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Factors determining drip irrigation system (DIS) inTamil Nadu

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Abstract

Objective: To give details about socio-economic conditions of respondents and find out factors determining the establishment of drip irrigation system in Aruppukottai block in Virudhunagar district, Tamil Nadu in India.
Methods: Primary data is main supporting source of this research and it is collected in the year 2019. Totally 100 samples are collected from 10 villages and each in village 10 samples are selected on the basis of purposive sampling techniques. Respondents' information is gathered from various sources and they are as follows: Banking sectors, Panchayati Raj Institutions and District Rural Development Agency, Virudhunagar district. This data is analysed by percentage and factor analysis.
Findings: Primary data has been collected from 10 villages in Aruppukottai Block. Most of the farmers are more than 50 years old. Graduates are not interested to do farming activities. Almost three-fourth of respondent's islivingon nuclear family system. Nearly two-third of farmers' family income (62%) are between ₹1,00,000 - ₹2,00,000. Ten variables are selected and analysed to identify the influential reasons to launch drip irrigation system. This analysis identified two major factors: Most dominantfactoris systematic water distribution, easy soil infiltrations, increase land size, sustain moisture and minimise water scarcity. Least ranking factor is sustaining soil fertility, operating cost, media, government and NGO's support.
Application: Governments should start various irrigation related programmes and it must be reached gross root level. These programmes are associated with efficient water resource management.
Keywords: Drip Irrigation, Soil Infiltrations, Moisture, Fertility.

1. Introduction

Concept of irrigation facility had been emerged from prehistoric period. This facility was one of the most important grassroots of world civilisation development. Almost all the evolution of civilization had been progressed from irrigated area like river shore or basin. For example, Mesopotamia Civilisation - Tigris and Euphrates rivers in the place of Middle East in 3500 BC [1-2], Egypt Civilisation - Nile valley in Egypt began around 3100 BC, Indus valley Civilisation- Indus River around 2600 BC in parts of India and Pakistan and finally Yellow river civilisation- Huang-He River around 1700 BC.In these periods, most of the population were doing farming activities. In India, about 55% of the population's livelihood is agriculture and it related activities. This activity is depending on various factors and one of the important factors is an availability of water resources. It is renewable, natural and essential resources. It is supporting for all living things, cultivation and ecological system. Major quantity of this resource is utilised for agricultural and industrial activities in this country. Adequate and appropriate distribution of water resources has crucial part of agricultural productivity. But, it is not properly utilised and managed. It causes for water scarcity. It is main grounds for agriculture failure and affects the entire ecological system.

Above information shows that water is the most important factor for human development and their economic activity. The importance of this resource still continues throughout the world.In India, there are lot of conflicts between the Indian state government and it is significantly related to water distribution.For example: Cauvery river water distribution issue between Tamil Nadu and Karnataka governments. In this country, water sufficient areas are well developed and it helps to expand cultivation land more than expected level. Government set up various water storage and reservoirs facilities.

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The main problem of this region is that people are utilising excessive water resources and it is wasted by many ways. But in water scarcity areas, people cannot utilise optimum level. In this reason, farmers could not prove their capability in production and productivity. It reduces their involvement in agricultural activity.

2. Irrigation facility

1. Irrigation facility in pre - independence period

British Indian Government started lot of irrigation developmental activities. In the year 1854, British India was published irrigation policy. This policy recommended establishing Public Works Department and it suggested instituting a separate fund for irrigation works. Government of British India had been launched irrigation commission. This commission recommended and completed following irrigations facilities in this country and they are as follows: Ganga canal, Bari Doab canal, Krishna and Godavari Delta, Sirhind, Lower Ganga, Agra and Mutha Canals, Lower Sohag canal, Lower Chenab canal, Sidhnai canal, Betwa canal, Gokak canal, the Khaswad Tank, the Rushikulya canal, Nizamsagar and Krishnarajasagarand Mullai-Periyar dam.

2. Irrigation facility in post – independence period

The Betwa canal, the Nira left Bank canal, the Gokak canal, the Khaswad tank and the Rusikulya canal works started in the period Britishers. But, it completed in the first five year plan period 1951 – 1956 [3]. Main aim of second five year plan 1956 – 1961nwas emphasised that industrialisation. It was completely neglected agriculture and irrigation expansion works [4]. Third five year plan 1961 – 1966 was not properly functioned due to following reasons: Indo – China and Indo - Pakistan war. In the reason, most of the funds were spent for above mentioned purpose. After that, it created economic instability and government declared plan holidays for few years [5]. About 23% of fourth plan 1969 – 1974 total outlay spends for agriculture and irrigation facility [6]. During the Fifth Plan 1974-1978, Command Area Development Programme (CADP) was launched. It was a Centrally Sponsored Scheme. Main aim of this scheme was reducing the gap between the irrigation potential created and the optimum utilization of available land and water [7]. In the Sixth Plan period 1980 – 1985, an additional irrigation potential of 15 million hectares is likely to be created. Utilisation of incremental irrigation potential is estimated at 13.8 million hectares [8].

During Seventh five plan period 1985 – 1990, total potential irrigation was achieved of 4.41 million hectares against its target of 4.65 million hectares. However, investment on minor irrigation development was made of the order of ₹647 crore in 1985-86 and ₹730 crore in 1986-87 [9]. In the ninth five year plan period 1997 – 2002, this plan concentrated not only for agriculture and also for irrigation. It helps to maintain and preserve the rain water [10]. Tenth five year plan 2002 – 2007 highlighted the improve irrigation storage efficiency and establish new projects, renovation and restoration of old tanks and well [11]. The main objectives of the eleventh Plan 2007 – 2012 emphasized the creation of irrigation potentials and thereby highlights the need to close the gap between irrigation potential created and irrigation potential utilized so as to ensure effective ‘development’ and ‘management’ [12]. Hence it is concluded that, Government of India (After Independence) and itsState governments were allocating more funds for development of irrigation facilities in all the five year plans. Only some of the Indian states have properly utilised it.

3. Water resources in India and Tamil Nadu

In India, approximately 1859 Km^3 area of water resources are available. It is approximately 4 per cent of world water sources. Irrigation infrastructural development activities are linked with minor, medium and major canals from rivers, ground water well based systems, tanks and other rainwater harvesting projects for agricultural and industrial activities of the groundwater system is the largest. Nearly 16 crores hectares of land are available to cultivate. But, practically 4 crores hectare are utilising groundwater irrigation and 2 crores hectare are avail irritation facility from canal [13]. Almost one-third of agricultural lands are constantly getting irrigation facility and the remaining areas are depending on rain water [14].

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This infrastructure developmental activity helps to attain the self-sufficiency in agricultural production, improve productivity, minimise monsoon dependency, provides new openings in rural employment opportunities. Irrigation facilities like dam and reservoirs facilitates and provides regular and periodical water distribution for all living things. It facilitates to curtail adverse effects such as floods, famines and drought [15]. Comparing with other states if India, Tamil Nadu has 4% of the land and 6% of population.But, it has only 2.5% of India's water resources. More than 80% of the groundwater has been utilised for various purposes. Major usage of water resources are following purposes: human/animal consumption, agriculture and industrial use [16]. This state receives limited rainfall from South – West monsoon; because, most partof the state is situated in rain shadow region of Western Ghats and its average rainfall is 972 mm (per year) [17]. For this reason, demand for water is naturally high in this state and it is called as a '*water scarcity state*'.This study discusses about DIS in Aruppukottai block in Virudhunagar District at Tamil Nadu. Main aim of this research is to find out the factors of determining of DIS in the research area. In this district, about 64% of the population are living rural areas [18]. It average rainfall is 753mm per annum Virudhunagar district in the 2015 – 16 [19]. This measurement is low to compare with Tamil Nadu [20]. In this reason, most of the places has not availed appropriate water supply.

4. Objective and hypothesis of the study

This part of the study explains about DIS in Virudhunagar district. Main Objective of this research is (a) to study the socio-economical background of respondents and (b) to identify the influential factor for DIS in this district.

5. Methodology of the study

This study is based on purposive sampling techniques. It is non probability sample orjudgmental,selectiveorsubjectivesampling. It is selected based on characteristics of a population and the objective of the study. It can be very useful in situations when the researcher need to reach a targeted sample quickly. For this research, totally 100 samples were taken for primary survey. In this district, Aruppukottai block were selected for this study. These samples were collected from 10 villages from Aruppukottai block and 10 respondents from each village.

6. Analysis

1. Socio-economic backgrounds

The Table 1 explains about socio-economic background of respondents in the block. This part of the studyportrays the following variables: (1) sociological factors are sex, age, caste, religion, educational qualification, type of family and house ownership (2) economic factors are respondents' income and his/her family income and additional income sources for respondents. Table 1 describes about socio-economic conditions of respondents in Virudhunagar district.

1. Sex: About two – third of the respondents are male. This investigation exhibits that majority of the male respondents are implemented DIS in their lands.
2. Age: A close examination of the table indicates that more than half of the respondents are above 55 years old. This analysis shows that young age and middle group of people did not have any fascinate to do the farming sector.
3. Cast: About 41% of the respondents come under Most Backward Class (MBC). Less than one – fourth of respondents (24%) are belongs to Scheduled Caste and they are executed this system in the study area.
4. Religion: Majority of the respondents are belongs to the Hindu religion.
5. Educational Qualification: Nearly 50% of the respondents are passed in higher secondary level (HSC) of school education. About 15% of the respondents are completed under or post graduate in collegiate education like Under Graduate or Post Graduate studies.

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6. Type of Family: Almost three – fourth of the Aruppukottai block respondents are living in nuclear family system.
7. House Ownership: All the respondents exist in own house. This analysis shows that they are not living in rented or lease houses.
8. Additional Income: About 63% of the DIS users are earning additional income. Mostly 1 to 5 acres of landholders work for additional income in non- agricultural period. Other types of landholders are not interested to earn supplementary revenue.
9. Sources of Additional Income: More than 40% of the respondents are earning through business activities.
10. Income of the respondents: About two –third of the respondents are earnings ₹ 1 lakh to ₹ 2 lakhs per annum.
11. Total Family Income: Almost 33% of the respondents' family income is more than ₹ 2 lakhs per annum.

Table 1. Socio-economic backgrounds

Particulars		Freq.	%	Particulars		Freq.	%
Sex	Male	66	66	Type of Family	Nuclear	73	73
	Female	34	34		Joint	27	27
	Total	100	100		Total	100	100
Age	>25 Years (Young)	17	17	*	Own	100	100
	25 – 50 Years (Middle)	28	28		Total	100	100
	Above 50 Years (Elder)	55	55	Additional Income	Yes	63	63
	Total	100	100		No	37	37
Caste	BC	35	35		Total	100	100
	MBC	41	41	Sources	Business	41	41
	SC/ST	24	24		Industry	22	22
	Total	100	100		Not Applicable	37	37
Religion	Hindu	82	82		Total	100	100
	Christian	11	11	Income	Below ₹1,00,000	7	7
	Muslim	7	7		₹1,00,000 - ₹2,00,000	67	67
	Total	100	100		Above ₹2,00,000	26	26
Education	Up to Elementary Level	5	5		Total	100	100
	Up to Secondary Level	21	21	Family Income	Below ₹1,00,000	5	5
	Up to Higher Secondary Level	49	49		₹1,00,000 - ₹2,00,000	62	62
	Diploma	10	10		Above ₹2,00,000	33	33
	Degree	15	15		Total	100	100
	Total	100	100				

*Source: Primary Data. (Freq. – Frequency: % - Percentage). * - House Ownership*

2. Landsize and DIS details

Table 2 explains two different parts. First part makes clear about respondents' land size and second part of the study describes that area on implementation of DIS in Aruppukottai block.

1. Land Size: Majority of the respondents (66%) have 2 – 5 acres of agricultural soil in their area. Very meagre percentage of respondents holds more than ten acres of land property.

Table 2. Respondents' land size &DIS implementation

Sl. No.	Particulars		Freq.	*%*
1.	Land Size	1 – 2 Acres	13	13
		2 – 5 Acres	66	53
		5 – 10 Acres	15	28
		Above 10 Acres	6	6
		Total	100	*100*
2.	Implementation of DIS	Partially	35	*35*
		Fully	65	*65*
		Total	100	*100*

Source: Primary Data: Freq. – Frequency: % - Percentage

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2. Implementation of DIS: Morethan 60% of respondents are fully operated DIS in their lands. It shows that most of the farmers are affected by water scarcity in this area and they are interested to implement DIS.

3. Factors determining DIS

The following study discusses about factors determining DIS in the investigation region. It is analysed by factor analysis. This analysis is a technique that is used to reduce a large number of variables into fewer numbers of factors. This technique extracts maximum common variance from all variables and puts them into a common score.

Farmers are influenced by various factors to adopt DIS in their lands. These factors are classified into three categories and they are as follows: Soil Factors – (a) Sustain Soil Fertility (b) Easy Soil Infiltration and (c) Increase Cultivable Land Size. Irrigation Factors – Minimise Water Scarcity (b) Systematic Water Distribution and (c) Sustain Moisture. Other Factors – Operating Cost (b) Government Support (c) Non – Government Organisations Support and (d) Media Support. Respondents' opinions are obtained in the form of "YES" or "NO".

4. Rotated component matrix

RCM is the basis output of principal components analysis. It includesapproximationof the correlations between each of the variables and the estimated elements.In this study rises the important question and it is "What are the factors pressurisedto implement DIS in agricultural field?" and these factors has been analysed by factor analysis.This matrix for the supporting variables is given in Table 3.

Table 3. Rotated component matrix[a]

Determining Factors	Component	
	1	2
Systematic Water Distribution	.882	
Easy Soil Infiltration	.851	
Increase Cultivable Land Size	.846	
Sustain Moisture	.812	
Minimise Water Scarcity	.744	
Sustain Soil Fertility		.621
Operating Cost		.706
Media Support		.847
Government Support		.882
NGO'S Role		.907

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalization
Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy = 0.818

1. This analysis reveals that KMO value is 0.818and it is superior than 0.50.More than 0.50 values is eligible criteria and it is suitable for sampling test [21] and it can be applied in factor analytical tool.
2. Above statistical investigation indicates that there are two factors obtained from factor analysis. First segment explains about respondents' opinion on highly influencing factor to determine DIS. This segment is including following variables:
3. Easy Soil Infiltration: DIS users stated that Drip irrigation helps water resources to reach specific areas like bottom of the plant. It reduces weed growth and water evaporation.
4. Increase Cultivable Land Size: Respondents' acknowledged that no need to allocate separate land for water drainage system and it avoids unnecessary space occupations. It facilitates to utilise additional land for primary activities.
5. Minimise Water Scarcity: Respondents' viewed that 30 – 65% of water resource may be saved by DIS to compare with traditional irrigation system.
6. Systematic Water Distribution: Samples' point of view this system provides regular, periodical and optimum level of water supply for agricultural lands with minimal support of electrified motor pumps. It diminishes electricity consumption and easily adopts automated irrigation gadgets.

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7. Sustain Moisture: Respondents' believed that moisture continues through drip irrigation and it is used to maintain the plants' foliage, speed up seed germination and minimise nitrate leaching loss potential to groundwater.
8. Second segment portrays that what are the variables creates low level of impact to execute DIS. Respondents' view on implementation of this irrigation system and it aspect contains the following components:
9. Sustain Soil Fertility: Almost three – fourth (73%) respondents' accepted that functions of DIS help to ameliorate nutrient level in soil. It helps to get better agricultural fertile lands. This systemaids to utilise optimum level of fertilizer and pesticides. This level utilisation is better for disease control and it helps to increase root zone oxygenation functions. This system is simply adoptable for organic and inorganic agricultural related chemical usages for soil fertility.
10. Operating Cost: Respondents are perceived that operating cost is high and they acknowledged that insufficient DIS machinist or skilled labour. In this reason, supply of labour is limited and they are charging too much of labour cost. Most of the time, DIS is not working properly. Because, emitter clogging is blocked by various reasons and they are follows: salt deposit in plastic pipes and distribution system, dust and climatic conditions. Above mentioned factors are causes for increase operating and maintenance DIS cost.
11. Government Support: More than 50% of respondents are felt central and state governments did not implement properly and they are not aware of irrigation related rural development schemes. Because, it is not reach the grass root level.
12. Role of NGOs: In this region, NGOs did not play major role to implement DIS.
13. Media Support: DIS users opined that News Papers, Televisions and Social Medias did not give importance for agricultural and its related activities.
14. Hence, it is concluded that soil factors and irrigation factors are most influencing aspect to implement DIS. This system is availed inadequate support from other factors like Government support, NGO's support and finally Media support.

7. Conclusion

From the above studyconcluded thatone – third of female respondents are utilising DIS. Younger and middle age groups are not interested to involve in agricultural activities. This district's educational level is high to compare with Tamil Nadu literacy rate. Most of respondents are engaged other than agricultural sector for additional income earning in non-agricultural or unemployment periods. This investigation shows that medium level of land holders (2 – 5 Acres) occupies major share in Aruppukottai block. Nearly two – third of respondents are completely applied DIS for their lands. About 85 to 97% of DIS users are honestly accepted that they are utilising this system for improve the water efficiency level.

8. Suggestions

Central and State governments and implementing agencies should introduce various irrigation related rural development programmes for rural development. They must be taught that importance of modern irrigation system and how it will be utilised? It should teach through media, Non-Government Organisations, Stage Shows, Campaigns, movements, Audio – Video visuals and advertisements. It must be reach gross root level. Implementing agencies should recommendapt and verified DISmethods and strategies for the system user. They must be set up several DIS service and training centres, constructiveintensive courses. This agency should supervise all the DIS users andshould help them solve their problems. DIS users should supported by Banking sector and financial institutions. This sector should give monetarybacking, guidelines, and subsidiesandgrants for farmers.

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