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**An Analysis of Factors Affecting Agriculture Productivity in Thanjavur District of the Cauvery Delta Region**

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**Abstract**

Agriculture plays a vital role in achieving food and nutritional security of the country. Cauvery delta zone in Tamil Nadu is a major contributor to agriculture production in the state. But in the recent years there is a decline in production of this region and farmer's conditions has deteriorated in the delta region since 2010. Atleast 80% of land in Thanjavur district had forgone the Kuruvai crop in the last five years and there has been a noticeable decline in agricultural land in this region due to climate change. The factors like change in soil water intrusion, increase in irrigation patterns and prices of agricultural inputs leads farmers to have low incomes(Jagannathan & Ramaraj, 2016). Further, the Climate change has increased cost of production for farmers as they are forced to buy more pesticides and insecticides to resolve new crop diseases. Scarcity of water and indebtedness are the common reasons behind farmers' suicides in the Cauvery delta region(Sabarisakthi, 2016). An understanding of the nature of landholding is required to understand the importance of agriculture to household income. According to the Agriculture Census 2010-11, Small and marginal farmers cultivating less than five acres account for 91% of all farmers in Nagapattinam, 90% in Thiruvarur and 93% in Thanjavur. The proportion of net area sown to total geographical area is more than 50% in Thanjavur and Nagapattinam and more than 70% in Thiruvarur district, highlighting the importance of agriculture. This paper studies the problems faced by the farmers in the region and reasons behind the decline in agriculture activities over the years. Furthermore, this study uses time series analysis to analyse land use and cropping patterns in the Tamil Nadu district. The results reveals that there is a decrease in net sown area and change in cropping pattern due to erratic rainfall pattern and inadequate water facilities available for irrigation in the district.

**Keywords:** Cauvery delta zone, Land use pattern, Cropping pattern.

**Introduction**

The agriculture sector contributes to rural livelihoods, food security, and employment in the country. Agriculture acts a path towards inclusive growth by improving rural areas. According to the economic survey 2019-20, India's share of world agricultural trade is nearly 2.15 percent, which is a significant contribution to the economy. One of the most significant rivers in south India is the Cauvery River. Tamil Nadu has 416 km of the 800 km long Cauvery River flowing through the state. It is praised for being one of the best-managed rivers in the nation, with 90–95 percent of its flow going toward irrigation and the production of hydropower.

Tamil Nadu is a state with 6 percent of the total population of the country of which 79.38 lakh are operational landholders. The state received Krishi Karman award during 2011-12 for the achievement of production of 10.11 million tonnes of food grains. The eight crops which are predominantly cultivated in Tamil Nadu are Paddy, Millets, Pulses, cotton and Sugarcane. The major soil types are red loamy, alluvial, Laterite and saline soils. Availability of water is a big question when it comes to the state of Tamil Nadu as the agriculture is dependent on monsoon and Irrigation facilities. The per capita availability of water and average rainfall of the state is far below that of national level. The major sources of irrigation are tube wells and bore wells (62 percent) followed by canals (25 percent) and tanks(13percent). Cauvery Delta Region is one among the seven climatic zones in the state of Tamil Nadu which is located in the eastern part of Tamil Nadu and known for its major contribution to agriculture in the state (Paramasivan & Pasupathi, 2021). Eight districts are covered under the zone which includes Thanjavur, Nagapattinam, Thiruvarur, Tiruchy and Parts of Karur, Ariyalur, Pudukkottai and Cuddalore . The region contributes to more than 70 percent of Paddy In the state of Tamil Nadu, Black gram, Green Gram, Banana, sugarcane are also the principal crops in the region. The major source of irrigation is the River Cauvery which has its origin in the Kodagu district of Karnataka. The Grand Anaicut and Kallanai Dam play a major role in ensuring adequate availability of water throughout the region. Recently the Government of Tamil Nadu has declared Cauvery delta region as protected special agriculture zone implies that over the years the dependence on this region has reduced and steps are to be taken to revive the agriculture.(Misra, 2014)identified agriculture productivity index in the region of Cauvery zones of the Tamil Naduas Ariyalur is classified as a highly protective region in case of pulses, cereals and oil seeds. In case of cash crops Pudukkottai is high. There is a slight variation in land use in Thanjavur and Pudukkottai Districts. The major determinants of the change are soil fertility and the size of landholdings. The other factors include shortage of rainfall, lack of storage facilities(Baskaran, 2014). Thanjavur District also known as 'Rice bowl of Tamil Nadu' it is one among the eight districts of the Cauvery delta region which is located on the east coast of the state (Vasanthakumar, 2018). Introduction of High yielding variety seeds like IR8 and IR20 as a part of green revolution has increased the agricultural production in the district during 1960s.The place is also known for its temples, arts and crafts. The district consists of 3.39 lakh Hectare geographical area of which the net sown area constitutes 2.69 lakh Hectare. Main soil types are loamy, clayey and sandy alluvial. The major sources of irrigation are canals, Tanks and wells Cauvery,Vennar and Grand Anicut prove to be source of canal irrigation in the district .For development purpose the district is divided into 14 blocks .Over the years the problems of non-availability of water ,farmers suicide and industrial projects have been increasing in the area(Sabarisakthi, 2016). The climate change has also affected the region by increasing mean sea levels and increasing mangrove cover. There is a diversification of crops in the region over the years as there is a shift in production of Paddy to other crops like sugarcane ,Cotton, Pulses, Banana and Vegetables have increased .

### **Objectives of the study**

1. To compare the land use pattern among different blocks in the Thanjavur District.
2. To identify the reasons behind the cropping pattern in the district.

### **Scope of the study**

Thanjavur also known as Granary of South India; it is a most fertile district. The growing population and the resources being constant increases the competition for land. The farm lands are being converted for other purposes. As per the latest State Human Development Report of Tamil Nadu (Features, 2017) all the three districts are classified as high poverty areas in the state. A majority of the population lives in rural and poor districts due to its dependence on agriculture, but decline in proportion, it is essential to identify and map the factors that will make agriculture viable and sustainable in the Cauvery delta region. intends to do. The study about the changes in land use pattern of the district over the years points out the reason behind decrease in net sown area and gross cropped area of the district over the years. Cauvery as a source of irrigation is uncertain and groundwater availability and quality has been reduced due to the over usage for agricultural purposes and Industrial purposes (Jagannathan & Ramaraj, 2016). The recent initiative of state government by categorising the Cauvery delta region as “protected special agriculture zone” necessitates the needs for the suggestions to improve the condition of agriculture in the region.

### **Methodology**

The study is Descriptive in nature and it is based on secondary sources of data collection. The secondary data with respect to the demographic, social, economic, cultural, political, agricultural and environmental characteristics of the district is compiled from various sources, such as census, agricultural census, livestock census, district statistical handbook, reports from various departments sources like from Geographical return of Thanjavur district, Season and crop report of Tamil Nadu, State of environment Tamil Nadu report (2017), various journals and newspaper articles. The Statistical tools used to analyse are percentage, graphs and Time series analysis.

### **Layout and framework of analysis**

Analyses and findings are presented in two parts. The first part deals with the comparison of land use pattern among 14 blocks of the district by finding the difference in percentage area under a particular category of land to its total geographical area between the years 2006-07 and 2016-17. The second part shows the time series graph of percentage of area under major food crops and non-food crops to the total gross cropped area in the district over the years and the states the reasons behind the change in cropping pattern.

Land as a natural resource is limited in nature but has to meet the needs of growing population in terms of agricultural production, residential purpose and industrial purpose. This leads to change in pattern of land used over the years due to rapid growing population which is accompanied the industrial development and further leads to resource depletion (Division & Paper, n.d.) Land is classified based on its quality, characteristics and the potential it has for agriculture use. In Thanjavur district the Nine fold classification has been followed. A change in land use indicates a change in agriculture production. The percentage of the particular category of land to the total geographical area of the first year and the last year are compared to analyse the land use pattern among the blocks in Thanjavur District for the years 2006-07 to 2016-17.

**Net Sown Area** - This represents the area sown with crops and orchard. Area sown more than once is counted only once (Ministry of statistics and programme implementation (MOSPI)).

Increase in net sown indicates that there is an increase in area brought under agriculture and thereby increases the production of crops. The below figure shows the percentage change in net sown area among 14 blocks.

**Other fallow lands** - Land which is not cultivated for more than one year but less than five years due to poverty of the farmer, inadequate water supply (MOSPI). The below figure shows the difference in the percentage of other fallow lands to the total geographical area in the years 2006-07 and 2015-16.

**Culturable waste lands**- The lands that are available for cultivation. The lands are left fallow or covered by any shrubs and not taken up for cultivation for more than 5 years in succession for a reason. There is an overall decrease or no change (Budalur and Thiruvaiyaru) in culturable waste lands in all blocks.

**Land put to non-agricultural use** -This includes the land that are put under buildings, roads, railways and occupied by water resources.

**Miscellaneous trees, crops and groves not included** -These lands are cultivable but are not included in the net sown area. It includes Bamboo, Thatching grasses and bushes for fuel. The category includes those crops which are not included under orchards.

**Current Fallows** -The lands which are kept fallow for the current year. There is an increase in all the blocks which means there is decrease in net sown area in the block for that year.

Table 1: Block wise comparison of Land Use Pattern among 14 blocks

Blocks	Net Sown Area	Other fallow	Culturable waste	Land put to non-agriculture use	Miscellaneous Tress Crops & Groves not included	Current fallows
Ammamet	5.08	-6.65	-0.01	0.03	-0.27	1.82
Budalur	-6.47	1.78	0	0	0.76	3.93
Kumbakonam	-5.01	-2	-0.02	0.36	1.69	5.75
Papanasam	3.37	-9.13	-0.11	0.01	-0.36	6.22
Pattukottai	-2.03	1.17	-0.11	-0.06	-0.4	1.33
Peravurani	-2.64	2.09	-0.18	0.02	-0.2	0.9
Orathanadu	-1.42	-4.6	-0.42	-0.44	-0.76	8.16
Madukkur	-5.93	2.72	-0.33	0	0.33	3.2
Thanjavur	-7.18	1.54	-1.41	0.01	0.99	6.05
Thiruidamarudur	8.79	-8.49	-1.13	0.58	0.07	0.07
Tiruppanandal	5.36	-11.1	-1.28	0.01	-0.08	7.09
Thiruvaiyaru	-2.46	1.62	0	0	-0.19	1.03
Thiruvonam	0.8	-2.1	-1.15	0	1.87	0.57
Sethubavachatram	-18.64	2.01	-0.23	0.03	-0.1	16.92

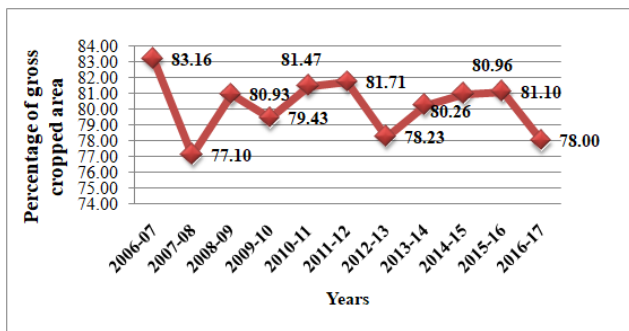
Source: Computed by researcher from secondary data Geographical return of Thanjavur district

The Highest increase (8.79) in percent of net sown area was in Thiruvudaimarudur, followed by Tiruppanandal with 5.36 percent. The highest decrease of 18.64 percent in Sethubavachatram block followed by Thanjavur block with 7.18 percent. The main reason can be attributed to the water availability to agriculture as the proportion of water usage of residential purposes is bit high in the Thanjavur block. The decrease in other fallow lands is high in Thiruppanandal block with 11.1 percent, followed by Papanasam block with 9.13 percent which indicates that more lands can be brought under cultivation and the increase is higher in Peravurani Block with 2.09 percent followed by Sethubavachatram block with 2.01 percent which indicates there is a reduction in number of lands brought under cultivation. The highest decrease in case of culturable waste lands is in Thanjavur block with 1.41 percent. The decrease in culturable waste lands indicates that there is either an increase in the number of lands used for other purposes like construction, Industrial and other developmental activities (Thanjavur Block) or increase in net sown area (Thiruvudaimarudur Block)(Baskaran, 2014).The increase in lands under non-agricultural use shows that there is conversion of farm lands to non-farm lands .Urbanisation and infrastructural activities can be a major reason for the increase in these lands in case of Kumbakonam Block. There is a highest increase in case of Thiruvonam with 1.87 percent, followed by Kumbakonam with 1.69 percent. The highest decrease is in Miscellaneous trees, crops and groves is in the case of Orathanadu with 0.78 percent. The highest increase is in Sethubavachatram with 6.92, followed by Orathanadu with 8.16 percent. The least increase is in Thiruvudaimarudur with 0.07 percent. Under land put to non-agriculture use there is highest increase in blocks of Thiruvudaimarudur with 0.58 percent and followed by Kumbakonam with 0.36 percent. The highest decrease is in Orathanadu (0.44 percent) and Pattukottai (0.06 percent).

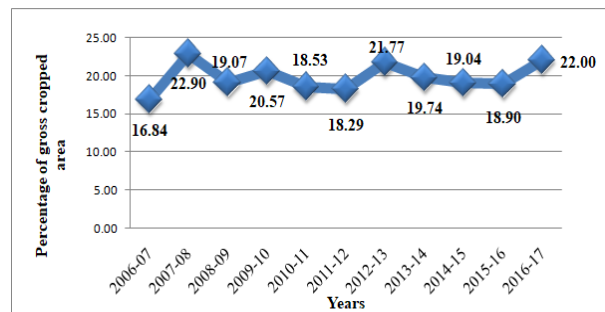
**Time series analysis of Cropping Pattern**

Cropping pattern refers to the distribution of area under different crops under different time periods expressed in percentage of total cropped area. The change in cropping is caused by the market forces and the climatic conditions prevailing in the region. The food and non-food crops like Paddy, Pulses, cotton, Sugarcane, gingelly, Groundnut, fruits and vegetables are analyzed through Time series graph.

**Fig 1 Graph showing the area under food grains Fig 2 Graph showing the area under non-food crop**



**Fig 3: Graph showing the area under Paddy**



**Fig 4: Area underpulses**

Fig 5: Area under Groundnut

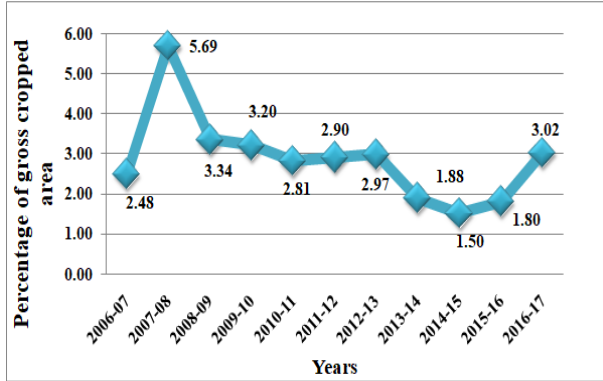


Fig 6: Area under cotton

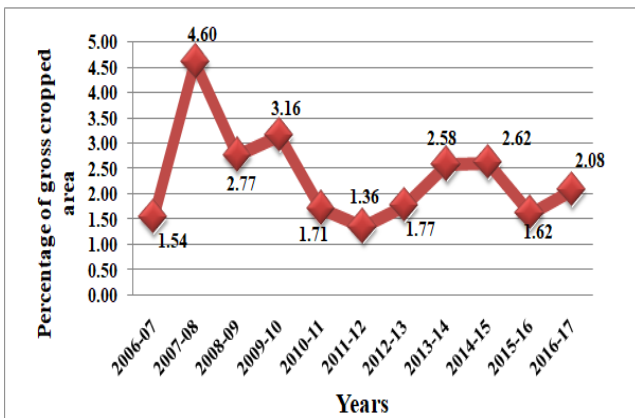
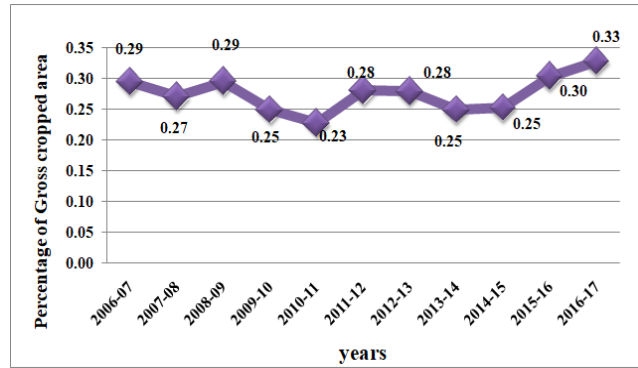


Fig 7: Area under Gingelly

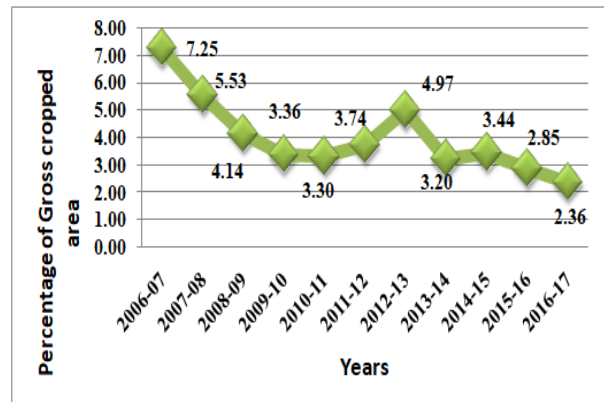


Fig 8: Area under sugar crops

Fig 9: Area under Fruits

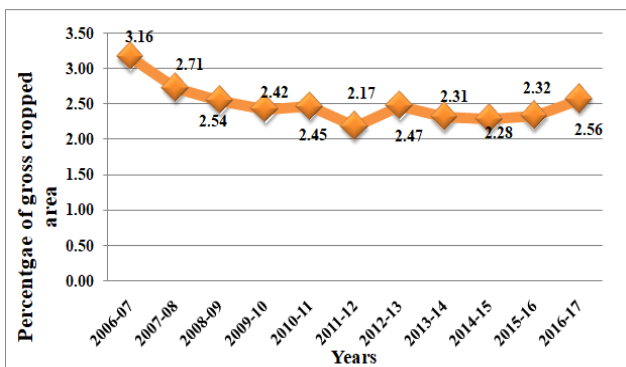


Fig 10: Area under Vegetables

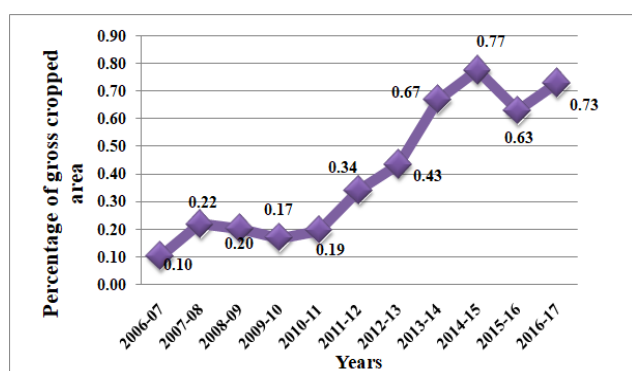
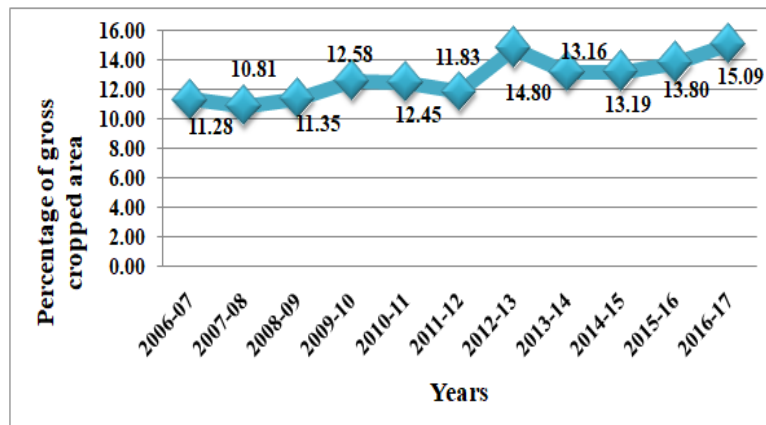


Fig 11: Area under Coconut



*Source: Computed by researcher from secondary data Geographical return of Thanjavur district*

The above graph shows the area under different crops for the year 2006-07 to 2016-17.

**Food grains**-Food grains includes cereals, pulses and millets. They play a major role in providing nutrition to the people. The above graph shows the trends in percentage of area under food grain production to the total gross cropped area of Thanjavur district from 2006-07 to 2016-17. The graph shows that there is a fluctuation in the area cropped over the years.

As a whole the area under food grain production has decreased by 5.16 percent. The main reason behind the change is due to crop diversification practised in the district in order to overcome the problem of unavailability of water facilities needed for the agriculture. The decline in 2007-08 is due to reduction in area under Paddy.

**Non-food crops** -Non-food crops are those which are produced for industrial purposes. Over the years there is an increase in area of non-food grains. The increase in infrastructure development and urbanisation in the district has led to increase in demand for non-food crops which is evident from the above graph, there is an increase of 5.16 percent. The main contribution is made by cotton and sugar crops which has also increased.

**Paddy**-Paddy is a principal crop of Thanjavur district which stands out to be the second largest district both in terms of area under cultivation and production in tonnes in the state according to the season and crop report of Tamil Nadu 2017-18. The major determinant of cultivation of Paddy is the availability of water which is a big concern for the farmers of the district over the years. The crop requires 5 cm of stagnant water in the fields to avoid percolation loss and especially at times of booting, heading and flowering. the percentage area of Paddy to gross cropped area over the years. The trend line shows that there is a decrease in area under Paddy over the years(Ganesan, 2016)

**Cotton-** The above figure shows that there is a 0.63 percentage increase in area under cotton to the gross cropped area from 2006-07 to 2016-17. Similarly for the other crops the graph depicts the variations over the period of time.

### **Summary of findings and conclusion**

The study on factors affecting Agriculture in Thanjavur district shows that Over the years (2006-07 - 2016-17), the study on factors affecting agriculture in Thanjavur district shows that both net sown area and gross cropped area have declined in the district. The area under agriculture has increased only in 5 out of 14 blocks. There is a crop diversification which is noticed from the time series graphs of principal crops in the district. There is a shift from Paddy cultivation to Pulses and Non-food grains. Rainfall and irrigation are the most important factors to increase productivity in agriculture. Rainfall in the region is most affected by the North East monsoon, but the South West monsoon is also a significant factor indirectly through the outflow of water from the River Cauvery(Kumar & Subrahmaniyan, 2020). The groundwater depletion levels are increasing in the district which may lead to shortage of water in the future. Agriculture in Thanjavur district seems to be a big question in the present scenario. The district is gifted with the natural resources which is needed for agriculture and has proven its potential from the green revolution period. Due to the growing population and limited use of land there is a conversion of farm lands. Measures have to be taken in terms of sustainable use of resources available and reviving the agricultural status of the district.

A theoretical background in the study is given based on the linking the production to land use, cropping pattern and the water resource. Von Thunen general theory of land use(1826) shows that the land use pattern is dependent on the relative distance of the land has with respect to the market area. The intensity of production of a crop also differs according to the distance from the market, it decreases as the distance from market. Perishables are produced in the lands that are close to the markets, next zone was cultivated with woods needed for fuel. Cobweb model (1938)in general explains the fluctuations in price and demand of commodities. With reference to this the farmers decide the supply of a particular crop according to the price prevalent in current year, otherwise they shift to other crops or lower the production in order to increase the price in the next season. The current price is decided when demand is equal to supply that is when there is no stock left. Tragedy of commons shows how people behave independently and rationally according to their self interest in using the common resources and which leads to depletion of the resource. This is relevant to the study in case of water usage in the district as there is a high exploitation of groundwater. Externalities play a important role in explaining how farmers are affected due to the pollution of river Cauvery by the industries on the bank.

### **Suggestions**

- Farmers can test their lands with wider cropping of crops in dry areas in order to overcome the water scarcity. This was successfully practiced in Bijapur region of Karnataka with pearl millets and Sunflower.
- Measures have to be taken to clean river Cauvery which is considered to be the lifeline of the region as the measures were taken to clean river Ganga. A unmanned surface vehicle called Ro-boat was found successful in cleaning river Ganga under the Ganga action



plan. The vehicle with operation of 12 hours was able to clean 600 kg of waste per day. It is capable to operate for 24\*7 and it can also submerge into the water.

- Rice varieties which grow even in rainfall deficit seasons can be practiced in order to overcome the scarcity of water.
- More concentration on precision farming methods in order to avoid the productivity risk by collecting and testing samples from the fields. This method had success in case of crops like Brinjal where a farmer was able to harvest 170 tonnes in 120 cents of lands. The seeds were raised under a shade net and were transmitted on their 35<sup>th</sup> day.
- Groundwater table has to be increased for a better future. Increase in groundwater exploitation is due to the subsidies given by the government in terms of power. To reduce this some amount of extra electricity charges can be charged for those who over exploit the water resource.
- Enhancing the marketability of the produce beyond MSP.
- There is no awareness about available technologies such as app. New camps to create awareness on new technologies would be helpful for farmers.
- Macro level policies should be implemented to overcome sea water intrusion.
- If government provides any prize for farmers who performs well, it would induce youngsters to enter into farming.
- The companies along the river have allot some amount of money as a part of their corporate social responsibility to ensure that they treat the sewage which they let out and have to take measures to clean the river which they pollute as it becomes a negative externality to agriculture in the region.
- Labour saving and fertilizers saving technologies have to be adopted in order to overcome the labour scarcity and land degradation.
- The present numbers of beneficiaries of 579 for the financial year 2014-21 have to be increased under the National mission for sustainable agriculture in order to make agriculture sustainable, productive and resilient to climate change.
- Areas covered under Pradhan Mantri krishi sinchayee yojana have to be increased in order to achieve the status of more crops per drop which is much needed for the present status of water availability in the district.

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