**
Highly negative	0.00	0.00	0.00
Negative	0.00	0.00	2.40
No impact	69.10	66.00	56.80
Positive	24.80	28.70	38.20
Highly positive	6.10	5.30	2.60

The results show that farmers prefer savings benefits followed by assurance of income benefits and only one third prefer increased income benefits singifying that more enterprises are delivering on cost reduction than an increase in income.

Table 4.3.3 presents the impact of the irrigation service on the area cropped and cultivated. The survey results reports 41% of the respondents reported that the cropped area has increased significantly while 57% responded no impact. A little more than half of the farmers reported

the irrigated area had been increased and had a positive impact due to the adoption of the irrigation service. On the other hand, about 47% reported no impact with regards to expanding irrigated area. More farmers report increase in cropped area and irrigated area than reporting increased income singifying that more enterprises are working on the Theory of Constraints (ToC).

Table 4.3.3: Impact of the irrigation service on the cultivable area		
Status	**Expanding cropped area (%)**	**Expanding irrigated area (%)**
Highly negative	**0.00**	**0.00**
Negative	**1.80**	**0.00**
No impact	**57.20**	**47.40**
Positive	**38.20**	**50.70**
Highly positive	**2.90**	**2.00**

Table 4.3.4 shows the status of respondents about the impact of irrigation service on the crops. It could be observed that almost 50% of the respondents agreed to a positive or to a highly positive shift in the varieties of crops whereas other half of the respondents reported no impact but not a negative impact. In addition to this, almost three-fifths half of the respondents reported a positive impact on equitable distribution of water due to the irrigation service on the crops. However, the other 43% did not observe any impact.

Table 4.3.4: Impact of the irrigation service on the crops		
Status	**Shift in varieties of crops (%)**	**Equitable distribution of water (%)**
Highly negative	**0.00**	**0.00**
Negative	**0.00**	**0.00**
No impact	**50.40**	**43.20**
Positive	**45.20**	**50.20**
Highly positive	**4.40**	**6.60**

The table 4.3.5 collates the responses pertaining to diversification and consistent growth of cropping. It can be observed that about 43% of the respondents were positive or highly positive about impact of the irrigation service on the diversification of the cropping pattern. However, a little less than 60% of the farmers saw no impact. One third of the respondents were positive or highly positive about the consistency of crop growth. However, another two-thirds of users had no impact regarding consistency in crop growth due to irrigation service.

Table 4.3.5: Impact of the irrigation service on the crops		
Status	**Increased area under high value crops (%)**	**Increased area under less water using crops (%)**
Highly negative	**0.00**	**0.00**
Negative	**0.00**	**0.90**
No impact	**57.90**	**57.90**
Positive	**35.70**	**36.80**
Highly positive	**6.40**	**4.40**

Table 4.3.6 presents the survey-responses of impact of the irrigation services on increasing the productivity of crops. About 42% responded that land area should be increased under high value crops whereas close to 58% did not report any impact of the irrigation service on the area under high value crops. The next column enunciates that approximately 42% observed an increase in area under less water intensive crops whereas close to 58% observed no impact for the same.

Table 4.3.6: Impact of the irrigation service on the crops		
Status	**Increased area under high value crops (%)**	**Increased area under less water using crops (%)**
Highly negative	0.00	0.00
Negative	0.00	0.90
No impact	57.90	57.90
Positive	35.70	36.80
Highly positive	6.40	4.40

Table 4.3.7 shows the perception of the respondents about the impact of irrigation service on water usage in the village in general. The table shows that a little less than 40% of the respondents reported positive or highly positive impact in avoiding the misuse of water used for irrigation whereas close to 60% of the respondents reported no impact.

The next column depicts the responses related to resolution of disputes for water in the village. About 40% of the respondents reported a positive or very positive influence on resolution of disputes pertaining to irrigation. However, a little less than 60% could not see any impact on resolution of disputes related to irrigation water.

Table 4.3.7: Impact of the irrigation service on water profile of the village		
Status	**Misue / abuse of water (%)**	**Resolution of disputes (%)**
Highly negative	**0.00**	**0.00**
Negative	**3.30**	**3.10**
No impact	**58.30**	**56.80**

Positive	**33.80**	**36.00**
Highly positive	**4.60**	**4.20**

Table 4.3.8 collates the responses towards water situation in the village including the water table. One third of the respondents reported a positive change in water table since the adoption of the irrigation services whereas two third of the respondents showed no impact for the same. At the same time a negligible 2.50% responded a negative or highly negative influence on the water table since the adoption of the irrigation services. The next column tabulates the responses about the overall water situation in the village. It was observed that almost 40% of the respondents reported a positive impact on the overall water situation in the village due to the adoption of the irrigation services.

Table 4.3.8: Impact of the irrigation service on water profile of the village

Status	Water table increase (%)	Overall water situation in the village (%)
Highly negative	**0.70**	**0.00**
Negative	**1.80**	**2.20**
No impact	**62.10**	**58.60**
Positive	**33.20**	**37.70**
Highly positive	**1.80**	**1.50**

Table 4.3.9 presents the responses about impact of the irrigation service on the maintenance and costs. A little more than one third of the respondents were positive or highly positive about better maintenance of irrigation structures whereas almost three-fifths of the farmers indicated no effect of the same. The next column shows that almost 45% of them were positive or highly positive about having experienced reduction in the price of irrigation water. The remainder 55% of the respondents observed no impact on the costs of the irrigation water.

Table 4.3.9: Impact of the irrigation service on the maintenance and costs

Status	Better maintenance of irrigation structures (%)	Lower prices / cost of water (%)
Highly negative	**0.00**	**0.70**
Negative	**3.30**	**3.30**
No impact	**59.40**	**52.90**
Positive	**35.50**	**39.70**
Highly positive	**1.80**	**3.50**

Table 4.3.10 shows the responses of the farmers about the impact of the irrigation services on various cost factors. Altogether, about 42 to 45% of the respondents responded positive or

highly positive to reduction of costs fertilizers, pesticides, harvesting and the overall cost of farming. However, the other half of the respondents reported no impact on costs listed earlier.

Table 4.3.10: Impact of the irrigation service on various costs

Status	Cost of Fertilizers (%)	Cost of pesticides (%)	Cost of harvesting (%)	Cost of farming (%)
Highly negative	0.00	0.00	0.00	0.00
Negative	1.80	3.70	4.60	1.50
No impact	55.30	53.70	53.50	52.60
Positive	41.40	42.30	40.10	44.50
Highly positive	1.50	0.20	1.80	1.30

Table 4.3.11 presents farmers' responses about the impact of the irrigation service on the produce with respect to its quality consistency, better market prices and for their own consumption. Almost two-fifths of the farmer respondents indicated a positive or highly positive influence of the irrigation service on the consistency of produce quality. However a little less than 60% of the farmers failed to see any such influence. Further, 38.20% farmers observed that they were able to get better market prices for the produce post adoption of the irrigation service whereas 57% of the farmers failed to see such an impact and reported no impact. Also, a little over one-third of the respondents reported a positive influence on quality of produce for their own consumption due to the irrigation service adoption. However, two-third of the farmers reported no such impact.

Table 4.3.11: Impact of the irrigation service on the produce

Status	Consistency of produce quality (%)	Better market prices for the produce (%)	Better quality produce for own consumption as well (%)
Highly negative	0.70	2.00	0.00
Negative	3.30	2.90	4.20
No impact	58.60	57.00	60.50
Positive	34.0	38.20	34.90
Highly positive	3.50	0.00	0.40

Table 4.3.12 collates the responses to the impact of the irrigation service on the community and individual status. A little less than of 30% of the respondents responded positive or very positive having better market power while dealing with the traders post the adoption of the irrigation service. Little less than 10% respondents reported a negative impact on the same. However, more than 63% farmers did not see any impact.

About one-fourth of the respondents had a positive response regarding better individual social status within the community due to the adoption of irrigation service. However, a majority of

75% of the respondents had no effect or comparatively negative response regarding improved social status.

Table 4.3.12: Impact of the irrigation service on the community and individual status		
Status	**Better market power when dealing with traders (%)**	**Better social status (%)**
Highly negative	0.00	0.00
Negative	8.10	5.90
No impact	63.20	68.60
Positive	28.70	24.30
Highly positive	0.00	1.10

Table 4.3.13 shows the overall responses about the assessment of the improvement in the irrigation service as a binary yes or no response. Almost all of the survey respondents assessed that irrigation services had improved.

Table 4.3.13: The irrigation service has improved	
Response	**(%)**
No	0.90
Yes	99.10

Table 4.3.14 shows the farmers responses if the irrigation service had helped them to achieve their desired goals. Almost 70% of the respondents were satisfied or highly satisfied that the irrigation services helped them to succeed in their intended goals. A little less than one-third of the respondents were undecided about the same.

Table 4.3.14. The irrigation service has helped to achieve the wanted goals	
Response	**(%)**
Highly dissatisfied	0.00
Dissatisfied	0.70
Undecided	31.60
Satisfied	60.50
Highly satisfied	7.20

Table 4.3.15 shows the responses whether irrigation service led to increased control in managing irrigation. 39% of the farmer respondents agreed or strongly agreed that irrigation service led to greater control of irrigation. However, three-fifth of the respondents were undecided for the same.

Table 4.3.15. Irrigation Service leads to greater control to manage the irrigation	
Response	**(%)**
Strongly disagree	0.20
Disagree	0.70
Undecided	60.10
Agree	34.20
Strongly agree	4.80

Table 4.3.16 collates the farmers' responses to the influence of irrigation service on their income. A little less than one-third of the respondents agreed or strongly agreed that their income increased due to the irrigation service. At the same time, almost 70% of the respondents could not decide if the irrigation service influenced their income or not.

Table 4.3.16 The irrigation service has helped in increasing the income	
Response	**(%)**
Strongly disagree	0.00
Disagree	2.40
Undecided	69.70
Agree	25.00
Strongly agree	2.90

Table 4.3.17 shows the farmers responses if the irrigation service had met their varied irrigation needs. Nearly 30% of the respondents agreed or strongly agreed that irrigation service had met their varied irrigation needs successfully. Only about 2% did not agree and the rest almost 70% of the respondents were not sure of the effectiveness of the irrigation services on this parameter.

Table 4.3.17. Irrigation service has met the varied irrigation needs successfully	
Response	**(%)**
Strongly disagree	0.00
Disagree	2.00
Undecided	69.30
Agree	26.30
Strongly agree	2.40

Table 4.3.18 collates the responses from farmers about the success of irrigation service. Three-fourths of the respondents perceived the irrigation service to be successful or very successful.

Almost 20% of the respondents considered it to be at satisfactory level whereas about five percent responded that the irrigation service was poor or very poor in terms of its success.

Table 4.3.18: Assessment about the success of the irrigation service	
Response	**(%)**
Very poor	4.20
Poor	0.90
Satisfactory	19.70
Successful	47.80
Very successful	27.40

Table 4.3.19 gives an overview of the survey responses about the financial proposition assessment of the irrigation service without and with subsidy. Almost 38% of the respondents assessed the service strongly or very strongly in financial terms considering the irrigation service to be adopted without subsidy. Additionally, about 42% of the survey respondents responded an average assessment of the irrigation service without subsidy.

At the same time, almost half of the respondents assessed the irrigation service with subsidy as strong or very strong in the same financial terms whereas almost 50% of the respondents reported an average assessment of the irrigation service with subsidy in terms of financial proposition. Those who assessed the service as poor or very poor without subsidy were more than 21% but the proposition went down to only 2.2% for the assessment of services with subsidy. This signifies that there is still a segment that requires subsidy as an incentive for adoption but the subsidies need to be smart and targetted at only the needy farmer segment.

Response	**Assessment about the financial proposition of irrigation service without subsidy (%)**	**Assessment about the financial proposition of irrigation service with subsidy (%)**
Very poor	13.40	1.80
Poor	7.70	0.40
Satisfactory	41.40	48.90
Strong	29.80	35.10
Very Strong	7.70	13.80

Table 4.3.20 shows the responses in regards to the status of adaptiveness in agriculture with the irrigation service. Almost 70% of the respondents assessed agriculture to be adaptive or very adaptive with the irrigation service availed. About 30% of them could not decide about

the same whereas a negligible 1.3% of the respondents considered agriculture to be rigid or very inflexible due to the irrigation service availed. This is by far the biggest benefit that has accrued to farmers as per their responses.

Table 4.3.20: Assessment about the adaptiveness in agriculture with the irrigation Service

Status	(%)
Very rigid	0.00
Rigid	1.30
Cannot decide	29.20
Adaptive	58.60
Very adaptive	11.00

Table 4.3.21 collates the responses from farmers about the assessment of irrigation service in enabling agriculture with limited resources. Between 29 to 43% of the respondents hold a strong or very strong view for the assessment of irrigation service in enabling agriculture with limited water (29%), power(43%), labour(38%) and financial availability(34%). Additionally almost 50 to 60% of the respondents have had a satisfactory experience of the irrigation service facilitating agriculture within limited resources available.

Table 4.3.21: Assessment of the irrigation service in enabling agriculture with limited resources

Response	With limited water availability (%)	With limited power availability (%)	With limited labour availability (%)	With limited financial availability
Very poor	**3.10**	**1.10**	**1.50**	**2.40**
Poor	**7.20**	**5.30**	**2.40**	**7.50**
Satisfactory	**60.70**	**50.20**	**58.10**	**55.70**
Strong	**25.70**	**35.50**	**33.30**	**32.70**
Very strong	**3.30**	**7.90**	**4.60**	**1.80**

Table 4.3.22 shows responses about the increased number of crops every year due to the irrigation service. 39% of the respondents observed high or very high increment in the number of crops per year. A little more than half of the respondents considered a moderate increase in the number of crops. A little less than one-tenth observed the increment to be very less or negligible.

Table 4.3.22 Increase in crops every year due to irrigation services

Response	Increased number of crops per year (%)
Very low	**0.00**
Low	**9.00**
Medium	**52.00**
High	**34.00**
Very High	**5.00**

Table 4.3.23 shows the responses for the increase in total quantity produced due to use of irrigation services for farming. Almost 40 % of the respondents' reported a high or very high increment in the total quantity produced. A little more than half of the respondents observed a moderate increment whereas a little less than 6% of the respondents reported a reduction in the total quantity produced.

Table 4.3.23 Increase in total quantity produce due to irrigation service	
Response	**Increase in total quantity produced (%)**
High reduction	0.40
Reduction	5.00
Medium	54.80
Increase	32.90
High increase	6.80

4.4 Institutional aspects concerned with the irrigation service

Table 4.4.1 shows the responses for the benefits through irrigation institution. More than 60% of the respondents agreed that irrigation institution had brought benefits. However, almost all of the remaining nearly 40% respondents were unsure of the benefits brought by irrigation institutions. Institutions are therefore an important enabling component for success of entrepreneurial irrigation services.

Table 4.4.1: Irrigation institution has brought benefits	
Response	**(%)**
Strongly disagree	0.00
Disagree	0.20
Undecided	38.20
Agree	55.10
Strongly agree	6.50

Table 4.4.2 presents their responses about the water measurement system. A little less than 60% of the respondents agreed that water measurement system was good whereas about 43% of the respondents were undecided about their experience.

Table 4.4.2: The water measurement system is good	
Response	**(%)**
Strongly disagree	0.00
Disagree	0.00
Undecided	43.30
Agree	51.30
Strongly agree	5.30

Table 4.4.3 shows the responses about the fairness of water distribution. Almost two-third of the respondents agreed that the water distribution system was fair to them. A little about two-thirds of the respondents were undecided and not even a single respondent reported a negative rating on fairness of water distribution. Fairness in water distribution appears to be a qualitfies and not a a clincher for irriation enterpreneurs. This is a very important result from the point of view of existing but struggling irrigation entrepreneurs.

Table 4.4.3: The water distribution is fair to you compared to other farmers	
Response	**(%)**
Strongly disagree	0.00
Disagree	0.00
Undecided	36.00
Agree	61.30
Strongly agree	2.70

Table 4.4.4 presents the overall response to the experience with the irrigation management system. A little less than 45 % of the surveyed farmers were satisfied or highly satisfied with the current irrigation management system. However, a large percentage of about 56% of the respondents were indifferent about their experience. This prompted the query if they would be willing to experiment with a different irrigation service.

Table 4.4.4: Satisfaction with the current irrigation management system	
Response	**(%)**
Very bad	0.00
Bad	0.20
Undecided	56.40
Good	42.00
Very good	1.30

Table 4.4.5 shows the responses about their willingness to experiment with a different irrigation management system. Almost 40% of the respondents were willing to experiment with a different water management service. However, the remaining almost three-fifths were not so sure and it seems that there is a lot of scope of innovation as well as newer and better irrigation services. Hence there is a lot of scope for entry of new irrigation entrepreneurs in the future as well.

Table 4.4.5: Willingness to experiment with a different water management service	
Response	**(%)**
Very bad	0.20
Bad	0.70
Undecided	59.30

Good	35.10
Very good	4.70

Table 4.4.6 shows the responses of the farmers to the query if the new institutional arrangement was different from the previous one. A little less than 40% of the respondents agreed or strongly agreed that the new institutional arrangement was different from the old one while, remainder of the respondents were undecided about the same.

Table 4.4.6: The new institutional arrangement is different from the old one	
Response	**(%)**
Strongly disagree	0.00
Disagree	0.00
Undecided	62.70
Agree	31.30
Strongly agree	6.00

These results tend to imply that there is a lot of scope in formulating new irrigation services and enterprises can be supported in various ways to enable them in formulating services for success that increse satisfaction level of user-farmers.

Tables 4.4.7 and 4.4.8 collate the sampled farmers' responses about their experience with the rules and policies of the participating institutions. Table 4.4.7 presents that a little less than 40% of the respondents agreed or strongly agreed any member could request for an exception based on their need. However, almost 60% of the respondents were undecided about the exception policies or rules of the institutions. A minor 2.30% also disagreed that a member had such privileges or such an option existed.

Table 4.4.7: Any member can request for an exception / special consideration rules based on need	
Response	**(%)**
Strongly disagree	0.00
Disagree	2.30
Undecided	58.60
Agree	35.00
Strongly agree	4.10

Table 4.4.8 collates the responses to the existence of separate rules or policies for dealing with special considerations. One- third of the respondents agreed or strongly agreed that such rules and policies exist in order to deal with special requests. However, two-thirds of the respondents were undecided about the same.

Table 4.4.8: Separate rules and policies exist to deal with requests for special considerations	
Response	**(%)**
Strongly disagree	0.00

Disagree	0.00
Undecided	66.40
Agree	31.40
Strongly agree	2.30

Table 4.4.9 shows the responses if a farmer member is allowed to suggest changes in the policies and rules. A little less than half of the respondents agreed or strongly agreed that such provisions existed whereas slightly more than half were undecided for the same.

Table 4.4.9: Any member can suggest changes in the policies and rules	
Response	**(%)**
Strongly disagree	0.00
Disagree	0.00
Undecided	52.70
Agree	42.70
Strongly agree	4.70

From table 4.4.10 it is observed that almost 40% of the respondents agreed that the existing policies and rules of the institution could be changed with ease whereas, almost 60% of the respondents were undecided about the same. A mere 1.30% disagreed that existing rules and policies could be changed with ease.

Table 4.4.10: The existing policies and rules of the institution can be changed with ease	
Response	**(%)**
Strongly disagree	0.00
Disagree	1.30
Undecided	59.30
Agree	35.00
Strongly agree	4.30

Table 4.4.11 collates the responses about the fairness of the rules and policies of the institution to the members. Almost 45% of the respondents agreed that the institutional rules and policies were fair or very fair and just for all. More than half of respondents rated the rules and policies only mildly fair whereas 1.10% rated them unfair. This indicates huge scope for innovations and management input to make the institutions and enterprises fairer.

Table 4.4.11: The rules and policies of the institution are fair and just to all	
Response	**(%)**
Very unfair	0.00
Unfair	1.10
Somewhat fair	56.40
Fair	39.10
Very fair	5.20

From table 4.4.12 it is seen that 54% of the respondents agreed or strongly agreed that there was no interference from any external or internal entity in determining the rules and policies of the institution. However, about 46% of the respondents were undecided of their response on the same.

Table 4.4.12: There is no interference in determining the rules and policies	
Response	**(%)**
Strongly disagree	0.00
Disagree	0.30
Undecided	45.70
Agree	53.00
Strongly agree	1.00

From table 4.4.13 it is observed that almost 40% of the respondents agreed that a very good understanding exists between the village level and higher institutions. At the same time, almost 60% did not were not sure about the same.

Table 4.4.13: A very good understanding exists between the village level institutions and higher institutions/ authorities	
Response	**(%)**
Strongly disagree	0.00
Disagree	1.80
Undecided	58.90
Agree	35.30
Strongly agree	4.00

Table 4.4.14 collates the farmers' responses of the ability of the management committee to enforce compliance to the rules. A little more than half of the respondents agreed that the management committee made users to comply with the rules whereas slightly less than half were undecided on the compliance aspect.

Table 4.4.14: The management committee makes users comply to rules	
Response	**(%)**
Strongly disagree	0.00
Disagree	0.30
Undecided	46.00
Agree	46.00
Strongly agree	7.60

Table 4.4.15 collates the responses with regards to the ease of changing the management committee. It could be observed that 50% of the respondents agreed or strongly agreed to the statement that management committee could be changed easily whereas the other half of the respondents were undecided about the same.

Table 4.4.15: The management committee can be changed easily	
Response	**(%)**
Strongly disagree	0.00
Disagree	0.00
Undecided	49.30
Agree	47.00
Strongly agree	3.70

From table 4.4.16 it could be deduced that about 45% of the farmers agreed that the objectives of the institution were decided by management committee independently. However, more than 54% of the farmers' respondents were undecided about the same.

Table 4.4.16: Management committee independently decides the objectives of the institution	
Response	**(%)**
Strongly disagree	0.00
Disagree	0.00
Undecided	54.30
Agree	40.00
Strongly agree	5.70

Table 4.4.17 shows the responses of farmers' participation in decisions taken by the institutions. Almost three-fourth of the respondents agreed that their interest and opinion was well taken into account for considering important decisions whereas a little more than one fourth of the respondents were not sure.

Table 4.4.17: Farmer's interest and opinion is well taken into account in important decisions	
Response	**(%)**
Strongly disagree	0.00
Disagree	0.40
Undecided	26.10
Agree	51.00
Strongly agree	22.50

From Table 4.4.18 it is observed that a little less than 45% of the respondents agreed that farmers were involved in deciding the price for irrigation service but the remaining were undecided about the same.

Table 4.4.18: Farmers participate in deciding the price of water	
Response	**(%)**
Strongly disagree	0.00
Disagree	0.30
Undecided	56.70
Agree	41.00
Strongly agree	2.00

From table 4.4.19 it is observed that 45% of the respondents agreed or strongly agreed that the individual entrepreneurs did not play an active role in the institution whereas close to 54% of them were undecided. This indicates that the institutions are self-governing despite being a part of the enterprise and the individual entrepreneur does not need to interfere in their day to day functioning.

Table 4.4.19: The private entrepreneur does not play an active role in the institution	
Response	**(%)**
Strongly disagree	0.00
Disagree	0.70
Undecided	53.30
Agree	43.00
Strongly agree	3.00

From table 4.4.20 it is observed that almost 45% of the respondents agreed that members from all the castes and classes had actively participated in meetings of the institutions whereas more than half were undecided about the same and a mere 1% disagreed that members of all castes and classes actively participated in the meetings.

Table 4.4.20: Members of all castes and classes actively participate in meetings	
Response	**(%)**
Strongly disagree	0.00
Disagree	1.00
Undecided	54.50
Agree	42.20
Strongly agree	2.30

Table 4.4.21 shows the responses about the decision making processes and related governance in the institutions. Almost 45% of the respondents agreed or strongly agreed that suggestions were welcomed from all members. More than half of the respondents were undecided about the same. 40% of the respondents agreed that they had the option to question or challenge the management's decision. However, 60% of the members were undecided on this aspect. When enquired about flexibility in decision making a little more than 45% of the respondents agreed that decision making was flexible whereas; about 53% of the members were undecided of their response on this aspect.

Table 4.4.21: Experience about the decision making process in the institution			
Response	**Decision making is open to suggestions from all members (%)**	**Decisions of the management can be challenged or questioned by any member (%)**	**Decision making is flexible (%)**
Strongly disagree	0.00	0.00	0.00
Disagree	0.00	0.00	0.00
Undecided	55.10	59.70	53.10
Agree	42.70	37.00	42.0
Strongly agree	2.30	3.30	4.50

Table 4.4.22 depicts the responses about the flexibility of the institutions in dealing with special situations. About 45% of the respondents agreed or strongly agreed that existing processes of the institutions could deal appropriately with special cases and situations as and when the need arose. At the same time, about 54% of the respondents were undecided for the same and only less than 1% disagreed or strongly disagreed with the same.

Table 4.4.22: Existing processes can deal (adjust) with special cases and situations	
Response	**(%)**
Strongly disagree	0.20
Disagree	0.40
Undecided	53.70
Agree	42.00
Strongly agree	3.60

Table 4.4.23 presents the responses to the ability of the institutions to respond quickly to new situations as and when needed and to take up new activities. As seen from the table more than one-third of the respondents agreed or strongly agreed that the institution was capable enough to respond quickly to a new situation. Two-thirds of the respondents were undecided if the institution had this capability. Moreover, a little over 30% of the respondents agreed or strongly agreed that the institution was capable of taking up new activities. However, almost two-thirds of the respondent were undecided of their response for the same.

Table 4.4.23: The ability of the institutions to respond quickly and take up new activities as and when needed

Response	The institution is capable of responding quickly to a new situation (%)	The institution is capable of taking up, with ease, new activities that it has never performed before (%)
Strongly disagree	0.00	0.00
Disagree	0.00	0.00
Undecided	63.30	67.80
Agree	33.60	29.70
Strongly agree	3.10	2.50

4.5 Suggestions for the improvement of Private Irrigation Service

Tables 4.5.1 collate the farmers responses on suggestions provided for improving the adoption of irrigation service. A little more than 80% of the survey respondents desired the involvement of the more technical persons for the irrigation service. However, a little less than 20% farmers considered the current involvement of technical personnel as satisfactory.

A little more than half of the respondents considered that it was good or very good to seekbetter coordination between the government and private entrepreneurs for improving the irrigation services. However, a little less than half of the farmers considered the current coordination level between government and private entrepreneurs as satisfactory.

Policy should clearly ensure and incentivize the involvement of more technical personnel and devcise wasy for better coordination between government and private entrepreneurs.

Table 4.5.1: Suggestions for the entrepreneur and the irrigation service		
Response	**The involvement of more technical persons is required (%)**	**Better coordination between the government and private entrepreneur/s (%)**
Very bad	0.00	0.00
Bad	2.00	1.30
Average	16.90	46.10
Good	66.70	45.40
Very good	14.40	7.20

From table 4.5.2 it is observed that a little less than half of the respondents thought that the suggestion for dealers to play a better role as a good or o very good suggestion. The remainder of the respondents considered the suggestion as satisfactory. A little less than half of farmers rated the suggestion for company salespersons to play a better role in aiding adoption of the irrigation service as good or very good whereas the other half considered it as an average suggestion.

Table 4.5.2: Suggestions for the entrepreneur and the irrigation service		
Response	**Dealers can play a better role in aiding adoption (%)**	**Company salespersons can play a better role in aiding adoption (%)**
Very bad	0.00	0.00
Bad	0.00	0.90
Average	51.70	50.00
Good	40.40	42.30
Very good	7.90	6.80

Table 4.5.3 collates the responses from farmers with regards to suggestions on economic issues and crop advice for the irrigation service. 59% of the respondents responded that it would be good if more economic issues were discussed with farmers prior to adoption of the irrigation service. Whereas 41% of the respondents considered that it was an average suggestion to discuss more economic issues prior to the adoption of the service. Moreover almost 45% of the respondents considered it as a good suggestion that a better crop advice be made available in order to aid the spread and adoption. However, the remaining more than half of the respondents observed it to be an average suggestion only. Policy can be formulated to incentivise more eocnomic discussions before adoption.

Table 4.5.3: Suggestions for the entrepreneur and the irrigation service		
Response	**More economic issues to be discussed with farmers prior to adoption (%)**	**Better crop advice can help the spread and adoption (%)**
Very bad	0.00	0.00
Bad	0.00	0.00
Average	41.00	55.30
Good	46.10	36.60
Very good	12.90	8.10

From Table 4.5.4 it is observed that about 42% of the respondents rated the suggestion of expanding water usage for other purposes apart from irrigation as good or very good whereas almost all of the remaining 58% of the respondents considered this suggestion to be average.

Table 4.5.4: Suggestion of expanding water usage other than irrigation service	
Response	**Expand to include water uses other than irrigation (%)**
Very bad	0.00
Bad	0.70
Average	57.20
Good	33.30
Very good	8.80

From table 4.5.5 we find that a little more than 70% of the respondents considered that it as a good or very good suggestion that more technical issue be discussed prior to adoption of the irrigation service whereas about 28% of the respondents observed this to be an average suggestion. Almost half of the respondents rated the time taken for installation to be good or very good. Another half thought that the time taken for installation from time of showing interest as average whereas only 2% reported it as poor or very poor.

Table 4.5.5: Suggestions for the entrepreneur and the irrigation service		
Response	**More technical issues to be discussed prior to adoption (%)**	**Time taken for installation from time of showing interest was long (%)**
Very bad	0.00	0.90
Bad	1.80	1.10
Average	26.10	52.20
Good	64.30	38.60
Very good	7.90	7.20

Table 4.5.6 shows the responses about the suggestions related to community institutions for improving the irrigation services. It is observed that a little less than 50% of the farmers suggested that it was good or very good for community institutions to play a better role in

aiding adoption of the irrigation service while the remainder almost 54% of the respondents rated this as an average advice. It is observed that a little more than 50% of the farmers responded that it would be good or very good if panchayats and bank officials or financial institutions could play a better role in aiding adoption. The other half of the respondents considered it as an average response.

Table 4.5.6: Suggestions for the community institutions

Response	Community institutions can play a better role in aiding adoption (%)	Panchayats can play a better role in aiding adoption (%)	Bank officials / financial institutions can play a better role in aiding adoption (%)
Very bad	0.00	0.00	0.00
Bad	0.00	0.00	0.00
Average	53.30	48.00	45.20
Good	37.10	41.40	45.60
Very good	9.60	10.50	9.20

Table 4.5.7 provides responses about the suggestion for the role of government in enhancing the irrigation service provided by the entrepreneurs. Almost 50% of the farmers perceived that it was good or very good if the government officials could play a better role in helping them with the adoption of the irrigation service whereas the other half responded with a moderate response. A little less than half of the respondents said it was good or very good if the government institutions could play a better role in aiding adoption as compared to the other 53% of the farmer respondents who thought that this to be an average suggestion for the improvement of adoption of the irrigation services.

Table 4.5.7: Suggestions for the government

Response	Govt. Officials can play a better role in aiding adoption (%)	Govt. institutions can play a better role in aiding adoption (%)
Very bad	0.00	0.00
Bad	0.00	0.00
Average	50.40	53.70
Good	40.10	35.10
Very good	9.40	11.20

Table 4.5.8 gives us the responses to the suggestions for improving the parity among users. It was observed that almost 54% of the respondents reported more equality or fairness towards all section of society could aid better adoption of the irrigation service as a good or very good suggestion. While the remainder considered it to be an average suggestion. As observed, a little more than half of the respondents considered that it was good if adoption of the irrigation service could be helpful to the farmers from all caste and genders in

particular apart from sections of society thereby supporting equity on multiple axes as an enhancer of adoption.

Table 4.5.8: Suggestions for parity among users		
Response	**More fairness towards all sections of society can aid adoption (%)**	**Adoption should be aided for all caste and genders**
Very bad	0.00	0.00
Bad	0.00	0.00
Average	46.90	48.70
Good	44.10	43.00
Very good	9.40	8.30

Table 4.5.9 shows us the ratings of the respondents for the suggestions for inclusion of compulsory and voluntary crop insurance for subsidy allocation. A little less than 50% of the respondents measured that rated inclusion of compulsory crop insurance for subsidy as good or very good while the remainder rated a moderate response on the same. About 47% of the respondents rated the inclusion of voluntary crop insurance as a good or very good suggestion however, 53% of them rated it as a moderate response.

Table 4.5.9: Suggestions for inclusion of compulsory and voluntary crop insurance for subsidy		
Response	**Inclusion of compulsory crop insurance for subsidy (%)**	**Inclusion of voluntary crop insurance for subsidy (%)**
Very bad	0.00	0.00
Bad	0.00	0.00
Average	52.00	53.30
Good	41.70	39.50
Very good	6.40	7.20

As these suggestions could be coming from social desirabilty caution is needed in presnting this to or including it in policy.

4.6 The Role of the Entrepreneur

Table 4.6.1 collates the responses with respect to the importance of the role played by the private entrepreneurs. 90% of the respondents reported a strong response towards the significance of the role played by private entrepreneurs. More than one-fifth of the respondents reported a very strong significance of the role played the entrepreneurs. However, one-tenth of the surveyed farmers rated the role played by private entrepreneurs as merely satisfactory.

Table 4.6.1: Significance of the role played by the private entrepreneur	
Response	**(%)**
Very poor	0.00
Poor	0.20
Satisfactory	9.40
Strong	70.20
Very Satisfied	20.20

Table 4.6.2 collates the responses for satisfaction of the respondents with the role played by the private entrepreneurs. It is observed from the table that a little more than 76% of the respondents were satisfied or very satisfied with the role played by the private entrepreneurs. The remaining 24% farmers rated their satisfaction an average for the same.

Table 4.6.2: Satisfaction with the role played by the private entrepreneur	
Response	**(%)**
Very poor	0.00
Poor	0.20
Satisfactory	23.50
Strong	62.50
Very Satisfied	13.80

Table 4.6.3 shows the responses of the farmers with regards to the possibility of the entrepreneurship without the participation of the private entrepreneurs. Almost 56% of the farmers responded strongly towards the possibility of the entrepreneurship even without the participation of the private entrepreneurs. The other 44% of the respondents report satisfactory response for the same.

While the entrepreneurs have a role to play in irrigation service provision, there is also a lot of room to improve it they have to service proftiably in the future.

Table 4.6.3: Impact of the entrepreneur's participation on the planning	
Response	**(%)**
Very poor	0.00
Poor	0.20
Satisfactory	9.40
Strong	70.20
Very Satisfied	20.20

Table 4.6.4 collates the survey responses about the government role in the entrepreneurship. 55% of the respondents were strongly satisfied as to the government could do the entrepreneurship better on their own. However, 45% of the respondents responded medium satisfaction towards the same.

Table 4.6.4: The government can do the entrepreneurship better on its own	
Response	**(%)**
Very poor	0.20
Poor	0.0
Satisfactory	44.10
Strong	42.30
Very Satisfied	13.40

Table 4.6.5 shows the responses towards the impact of the entrepreneurs' participation on the planning aspects of the irrigation service. Two-third of the respondents observed there was a strong or very strong impact of the entrepreneurs' participation on the planning whereas one-third responded moderate impact on the same. This could be important for policy.

Table 4.6.5: Impact of the entrepreneur's participation on the planning	
Response	**(%)**
Very less impact	0.00
Less impact	0.00
Moderate impact	34.20
Strong	45.40
Very strong	20.40

Table 4.6.6 collates the responses towards the entrepreneur's participation on the implementation aspects. Here, 60% of the respondents observed a strong or very strong impact of the entrepreneurs' participation on the implementation aspects whereas 40% of the respondents responded moderate impact on the same.

The entrepreneur as an individual is a promoter or founder of the enterprise and need not get invovled in day to day functioning. However farmers' responses show that to them it appears that involvement of an entrepreneur in implementation is critical for success. This can be serious implication for scale of irrigation enterprises and their scalability.

Table 4.6.6: Impact of the entrepreneur's participation on the implementation	
Response	**(%)**
Very less impact	0.00
Less impact	0.00
Moderate impact	39.90
Strong	42.80
Very strong	17.30

Table 4.6.7 presents the responses towards the impact of the entrepreneurs' participation on the ease of acquiring the irrigation service. 44% of the respondents observed a strong or

very strong impact of the entrepreneurs' participation on the ease of acquiring the irrigation service whereas, 56% of the respondents responded moderate impact for the same.

Clearly the aspects of planning, implementation and ease of acquiring have benefitted from the participation of the entrepreneur and the impact was in this order as well. However almost half of the respondents reporting no impact indicate that a lot more can be done and delivered by the entrepreneurs. This should be an important input to the irrigation and water management policy in India.

Table 4.6.7: Impact of the entrepreneur's participation on the ease of acquiring	
Response	**(%)**
Very less impact	0.00
Less impact	0.00
No impact	55.90
Strong	32.20
Very strong	11.80

Table 4.6.8 collates the responses about the impact of the entrepreneur's participation on the training of farmers. Half of the respondents observed a strong or very strong impact of the entrepreneurs' participation on the training given to the farmers whereas the other half of the respondents showed moderate impact for the same.

Table 4.6.8: Impact of the entrepreneur's participation on the training	
Response	**(%)**
Very less impact	0.20
Less impact	0.00
Moderate impact	50.40
Strong	30.00
Very strong	19.30

Table 4.6.9 shows the responses towards the entrepreneur's impact on the after sales service. Almost 45% of the surveyed respondents showed a strong or very strong impact for the entrepreneur's effect on the after sales service whereas 55% showed moderate impact for the same.

Table 4.6.9: Impact of the entrepreneur's participation on the after sales service	
Response	**(%)**
Very less impact	0.00
Less impact	0.20
Moderate impact	54.80
Strong	34.20
Very strong	10.70

Table 4.6.10 collates the responses towards the impact of the entrepreneur's participation on the fairness perception for the irrigation services provided. It is observed from the collated responses that 44% of the respondents perceived a strong or very strong impact of the entrepreneur's on the fairness perception on the irrigation service. However, 56% of the respondents reported only a moderate for the same.

Table 4.6.10: Impact of the entrepreneur's participation on the fairness perception about the irrigation service

Response	(%)
Very less impact	0.00
Less impact	0.00
Moderate impact	56.10
Strong	34.40
Very strong	9.40

Table 4.6.11 shows the responses about the impact of the entrepreneur's participation on the quality of management of the irrigation service. 42% of the respondents reported that the impact of the entrepreneurs' participation on the management of the irrigation service was strong or very strong. However, the other 58% of the respondents observed only a moderate impact.

Table 4.6.11: Impact of the entrepreneur's participation on the management of the irrigation service

Response	(%)
Very less impact	0.00
Less impact	0.00
Moderate impact	57.70
Strong	29.20
Very strong	13.20

These collections of tabulations present deep insight into a vareity of specific irrigation enterprises and into entreprenurship in Irrigation in general .The findings are summarized and recommendations are made based on them in the next chapter.

Chapter 5

Conclusions and Recommendations

This report is a first attempt of its kind at studyign entrpreneurship in irrigation. Chapter 4 presented many findings from the study and these have been summarized in this chapter and recommendations are made for policy based on these findings.

5.1 Observations and findings

Within technology adoption also there are multiple segments as is clearly seen that the maximum number of younger farmers under the age of 30 are part of the subsample that comprised the drip irrigation and irrigation financing services, the middle age farmers were in majority adopters within the sub-samples of remote switches and older farmers were generally the clients who had purchased solar irrigation assemblies. Thus the policy has to be careful in avoiding drawing to the old age conclusions that only young gentleman farmers are technology adopters.

Also the general proportion of educated people is higher in the sample signifying that more adopters avail irrigation services from entrepreneurs than the illiterate people but this might be either due to affordability or due to complexity of processes and services and sophisticated equipment. At the same time the adoption of such services is not limited to educated farmers only. It must be seen that it is possible to innovate and entrepreneurs can have services which are focused on the illiterate farmers. This strengthens the notion that entrepreneurs are not entering for making money alone or only for the easy tasks. There is room for more generous but directed support from the government and the state at promoting such efforts by entrepreneurs.

It is also seen that maximum entrepreneurial services are obtained by general category farmers despite no bias from the entrepreneurs themselves. However with careful innovation some of the entrepreneurs were able to reach out to scheduled tribes who seemed to benefit from these services more than scheduled castes in terms of the number of respondents. Better policy making can address concerns here.

It is also clear that more than 70% of the sample respondents had access to non-agricultural sources of income and these seem to help affordability of such services. At the same time there were 30% farmers who did not have any non-agricultural source of income. This points

that while presence of non-agricultural sources of income benefits the adoption of services from irrigation entrepreneurs adoption is not restrictied to such households.

In general more food secure farmers are the ones that make use of the entrepreneurs' services. However careful design of some innovations by entrepreneurs has helped them tackle the issue of food security with a positive impact on the same due to the adoption of their services.

Other factors such as consolidation of landholdings, farm terrain, location in the command areas, sources of irrigation and the general water situation on the farm do not seem to have a major impact on farmers availing the services from irrigation entrepreneurs.

Farmers need for new and innovative irrigation services stems from the fact that irrigation needs of the farmers are changing due to changes in rainfall pattern, shortage of labour, poor soil quality and due to new irrigation practices. These were chosen by more than half of the respondents. They lend credence to the idea that most of the farmers are actually availing new and innovative services to cope up with a situation that they are faced with rather than for a pure growth seeking reason. This is very important and it is essential that the communication to the farmers about the benefits of adoption be modified accordingly. ***It must be taken note by the policy makers that given this situation there is urgent need to support entrepreneurs with policies that promote them rather than allowing them to function in the absence of any policy.***

A large proportion of farmers felt that their irrigation practices had to undergo major changes since they adopted irrigation services from the entrepreneurs and a large proportion of these farmers believed the change to be for the better.

The farmers were split in two groups with the slightly larger group observing that trainings had been held for farmers to aid the adoption of these services. However the respondents were split and less than 40% thought that the trainings were useful in getting better benefits from the irrigation services. A large majority however believed that trainings are needed for better adoption and economics from the irrigation services. This means that entrepreneurs need to focus more on the quality of trainings in terms of enabling the farmer to get more benefits from the irrigation services.

The irrigation services have had limited impact on reduction in energy consumption for irrigation while the services have been in general very robust in terms of extreme cases like drought and floods and have not had any untoward health impact as well. ***Thus in case of***

resolving the energy-irrigation nexus special policy incentives seem desirable for the irrigation entrepreneurs as both the solar pumps and family drip systems are subsidized services.

Responses also show that farmers treat irrigation more as an competing and exclusive good rather than a true public good increasing the chances of tragedy of the commons therefore ***necessitating the assignment of property rights or other usufructus rights to irrigation services for private entrepreneurs to be successful***.

The stisfiaction levels with the irrigaiton services are high but the overall satisfaction levels are far better than the responses to beng treated with fairness in a just manner. This leaves the scope for more transparency that entrpreneurs have to bring in their dealings with farmers. Interestingly a significant proportion of farmers is satisfied with the enterprises in dealing with them in terms of equality. This ***signifies that entrepreneurs need to devise innovative ways to establsih transparency***.

The respondents who find the impact of entrepreneurs moderate vary between 50-60% for various aspects such as impact on ease of acquiring irrigation service, enhancing participation in trainings, after sales service, fairness perception about the service and the overall management of irrigation service. This is a very important result and policy makers need to seriously think about ways to enhance the role of entrepreneurs in these. This is critical as ***a pure regulatory role may not be able to achieve this and thus the policy-makers have to be innovative*** on these counts.

The respondents were very appreciative of the role of entrepreneurs in planning and implementation of the irrigation services. These are definitely areas where the entry of irrigation entrepreneurs appears to have made a significant impact. The policy makers need to take this into account and ***draft policies that allow entrepreneurs to take up larger roles and more diverse roles in these arenae, as they seem to have developed a fair amount of expertise in the same to fulfill the mandate of delivery of public goods at the planning and implementation of services stages***.

While appreciating the role of entrepreneurs a sigificant proportion of respondents conveyed that they felt that while the entrepreneurs did a lot for the casue of irrigation services yet if the govenrment works seriously and efficiently it could do as good a job for providing the

services if not a better job. This is very interesting because it highlights the need for entrepreneurs to innovate much more and also focus on procedural justice as is available within the government processes and systems. ***This is another grey area for the policy makers as they need to devise new and innovative ways to get the same done***.

Many respondents which made up almost half of the sample felt that the government officials and instiutions need to play a better role to improve their expereince of irrigation services even with the entrepreneurs in place. This means that we have to take a fresh look at the complementarity of activities of the entrpereneurs and the government officials and institutions rather than treat the as sunbstitutes or competitors in a market. This is very improtant for the ***policy makers to treat entrepreneurs and government officials and instiutions are complementary to each other and then devise polocies for reforming the sector***. Most farmers had similar feelings for the community instituions.

Suggestions for improvement of services from the respondents included the ***need for discussing more technical issues and economics issues with the farmers and also the involvement of more technical personnel and special focus is needed on better coordination between private entrepreneur institutions and those of the government*** in delivering good services. Thes points need to be kept in mind by the policy makers.

The policy makers can take special note of the following issues with respect to the institutional aspects of irrgiation services to be provided by private entrepreneurs. The respondents did not rate the enterprises very high on flexibility though they rated them singificantly high on flexibility in decision making and enhancing participation of the farmers including equality in participation. Their responses hinted at a lot of progress in ***aspects such as autonomy of the management committee and primacy to farmers opinions but the progress still leave a lot desired. These are the critical aspects in which the government and the entrepreneurs need to come together and work in partnership and there needs to be a policy push for the same***.

The enterprises were seen as very sucessful in making the irrgiation services and the local institutional mechanisms for the dlivery of the same more democractic, efficient and compliance oriented. The respondents also rated them as better on water measurement and distribution compared to the earlier and traditional institutions.

The farmer respondents were also very forthcoming in expressing their views on the impacts of the participation of entrepreneurs in providing the irrigation services. The impact was very high and positive on aspects such as ***timeliness of irrigation, followed in magnitude of impact in terms of adequate irrigation, faciliating expansion of irrigated area, equitable distirbution of water, and adptiveness of the agricutlure*** using this irrigation service. Thus it is very clear that ***policy makers need to consider these additional reseons apart from those present in current literature in favour of participation of entrepreneurs in providing irrigation services to farmers***.

There are many other positive impacts from the presence of entrepreneurs but it was possible to enhance the impacts on some of these dimensions as reported by the respondent farmers. These dimensions included *water use efficiency, Increased financial benefits , expansion of cropped area, shift in varieties of crops along with diversificaiton of crops, area under high value crops and less water using crops, resolution of disputes, impact on water table and overall water situation of the villages. Better maintenance of irrigation structures , lower costs of farming, and better market participation and marketability of production*.

Overall the response was very positive that the irrigation services had enabled farmers to achieve their goals from agriculture as an occupation and livelihood for them. This ***ability of entrepreneurs to excel in providing irrigation as a derived demand of agriculture, surpasses all other benefits and sums up the logic for need for their presence in the irrigation domain***.

The assesment of success of irrigation services was more subdued but very positive on the whole. However, improvements were possible despite massive strides in making irrigation successful in fulfiling varied needs, incresaing income and enhacning control of the farmers on irrigation. Thus overall ***there is a strong logic that the government needs to positively consider in favor of the participation of entrepreneurs in irrigation service provisions***.

The strongest results have been in favour of irrigation services provided by entrepreneurs were successful in enabling agricutlure despite limited power,l abour and/or financial availability and to some extent even shortage of water itself. A lesser prorpotion of farmer reposndents reported a positive imapct on increased income or assured income. This signifies that ***entprenreurs have been particularly good at developing innovations and business models that enable farmers to cope up with the major challenges*** they are faced with. The incresae in savings and investments coupled with this results signifies that the ***overall impact***

of entrepreneurs is even more positive in such resource constrained scenarios enabling farmers to think more from a long term perspective and sustianbility of farming as an occupation and livelihood.

5.2 Recommendations

Based on the qualitative information collected during the case studies and the descriptive analysis of the survey responses the final recommendations emerge as important for the policy makers.

1. It must be taken note by the policy makers that there is urgent need to support entrepreneurs with policies that promote them rather than allowing them to function in the absence of any policy.

2. The success of private entrepreneur led irrigation services is significant and thus there is a strong logic that the government and policy makers need to consider in favor of the participation of entrepreneurs in irrigation service provision.

3. Special policy incentives seem desirable in case of resolving the energy-irrigation nexus as without subsidy it appears to be difficult for entrepreneurs to take up innovations and services that impact the energy irrigation nexus.

4. Policy makers need to pay special attention to the assignment of property rights or other usufructus rights to irrigation services for private entrepreneurs to be successful. This emerges as an enabling condition that helps the entrepreneurs to deliver what is expected of them thereby taking the load off the government authorities.

5. Policy makers need to regulate such that it is conveyed that entrepreneurs need to devise better innovative ways to establsih transparency such that their processes and procedures are understood by the farmers.

6. A traditional regualatory role may not be able to achieve much and policy makers have to be innovative on enhancing the user expereince with respect to ease of acquiring irrigation service , enhancing participation in trainings, after sales service, fairness perception about the service and the overall management of irrigation service.

7. It is required to draft policies that allow entrepreneurs to take up larger roles and more diverse roles as they seem to have developed a fair amount of expertise in the delivery of public goods at the planning and implementation of services stages.

8. Policy makers need to ensure that procedural justice and fairness are the cornerstones of irrigation services delivery to farmers.

9. Policy makers need a radical shift in looking at private entrepreneurs vis-à-vis govenrment fucntionaries and instituions as the survey clearly shows that there is need to treat entrepreneurs and government officials/ instiutions are complementary to each other and then devise polocies for reforming the sector.

10. There is a need for discussing more technical issues and economic issues with the farmers and also the involvement of more tehcnical personneland special focus is needed on better coorindation between private entrepreneur institutions and those of the government.

11. Aspects such as autonomy of the mangement committee and primacy to farmers opinions are the critical aspects on which the government and the entrepreneurs need to come together and work in partnership and a policy push is required for the same.

12. Policy makers need to consider many additional reasons apart from those present in current literature in favour of participation of entrepreneurs in providing irrigation services to farmers. Some of these reasons could be the postiive impact on timeliness of irrigation, followed in magnitude of impact in terms of adequate irrigation, faciliating expansion of irrigated area, equitable distribution of water, and adptiveness of the agriculture using this irrigation service.

13. Entprenreurs have been particularly good at developing innovations and business models that enable farmers to cope up with the major challenges. This directly means that after two succssive bad monsoons it is imperative that a great push be given to entpreneurs to ensure the long term sustainabilty and success of agriculture. It also implies that irrigation entreprenurs should not be rattled and hassled by taxation and other issues right now. They situation demands they be seen as an essential organizational format in a otherwise

gloomy situation of resoruce crises, nature's apathy and dwindling resources of the farmers esepcially the factors of production.

14. Overall impact of entrepreneurs is even more positive in resource constrained scenarios enabling farmers to think more from a long term perspective and sustianbility of farming as an occupation and livelihood.

15. Entrepreneurs in irrigation are still catering only the explicit and expressed demand only the actual scope is much wider leaving a lot of room for improvements within the enterprises and also from the policy support and regulator.

16. There is no single dominating benefit across the enterprises and as such policy makers need to take into consideration the specificity of each innovation and enterprise category in formulating supportive policies and government regualtions and orders to achieve desired results. The results of this study are very useful in understanding the same.

17. There is still a segment that needs requires subsidy support as an incentive for adoption but the subsidies need to be smart and targeted at the right segment for the right benefits.

18. The biggest benefit reported by farmers is that of increased adaptiveness of agriculture and this can be very useful in dealing with the direct and indirect threats of climate change and sustainability concerns around agriculture. Entrepreneurship in irrigation can deliver significant improvments on these counts.

19. The entrepreneur may need to be involved in implementation herself and this will have serious implications on achieving scale of operations and therefore policy has to enable replicability of innovation and enterprises in irrigation.

20. The irrigation entrepreneurs are working on business models based on either irrigation as a leading input or as a productivity enhancer based on the theory of constraints (ToC). However both of these are theoretically old and will only result in incremental benefits overtime whereas disruptive improvements are needed in the times to come. Policies are needed to promote entrepreneurs and enterprises that are disruptive and their innovation

can propel growth of a farm, the farmer as well as farming as a sector and an occupation too. Policy can go a long way in enabling the desired change.

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Annexure 1

No.	Name of Enterprise	Organisational Format	Field Location
1	Wastewater Irrigation	Registered Farmers Association	Vadodara, Gujarat
2	Tubewell Companies	Informal Farmers Association	Mehsana, Gujarat
3	Pimpalnare Lift Irrigation Society	Registered Irrigation Cooperative	Nashik, Maharashtra
4	Indore Lift Irrigation Society	Registered Irrigation Cooperative	Nashik, Maharashtra
5	Sustainable Agri-commercial Finance Limited (SAFL)	Non-Banking Finance Company	Maharashtra multiple districts
6	Claro energy	Registered Private Limited Company	Bihar multiple districts
7	KB Treadle pump, IDE India Ltd.	Registered Non-Governmental Organization	Kandhmahal, Odhisa
8	Ossian AgriTech	Registered Private Company	Pune, Maharashtra
9	Netafirm India Pvt. Ltd.	Registered Private Company	Jharkhand multiple districts

Annexure 2

Case Study Protocol for study of Entrepreneurship in irrigation

(Prof.Vaibhav Bhamoriya, Centre for Management of Agriculture, IIM Ahmedabad)

About the Entrepreneur

- Family background
- Professional background
- Motivation for the business and domain
- Ideals and idols
- Stages of learning and moving closer to the business
- First pull towards entrepreneurship

Genesis of Idea

- Inspiration of idea
- First time idea came- raw idea
- More refined idea and how it came about
- Modifications why and how

Genesis of Enterprise

- Synthesis of organization
- Institution including organization structure – how did it come about
- Processes and governance mechanism – how were they set up and modified
- Innovations – how did they come and influence business

Timeline of enterprise

Establishment of enterprise
Formalization of enterprise, if applicable
Funding sources along with timeline of funding
Human resources

- Skills
- Competencies
- Training of employees
- Training of community and farmers

Other enabling factors esp. Policies , institutions, individuals, weather , etc.

Other hindering factors such as policies, institutions, individuals etc.

Financial data

- Current status – top line and bottom line
- Cost drivers and revenue drivers
- Leverage
- Sources
- Profitability
- Balance sheet + P&L account + cash flows

Membership data

- Growth over time
- Types of memberships
- Membership rules and privileges

Employee data

- Growth over time
- Types of employees and basic qualifications
- Employee career paths and privileges
- Employee issues

Innovation data , if possible

The experience of Entrepreneurship
Institutional form and flexibility

Impact of policies
Experience of Users / Members

Government support & ecosystem support

- Funding – subsidies / grants / soft loans / taxations etc.
- Institution building and innovation
- Training and extension
- Interaction with other institutions
- others

Performance of the enterprise

- Status of existence – functionality , vibrancy, formalization, replication. Scale etc. Operations and Maintenance
- Cost recovery
- Income
- Yields
- Stated objectives
- Financial performance or sustainability
- Environmental sustainability
- Risks managed and exposed to
- Institutional innovation
- Other parameters

Village / community level impacts

- Economic changes
- Employment changes
- Migration changes
- Social changes
- Cultural changes
- Gender changes and shifts
- Caste and class changes
- General changes
- Political changes

Broader impact beyond the village