Paper presented in

Seventh Biennial Conference

Indian Society for Ecological Economics (INSEE)

Global Change, Ecosystems, Sustainability

December 4-8, 2013

Host:
Tezpur University

Cohost:
OKD Institute of Social Change and Development

MANAGING CANAL WATER UNCERTAINTY: Issues of Equity, Poverty and Sustainability among the Farmers of the Cauvery Delta

- *Dr. R. Rajendran**

Introduction

Agriculture is the world's largest water user in terms of volume. According to many studies, water used in this sector yields relatively low-value, it is used less-efficiently and water is supplied at highly subsidized rate. These facts along with others are forcing governments and donor organizations to rethink the economic, social and environmental implications of large publicly funded and operated irrigation projects.

In the past, domestic spending on irrigation dominated agricultural budgets in countries throughout the world. For example, since 1940, 80 percent of Mexico's public expenditures in agriculture have been spent for irrigation projects. In China, Indonesia and Pakistan, irrigation has received more than half of agricultural investment. In India, about 30 percent of all public investments have gone into irrigation (Bhatia and Falkenmark, 1992).

Now, the irrigation investment by both public and private sectors comes down sharply. In India, the overall investment in agriculture, already very low, has been declining drastically to low levels. In particular, public investment in agriculture has been declining for the last two decades ending 2000-01. As a proportion of GDP, it has fallen from 3.4 per cent in 1980-81 to 1.3 per cent in 2000-01. This is a situation for a sector that constitutes one-fourth of GDP in the above said period. Even in the agricultural sector's GDP, investment has fallen from 8.5 per cent to 6.1 per cent in the same period. In other words, from the value added in agriculture and smaller share is re-invested in agriculture. At the new series prices (1999-00 = 100) the share of public investment in GDP has fallen from 2.2 per cent in 1999-00 to 1.6 per cent in 2005-06 (Economic Survey, 2006-07).

It is noteworthy that as public sector investment in agriculture has fallen, private sector investment has constituted a larger share of total investment. However, it has not compensated for the fall in public investment; on the contrary, it too has fallen as a share of GDP. This is natural, as it is public sector investment that encourages private investment. It is also observed (Mallick, 2009) that there is a declining trend in the share of the agriculture sector in the growth of private investment.

Moreover, in the absence of public sector investment the type of private investment being carried out now has dangerous consequences. Most of the private sector capital formation goes towards minor irrigation facilities like establishment of new bore wells, deepening of existing bore well, installing energy consuming pump-sets and increasing the capacity of existing pump-sets.

---

* Associate Professor, P.G. and Research Department of Economics, Periyar E.V.R. College (Autonomous), Tiruchirappalli – 620 023, Tamilnadu. rajendranr65@yahoo.com .This paper is a part of the research project on *Water Uncertainty and Coping Strategies of the Farmers of the Cauvery Delta*, funded by Malcolm Elizabeth Adeshesiah Trust, Chennai.

Polarized Private Investment in Agriculture

Private sector capital formation in irrigation typically favours digging of new bore-wells, as this practice has the advantage of excludability, as opposed to the non-excludable nature of canal irrigation. However, it needs to be recognized that such implements draw water from the ground water table, which covers larger area beyond a farm size. This means that farmers with larger capacity pumps can draw water away from the water table adjoining their farms, and at a faster rate than those with smaller pumps and without any pumping sources. This tendency clearly has adverse impact on the level of the water table and the ability of small and marginal farmers to irrigate their farms. This would have several consequences: inequality would worsen; commercial crops would get priority over food crops; and overall productivity would fall, even as productivity of able farmers may increase. It is evident that there is a shift in access or distribution pattern of water resources. A concentration of water resource in few hands creates extreme scarcity for others.

Water resources in canal, tanks and underground are the important Common Property Resources (CPRs). CPRs are defined as natural or man-made resources with attributes of non-exclusion and subtractability. It may be noted, however, that all the water resources may not fall strictly under the above definition in all situations. In reality, most of these resources do not represent pure forms of open access, communal or state property. A classic example is groundwater in India. A groundwater basin is a common pool resource in the sense that exclusion of multiple users is difficult and costly. Groundwater tables go down, as water is extracted beyond optimum yield level. That is water withdrawals exceed replenishing capacity of the aquifer. The capital intensity of groundwater extraction makes it easier to exclude rival users especially in fragile environment resource regions where the high cost of groundwater extraction coupled with low and inequitable asset ownership makes the resource privy to a few well-to-do farmers. This gives rise to ‘free riding’ externalities.

The unregulated proliferation of bore-wells has resulted in the over-pumping of aquifers. Under current regulations, any farmer with access to sufficient capital can sink a bore-well, regardless of its proximity to other boreholes or its impact on the water table. Electricity for running electric pumps is highly subsidized, which contributes to unsustainable pumping. Furthermore, it is generally the market-oriented larger land owners can afford to sink bore-wells, leading to inequitable access to water resources.

Uncertain Canal Water Supply in the Cauvery Delta System

Now, water is the much pronounced commodity of the world, particularly in developing countries like India. Number of Indian rivers is under inter-state water disputes regarding the sharing of water. Familiar among them is *Cauvery* river water dispute between Karnataka and Tamilnadu. During the years in which rainfall is sufficiently good, there is no problem. But, in scanty rainfall years the river water sharing becomes a serious problem between the states.

Farmers of the *Cauvery* delta region in Tamilnadu are helpless to schedule the crops, mostly they waive one or two crops in a year, and uncertainty of river water flow for more than last 20 years forced them to make alternative arrangements. Normal date of opening of the reservoir is June 12. But, in the recent past the date of opening differs widely. The date of closing of the reservoir is also not certain. Farmers are affected owing to this uncertainty in many respects.

It is generally observed that the groundwater level in certain areas of *Cauvery* delta like *Mayiladuthurai, Kuttalam, Thiruvaiyaru* and *Needamangalam* is reported to have depleted to such an extent that shallow-point pump sets have failed to bring out the water. In *Nagapattinam* district, shallow-point pump sets with a depth of 10 to 40 feet in *Ananthanallur, Kuzhaiyur, Chithamur* and *Komal* in *Kuttalam* block; *Manganallur*, *Vazhuvur, Pandaravadai* and *Vadavur* in *Mayiladuthurai* block and *Narasinganallur* in *Sembanarkoil* block have failed.

Farmers with higher land holding and adequate financial power establish new bore-wells or they deepen the shallow-point bore-wells and establish powerful pumps. But, farmers of smaller land holdings with poor financial position are prevented from using this common resource. As a result some kind of change may be observed in agrarian relations in the river delta.

Farmers of the Cauvery delta are anxious about the uncertainty over the release of water in the river. This has affected farmers and resulted in reduction in the cultivable areas. If this trend continues, Cauvery delta will soon lose its name as the rice bowl of the state. It is generally observed that farmers of smaller land holding have lesser accessibility of water for their cropping. They are forced to rely upon farmers of larger land holding to access water. They rely upon different coping strategies to meet the changed situation.

So, able farmers can make investment decisions and assure their water supply for crops. Their cropping practices may be unaffected by making additional and timely investment. But, farmers with smaller and marginal (including sub-marginal) may be affected by uncertain surface water supply and less scope for ground water extraction. It is expected that as an impact of uncertain water supply condition, farmers of different size holdings will make different coping strategies. They may be in the form of the one or combination of the followings:

- Crop shifting;
- Reducing number of crops per annum;
- Rely upon water market – for whole year, for entire crop of particular season or for during the range of days or months in which the canal water supply is stopped;
- Construction of new bore well;
- Deepening of existing bore well;
- Land leasing – regular land lease or seasonal land lease;
- Breaking of current land lease;
- Leaving the land as fallow – long term or short term;
- Alternative land use or leasing land for alternative uses;
- Migration of small and marginal land holders and agricultural labourers;
- Change in the rate of rent and mortgage amount; and,

- Repair and maintenance work by the village organization(s).

Research Questions:

We need empirical evidences on nature and severity of canal water uncertainties in the past and consequences of it on canal water access, cropping, nature of ground water utilization among different size group of farmers. Thus, the study formulated specific research questions as given below:

- What is the nature of water uncertainty that prevails in the Cauvery delta system in the past?
- How dothe farmers of different land size groups manage the canal water uncertainty?
- Is the ground water accessed equitably among these groups? If it differs significantly,
- What factors determine that?
- How is sustainability of water affected in that region?
- What measures to be undertaken to maintain equity and sustainability of the ground water use and improve the economic conditions of poor resource owning farmers.

Period of the Study

The proposed study generally considers the agrarian facts of sample farmers in the study area for the last 15 years period between 1990-91 and 2004-2005. The variables to be measured for the study period are changes in the canal water status; history of the bore-well of the farms; improvements made in the bore-wells and water lifting devices; farmers' response to the slackening canal water supply; differential responses like, construction of new bore-wells, go for change in cropping pattern, improving the capacity of bore-wells, leaving lands as fallow - seasonal leasing of lands – forced by purchase water from big land owners by small holders, etc. However, in depth observations are made for the year 2005-06 for key variables of the study.

Area of the Study

The study conducted in the select villages of *Cauvery* delta, which spread in the three districts viz. *Thanjavur, Nagapattinam* and *Thiruvarur. Gopurajapuram* of *Papanasam taluk, Thiruvisanallu*r and *Thiruppanandal* of *Thiruvidaimaruthur taluk*, and *Punalvasal* of *Thiruvaiyaru taluk*, *Mathirimangalam* of *Mayiladuthurai* taluk and *Sithanvaloor* of *Valangaiman* taluk are the sample villages of the study. First four of them belong to *Thanjavur* district and each one of the last two villages comes from *Nagapattinam* and *Thiruvarur* districts, respectively.

Types of Data Used

The present study has used both primary and secondary methods to collect necessary data. Primary data have been collected from the sample farmers in the study villages with the

help of specially developed schedule. The secondary data that have been collected are land use pattern, cropping pattern, irrigated and unirrigated crops cultivated, number of bore wells, energy-wise pump sets, land holding pattern, agricultural labourers, rainfall information, canal maintenance work done, etc. These informations have been obtained from the offices of Joint-Director of Agriculture of Thanjavur, Nagapattinam and Thiruvarur; Assistant Director of Agriculture at *Kumbakonam*, *Thiruvidaimaruthur* and *Thiruvaiyaru* taluks of *Thanjavur* district, *Mayiladuthurai* of *Nagapattinam* district and *Valangaiman* of *Thiruvarur* district; Public Works Department office at *Thanjavur* district and above said taluks, Electricity Board at *Thanjavur*, and Agricultural Field Officers.

Methods of Data Collection

Primary data have been collected from the sample farmers with the help of specially developed schedule. The schedule is pre-tested before starting the main sample survey. Testing of research schedule is carried out with a view to check validity and reliability of the information collected for the study and making the scales and measurements more relevant to the study area. The schedule covered the following aspects: basic information of the respondents and their households; land holding and related information; details on irrigation; historical information on ground water extraction; cropping pattern and changes in it; changing land relations; and, different coping strategies followed by the farmers. However, collected primary data are cross checked with the key informants and progressive farmers of the villages, agricultural and revenue records, and agricultural field workers.

Secondary data are collected from the water resource organizations at various levels, revenue and Public Works Department; agricultural offices, different published and unpublished reports, books, journals, electronic sources, etc.

Method of Sampling

Ultimate sample units are selected with the help of multi-stage random sampling method. The study initially proposed to conduct its field survey only in the *Thanjavur* district and four of its sample villages with diversified water conditions. Later, it is incorporated to another two villages, each one from *Nagapattinam* and *Thiruvarur* (as part of the *composite Thanjavur district*). At the first stage, sample villages are selected at random. At the second stage, after preparing the list of farmers, farmers of different land-holding size are selected again at random basis. The study has proposed to cover at least 20 per cent of the farm households as sample at the village level. Finally, 448 sample farmers with different farm-size holding are selected for the study.

The research followed descriptive method for analysis. Facts collected from the sample farmers are analyzed with the help of simple tools like percentages, averages and other descriptive statistics.

ANALYSIS AND DISCUSSION

Water Storage System for the Cauvery Delta

The *Mettur* Reservoir is a very large and oldest reservoir in India. It is located across the river Cauvery at *Mettur* which belongs to *Salem* District of Tamilnadu. The reservoir had a long history from the year 1834 to 1934. The construction work of the reservoir was commenced in the year 1925, 20th of July and the entire work was completed and opened for irrigation by the Governor of Madras, his Excellency Sir George Stanley on 21st August, 1934. The total length of the reservoir is 1700 meters long and the maximum height of the dam is 214 feet. The structure of the reservoir was designed by a British Engineer Mr.Ellis. The whole construction was done under the supervision of a British Engineer Mr.Mullings, who was the chief Engineer of the entire project.

According to the Cauvery Committee on Irrigation and Drainage in the *Cauvery* Delta (1921) the objective of Mettur Reservior is "the supply of water from the *Cauvery* to irrigate lands is subject to great fluctuations depending on the vagaries of the river and the vicissitudes of rainfall; the crops in the delta suffer in consequence and it has long been recognised that measures are required to mitigate the failure or shortage of supply at critical seasons. There are no storage works in the Madras Presidency on the *Cauvery* or its distributaries and large quantities of water are consequently allowed to flow to the ocean nearly every year, much of which could be utilised with great advantage if the excess supply when the river is in flood could be stored for use during the periods of low supply. The *Cauvery Mettur* project has been framed with two main objects in view. The first is to provide an improved, controlled and steady supply of water to the land now irrigated in the delta, and second to extend irrigation to an additional area of 3,01,00 acres. The *Mettur Reservoir* will also act as a flood moderator and mitigate the effects of floods in the *Cauvery* in the district below the reservoir".

Past observations show that before the construction of the reservoir there were great fluctuations in the supply of water for irrigation both with regard to regularity and adequacy. Taking firstly the regularity of supply in the pre-project days, the delta was depending for its supply mainly on the southwest monsoon in the Western Ghats. The flow in the Cauvery was never regular and there was no certainty as to when the supply would come, how long would it last and whether it would be continuous and steady. The earliest date for the commencement was first week of June but often this was delayed, though the regularity was established from the first week of July. After the *southwest monsoon* has set, the peak flow being in the middle of July and August, the supply in the rivers continued more or less uninterruptedly till about September, when it subsided and quite insufficient to meet the requirements of irrigation till the northeast monsoon sets in. September is usually a month of scarce rainfall and being mostly a season of drought and resulting in a drying up of crops in the lower reaches, the supply would be quite insufficient for transplantation and other agricultural operations. *Northeast monsoon*, which commences from the middle of October and continues till December, promises full supply to the farmers and makes them independent of river supplies. Drainage rather than irrigation is the problem during this period. There is a tendency from December onwards from the river flow to slacken and sometimes this scanty flow in January leads to insufficiency of water for the second crop.

Therefore, the reservoir at *Mettur* aimed at eliminating this uncertainty and unsteadiness in supply and giving assurance from a definite date so as to enable the farmers to commence

their agricultural operations without suffering in the middle for want of water. Prior to the construction of the reservoir the rivers were generally in floods in July and August but subsequently the waste which formerly found its way into the sea was impounded into it to be let down in the rivers steadily to meet the actual needs of irrigation. Therefore, the provision of this great dam minimised the risk of overflow or scarcity of water to a great extent. Until it is actually full it will serve to check any flood water flowing down the river from the above reservoir and the adverse results from floods due to local rainfall below *Mettur* can be mitigated by the closure of the sluices in the dam. On the other hand, when the supply of water in the river is less than what is actually required for the crops and there is water in the reservoir it will be possible to send more water down the river than would otherwise flow into it.

Deviation in the Date of Opening and closing of *Mettur Reservoir*

It is a convention that the normal date of opening of *Mettur* Reservoir for delta irrigation is June 12th and date of closing is 28th January every year. However, this is not strictly followed in many years. Information gathered from the Public Works Department shows the uncertainty is continuing for the delta farmers. The dates of opening and closing between the period of 1991-92 and 2009-10 along with the storage are provided in Table 1.

Table 1: Dates of Opening and Closing of *Mettur Reservoir* for Irrigation and the Levels and Storages

Water Year	Date of opening			Date of closing		
	Date	Level (in Ft.)	Storage (in M.Cft.)	Date	Level (in Ft.)	Storage (in M.Cft.)
1991-92	21.07.91	85.60	45589	28.01.92	105.70	72154
1992-93	12.06.92	99.35	64002	28.01.93	99.28	63912
1993-94	12.06.93	95.75	59471	28.01.94	96.50	60399
1994-95	12.06.94	97.20	61272	28.01.95	68.97	31823
1995-96	03.07.95	74.03	36263	28.01.96	22.47	4850
1996-97	26.07.96	52.13	19180	28.01.97	98.39	62443
1997-98	12.06.97	97.38	61498	28.01.98	107.92	75486
1998-99	20.06.98	105.39	72004	28.01.99	74.70	36878
1999-00	01.07.99	87.35	49673	05.02.00	104.82	71229
2000-01	12.06.00	104.10	70257	28.01.01	95.06	58630
2001-02	12.06.01	98.05	62340	11.02.02	51.30	18641
2002-03	06.09.02	66.94	30128	19.02.03	28.16	6812
2003-04	07.10.03	72.52	34904	05.01.04	29.99	7519
2004-05	12.08.04	93.11	56277	28.01.05	56.26	21285
2005-06	04.08.05	106.32	73275	28.01.06	112.24	81632
2006-07	12.06.06	115.27	86127	28.01.07	84.56	56653
2007-08	18.07.07	109.85	78196	28.01.08	94.67	58152
2008-09	12.06.08	103.31	69199	28.01.09	62.23	26378
2009-10	28.07.09	94.80	58310	n.a.	n.a.	n.a.

Source: Executive Engineer, Public Works Department, Thanjavur.

The reservoir has opened as on normal date only eight out of nineteen years between 1991-92 and 2009-10 for which data is given. In six years, the reservoir is opened during the month of July. For another four years, the reservoir is opened during the months of August, September or October. In the remaining one year the reservoir is opened in June itself, but later than the normal date. The data show that in three out of five years the date of opening of

reservoir is not in the normal date. The situation becomes worsened after the period of 2001-02, because the date of opening of the reservoir varies largely. Storage level of reservoir is not good enough for many years and the reservoir is opened before it reaches 100 feet between 1991-92 and 2004-05 (except 1998-99), which indicates that the supply is not certain for the farmers of delta region and it may be interrupted at any time during the *kuruvai (*it is a season of paddy crop cultivated between June and August/September) cultivation. Further, for many years farmers are not certainly informed by the authorities whether they have to give up *kuruvai* or not. For *kuruvai* cultivation, nursery preparation work will be commenced during the middle of May in many parts of delta. Farmers with bore wells or possibility of getting water from the adjacent bore wells alone well planned and succeeded in *kuruvai* cultivation.

Normal date of closing of the reservoir is January 28th. Only three out of 19 years, the reservoir is closed after the normal date due to various reasons like, protection of standing crop because of late *kuruvai* and correspondingly reasonable delay in *thaladi* (this is the second season paddy after the *kuruvai*, cultivated during the months between September/October and January) cultivation; the reservoir has poor storage capacity before the normal date of closing; heavy demand from the farmers' for continuation of water release for some more days to protect the standing crop, etc. The reservoir level is less than 75 ft. for 6 out of 19 years for which data is given. It is exceptionally low in the years of 1995-96, 2002-03 and 2003-04 and in all these years the date of opening of reservoirs also far later from the normal date of opening. This implies that in those years water supply for the crops is more critical.

Date of Opening of Reservoir and Extent of Paddy Cultivation in the Cauvery Delta

Data presented in Table 2 shows the area under cultivation of paddy in different seasons of entire Cauvery delta comprising parts of Tiruchirappalli, Perambalur/Ariyalur and Cuddalore districts, and entire districts of Thanjavur, Nagapattinam and Thiruvarur. From the table it is understood that when the Mettur reservoir is opened in the normal date the area under paddy cultivation exceeds one lakh ha. Otherwise, the areas under paddy cultivation during this season lie down one lak ha. In the whole period taken for the analysis the normal area under *kuruvai* never reached the normal area of 2.07 ha. It clearly shows farmers are unable to predict the *kuruvai* cultivation, and farmers with assured water supply based on bore well irrigation alone take the cultivation in this season.

Table 2: Dates of Opening of Reservoir and Extent of Cultivation of Paddy Crop in different seasons of Entire Cauvery Delta

Year	Date of Opening of Reservoir	Extent of Cultivation in Lakh Ha.			
		Kuruvai	*Samba*	*Thaladi*	Total
1991-92	21.07.91	0.59	5.09	0.57	6.25
1992-93	12.06.92	1.67	3.97	1.67	7.31
1993-94	12.06.93	1.40	4.29	1.28	6.97
1994-95	12.06.94	1.68	3.94	1.38	7.00
1995-96	03.07.95	0.86	3.92	1.30	6.08
1996-97	26.07.96	0.44	5.12	0.43	5.99
1997-98	12.06.97	1.13	4.48	0.98	6.59
1998-99	20.06.98	1.18	4.48	0.97	6.63

1999-00	01.07.99	0.96	4.65	0.88	6.49
2000-01	12.06.00	1.26	4.37	1.12	6.75
2001-02	12.06.01	1.30	4.22	1.15	6.67
2002-03	06.09.02	0.51	3.98	0.52	5.02
2003-04	07.10.03	0.47	3.53	0.42	4.42

Source: C.Ramasamy, et.al., "Alternative Cropping Pattern for Tamilnadu", Report Published by Directorate of Research, Tamilnadu Agricultural University, Coimbatore, p.12.

Note: Normal area under cultivation is 2.07, 3.72 and 1.77 lakh ha. in *Kuruvai, Samba* and *Thaladi* seasons, respectively.

Against the expectation in all the years the extent of cultivation of *Samba* paddy exceeds the normal level of 3.72 lakh ha. When the reservoir is released on the normal date, the extent of cultivation of paddy in this season comes close to the normal level of area under cultivation. At the same time it always lies above (except 2003-04) the normal level. When the reservoir has opened later than the normal period the extent of cultivation of *Samba* season paddy is enormously high. It indicates that the farmers give up *kuruvai* crop due to non-availability or delayed supply of canal water and go for single seasoned *Samba* crop in full swing. Due to these reasons, the extent of *Samba* crop exceeds 4.5. or 5.0 lakh ha., which is sufficiently higher than the normal area under cultivation during this season. So, delayed opening of reservoir causes uncertainty in *kuruvai* cultivation and force the farmers to take the single crop in *Samba* seaons in their double crop land.

kuruvai and *thaladi* crops are linearly related, and there appear narrow differences for them. If there is decrease in the area under paddy during *kuruvai* there is similar reduction in the area under cultivation of *thaladi* season. However, in almost all the years reported here, the extent of *thaladi* cultivation is below the level of *kuruvai* cultivation. This can be explained in two ways. First, farmers who have opted for crop rotation in their part of cultivable area or entire area will stop the *thaladi* cultivation in order to cultivate crops like cotton and sugarcane. Second, delayed *kuruvai* cultivation (as a result of delayed opening of reservoir) makes the farmers reconsider the extent of delayed *thaladi* cultivation and escape from the uncertainty of water supply prevailing in the maturing stage of the crop. Due to these reasons in almost all the years the extent of *Thaladi* cultivation is significantly below the extent of *kuruvai* cultivation.

Normal area of cultivation of all seasons altogether comes to 7.56 lakh ha. Actual area under cultivation of all seasons never touched this normal level during the reported period. Exceptionally, in the year 1992-93 the actual area of cultivation comes closer to the normal area, after that the actual areas under total cultivation of paddy is far below the normal area. So, the facts indicate that the area under cultivation of paddy in the entire Cauvery delta is decreasing to a greater extent, and it fluctuates with the date of opening of reservoir.

WATER UNCERTAINTY AND ALTERNATIVE STRATEGIES OF THE FARMERS

This section analyses to what extent water uncertainty exists for the cultivators at the village level? What is the impact of water uncertainty? How does it affect different size group farmers, and what are the coping strategies adopted by different land size group farmers? And,

finally it provides some policy suggestion to safeguard the interest of small and marginal land holders with the view to making the equity and sustainability of use of water.

As mentioned earlier the study conducted in the select villages of *Cauvery* delta, which spreads in the three districts viz. *Thanjavur, Nagapattinam* and *Thiruvarur. Gopurajapuram* of *Papanasam taluk, Thiruvisanallu*r and *Thiruppanandal* of *Thiruvidaimaruthur taluk*, and *Punalvasal* of *Thiruvaiyaru taluk*, *Mathirimangalam* of *Mayiladuthurai* taluk and *Sithanvaloor* of *Valangaiman* taluk are the sample villages of the study. First four of them belong to *Thanjavur* district and each one of the last two villages comes from *Nagapattinam* and *Thiruvarur* districts, respectively. Primary data have been collected among 448 sample farmers with different farm-size holdings. Data collected from the sample farmers are analysed in the following sections.

Distribution of Sample Farmers

Land is a basic factor for farming. It is available for farmers in different sizes. Indian land holding pattern is highly skewed one. Farmers are generally classified on the basis of their size of land holding. It is important factor which determines most of the farm decisions – copping, crop rotation, crop scheduling, irrigation and other investments, etc. - are made on the basis of farm size. Similarly, farm size also influenced by many social, economic, institutional, and cultural factors. So, the study considers farm size as a controlling factor.

Table 3 provides detailed information on the size of land holding of sample farmers in the six sample villages. Here, land holdings are classified as *sub-marginal* (1 acre and less), *marginal* (1.01 - 2.50 acres), *small* (2.51 – 5.00 acres), *medium* (5.01 – 10.00 acres), and *large* (10.01 acres and above).

Sub-marginal and marginal land holders jointly accounts for more than 50 per cent in the total sample farmers. Small land holders are just more than one-fourth of the total farmers selected for the study. Medium and large land holders jointly share less than one-fourth in the total samples. Sample villages differ in land size and number of farmers. So, the size of the samples naturally differs from village to village in the study. Among the sample villages *Sithanvaloore* and *Punalvasal* are relatively smaller in size and each has less than 10 per cent in the total samples selected for the study. Other four villages give 17 to 23 per cent to the study. Except *Thiruvisanallur* village, the sample villages have more or less similar pattern of land distribution and thus sample pattern.

Table 3: Distribution of Sample Farmers according to Villages and Farm Size

(Number of HHs)

Sample Village	District	Number of Farmers					All Farms
		Sub-marginal	Marginal	Small	Medium	Large	
Punalvasal	Thanjavur	10	15	13	3	3	44
Gopurajapuram	Thanjavur	26	17	19	9	7	80
Thiruppanandal	Thanjavur	27	33	31	7	6	104

Thiruvisanallur	Thanjavur	19	22	22	16	5	81
Mathirimangalam	Thiruvarur	21	25	21	2	8	101
Sithanvaloore	Nagapattinam	9	7	14	7	1	38
Total		112 (25.0)	119 (26.6)	124 (27.7)	63 (14.0)	30 (6.7)	448 (100.0)

Source: Field survey.
Figures in parenthesis indicate percentage to row total.

Observation of social factors like religion and castes are also important for the analysis. Among the total samples, 96 per cent belongs to Hindu religion and remaining to Christianity. It is worthy to note that none of the farmers belong to Islam. Christian farmers have small, marginal or sub-marginal land holdings and none of them have other higher holdings.

Farmers belong to different castes like *Vellalar, Naidu, Bhramin, Ahamudiayar, Ambalakkaran, Barbar, Devar* and Kallar*, Moppanar, Padayachi/Vanniyar, Yadava*, and different schedule castes. Farmers belonging to forward castes account nearly 20 per cent in the total sample farmers. Among the forward castes *Vellalar* is dominant one. Vanniyar/Padayachi is more doiminant, not only among the backward/most backward castes (68 per cent), but also in all castes taken together (42 per cent). *Devar/Kallar* is another important caste. *Ambalakaran* and *Yadava* are some other important caste in the sample. Farmers belonging to schedule caste occupy important place in farming and they jointly share 18 per cent. Table 4 provides detailed

Table 4: Distribution of Sample Farmers according to Castes

(Number of HHs)

Castes	Sub-castes	Sub-marginal	Marginal	Small	Medium	Large	All
Forward Castes	*Vellalar*	7	7	20	16	9	59 (13.2)
	Other forward castes	3	6	8	6	4	27 (6.0)
Total		**10**	**13**	**28**	**22**	**13**	**86 (19.2)**
Backward/ Most Backward Castes	*Agamudiyar*	3	-	1	1	1	6 (1.3)
	Ambalakaran	4	5	1	1	1	12 (2.7)
	Barbar	2	1	-	-	-	3 (0.7)
	Devar, Kallar	5	12	14	8	2	41 (9.2)
	Moopanar	3	1	-	-	-	4 (0.9)
	Padayachi, Vanniyar	43	57	53	23	12	188 (42.0)
	Yadava	1	1	1	3	-	6 (1.3)
	Other backward castes	6	5	5	2	-	18 (4.0)
Total		**67**	**82**	**75**	**38**	**16**	**278 (62.0)**
Schedule castes		**35**	**24**	**21**	**3**	**1**	**84 (18.0)**
All castes		**112**	**119**	**124**	**63**	**30**	**448 (100.0)**

Source: Field survey.
Note: Figures in parenthesis indicate percentage to column total.

information on distribution of farmers according to castes. It is important to note that higher proportion of farmers belonging to forward castes have higher level of land holding, whereas higher proportion of farmers from backward/most backward castes have relatively smaller holdings. Farmers of scheduled caste mostly have land size of 5 acres or less.

Nature of Land Ownership

Among the 448 sample households 64 per cent have own land. Exactly 50 per cent of the households have own lands which come ancestrally. Twenty-one per cent of the households have purchased land in the present generation. Eight per cent of the households have both ancestral and purchased lands. Higher proportion of farmers belongs to large and medium farm groups purchase land in the present generation, than farmers of other smaller holdings. Details of the land ownership are provided in Table 5.

Table 5: Land Owning Pattern of the Households

Particulars		Sub-marginal	Marginal	Small	Medium	Large	All Farms
Own	Wet	0.34	0.83	1.97	4.94	12.40	2.37
	Garden	Neg.	0.02	0.12	0.59	1.65	0.24
	All Land	0.34	0.85	2.09	5.53	14.05	2.61
Leased-in	Wet	0.54	1.05	1.75	2.09	3.74	1.44
	Garden	0.00	0.02	0.01	0.00	0.07	0.01
	All Land	0.54	1.07	1.76	2.09	3.81	1.45
Leased-out	Wet	0.08	0.02	0.03	0.03	0.11	0.04
	Garden	0.00	0.00	0.00	0.00	0.00	0.00
	All Land	0.08	0.02	0.03	0.03	0.11	0.04
Total Operational Holding	Wet	0.83	1.86	3.68	6.98	16.87	3.84
	Garden	Neg	0.04	0.13	0.59	1.73	0.24
	All Land	0.83	1.90	3.82	7.57	18.60	4.08

Source: Field survey.

Leased-out in the Past

Households leased-out mostly part of their land for various reasons. Here, the number of household leased out during 1991-95 is 47 and it is more or less same in the next five year period. However, this number is reduced to 31 for the period of 2001-05 period. It shows that the there is declining trend in the land leased-out by the farmers. However, the rate of reduction is not significant for the marginal holding. This reduction starts from the small, medium and large holdings. Whereas, in the case of sub-marginal holdings the number of farmers engaged in

land leasing-out has increased in the period under study. It shows that the more number of subsistence land holders leased-out their land because of water uncertainty.

Leased-in in the Past

Number of farmers leasing-in land is highly erratic during every five year. It has 162 households during 1991-95 and it is slightly increased to 177 in the next five years period. However, it is sharply decreased to 120 during the period of 2001-05. In contrast to that, it has increased to 246 in the year in which survey conducted, which accounts for 55 per cent. Change in the percentage of farmers in land leasing-in across farm size group does not show any uniformity. It is worthy to note that a significant proportion of sub-marginal, marginal and small land holders leased-in temple or trust lands. Percentage of farmers having temple or trust land comes around 23 per cent. A number of farmers in *Thiruvisanallur* and *Thiuppanandal* villages have temple and trust lands.

Cropping Pattern

When the canal water is certain, it is expected that the farmers of all farm groups will follow a similar crop pattern and the cropping intensity will be also more or less similar. Thus, it is important to observe the cropping pattern of the farmers in the study period and in the past. As reported in the previous chapters, the Cauvery delta is the rice bowl of Tamilnadu. So, as one can expect, paddy is a dominant crop. Paddy is cultivated in three important seasons, *kuruvai*, *thaladi/samba* and summer (*samba* is a paddy season. Cultivation period of this season is more or less similar and started one or two before the *thaladi* season. If the paddy is cultivated only once in year during September/October to January/February then the season is called as *samba*. Normally long duration verities will be cultivated in the *samba* season). Other major crops cultivated in the area are pulses. Pulses are normally cultivated in two paddy crop land – *kuruvai* and *thaladi.* Pulses of various kinds, including green gram and black gram are cultivated after the *thaladi* season. Pulses are cultivated mostly in rice fallow. One or two wetting is enough to harvest these pulse crops. A sizeable portion of farmers also cultivate gingili after the *thaladi/samba* seasons. Farmers without own irrigation will go for cotton or soya cultivation in the first season with the help of purchased water, and then they will cultivate *samba* with the help of canal water. Sugarcane, an annual crop is cultivated by the farmers with assured ground water irrigation. Banana is also cultivated in some packets. Vegetables, flowers, sunflower are cultivated in a minor portion of land. Coconut and mango are perennial tree crops of the garden lands. Following section analyses the actual cropping pattern followed by the sample farmers in the study year 2006-07 agriculture year.

***Kuruvai* Paddy**

Kuruvai paddy crop is cultivated only by 240 out 448 farmers taken for the study, which accounts for 54 per cent. Proportion of farmers goes for *kuruvai* paddy cultivation is not uniform for the all farm groups. The percentage of farmers who cultivate *kuruvai* paddy has sharply increased from 38 for sub-marginal to 80 per cent for large land holding groups. Average area under paddy cultivation by these 240 farmers comes to 3.72 acres. It varies from 0.88 acre for sub-marginal group to 10.89 acres for large farm group. Average size of land used for *kuruvai* cultivation under the sub-marginal exceeds the average land holding size of this group. This

indicates that many farmers who fall above average limit in this category mainly go for *kuruvai* cultivation. Yield of the paddy crop in this season narrowly varies between 27 and 30 bags (1 bag = 60 kgs.) per acre for different farm size groups. Average quantum of production also varies from 23 bags for sub-marginal farm group to 328 bags for large farm group.

Farmers of medium and large group have own irrigation. They start paddy cultivation practices in mid-May. They do not wait for release of water from Mettur reservoir. But, other groups particularly all farmers in sub-marginal group, most of the farmers in marginal groups and many farmers in small land owning groups depend on water market for *kuruvai* cultivation.

***Samba/Thaladi* Paddy**

Samba/thaladi is the most important season for paddy cultivation, because it occupies most of the land. More than 90 per cent of the farmers cultivate paddy in the season. The proportion of farmers cultivating this paddy crop varies thinly between 87 for large farm group to 98 for medium land owning group. Average area under paddy cultivation by these farmers also varies from 0.85 acre for sub-marginal group to 13.02 acres for large land owning group. In this season, farmers particularly in the first three land owning group largely depend on canal water. Farmers who cultivate *samba* paddy crop can cultivate with the help of canal water alone. But, farmers of *thaladi* and late *thaladi* crop, need at least three or four wetting with the support of water sellers. Average yield also slightly varies among the farm groups. Quantum of production largely varies from 23 bags from sub-marginal group to 362 bags for large land owning group.

Summer Paddy

A least proportion of farmers go for cultivation of summer paddy. Only 8 per cent, ie, 34 out of 448 farmers take this season. Except medium group, in all other groups less than 10 per cent of the farmers cultivate summer paddy. Average area under the paddy ranges between 0.92 acre for sub-marginal group and 10.00 acres for large farm group. Yield of paddy in this season is negatively associated with farm size. Production of paddy varies from 26 bags for sub-marginal farm group to 268 bags for large farm group. As reported earlier, farmers of sub-marginal, marginal and small farmers cultivate paddy with water market. Farmers, who take summer paddy will wholly depend on water market for the cultivation. But, farmers of medium and large group cultivate paddy in this season with their own bore well irrigation.

Cotton

Ninety-four out of 448 farmers cultivate cotton, which accounts 21 per cent in the total number of farmers. The percentage of farmers who cultivate cotton crop varies 17 for medium group to 24 for sub-marginal group. Farmers, who are not ready to take *kuruvai* crop, will go for cotton crop. This is strongly true in the cases of sub-marginal, marginal and small farm groups. Average area under cotton crop cultivation by these farmers ranges between 0.74 acre for marginal group and 3.08 acre for large farm group. Yield of the crop is negatively associated with farm size.

Black Gram

Black gram is cultivated in the rice fallow land after *thaladi/samba* seasons. It needs lesser irrigation. One or two wetting is enough to harvest the black gram. Proportion of farmers who cultivate black gram is positively associated with farm size. Average area under black gram

cultivation is worked out as 3.78 acres, and it ranges between 0.84 acre for marginal group and 10.50 acres for large farm group.

Sugarcane

Sugarcane is cultivated by the farmers who have assured irrigation. This crop is cultivated mostly by the famers of large, medium and small land holding groups, and farmers who have the chance of access of water market in the sub-marginal and marginal groups. Fifteen percent of the farmers go for sugarcane cultivation, and the average area of sugarcane cultivation becomes 3 acres. Yield of sugarcane crop is positively and strongly associated with farm size.

Banana

Banana is cultivated only by limited farmers in limited lands. Banana is cultivated in garden land alone. Less than 4 per cent of the farmers cultivate banana in their part of the holding. Average area under this crop is 1.26 acres, and it varies from 0.33 acres for sub-marginal group to 2.20 acres for medium group.

All Crops

Table 6 summarises all the crops cultivated by the farmers. 442 out of 448 farmers taken for the study cultivate at least any one or combination of few listed crops above. Five farmers from sub-marginal group and one farmer from small land owning group have stopped the cultivation in the reference year because of water problem. Gross cropped area for the farmers taken altogether worked out is 7.89 acres and it varies from 1.76 for sub-marginal group to 30.46 large group. Cropping intensity worked out is 212, 204, 189, 225 and 164 per cent for sub-marginal, marginal, small, medium and large farm groups, respectively. It indicates that, the cropping intensity is decreasing clearly with farm size, if we exclude medium size farm group. We should carefully interpret this situation. Here, the cropping intensity is relatively high for sub-marginal and marginal holdings, because these groups generally go for number of seasonal crops. But, in the case of small and large group, they go for much annual crops in their land and they have less cropping intensity.

Table 6: Cultivation of All Crops

Particulars	Sub-marginal	Marginal	Small	Medium	Large	All Farms
No. of farmers	107	119	124	63	30	443
Average area (acres)	1.76	3.88	7.21	17.04	30.46	7.89
Production value (Rs.)	17,815	38,782	79,362	1,66,397	3,84,947	85,714
Cropping Intensity (in %)	212	204	189	225	164	193

Source: Primary data.

Changes in the Cropping Pattern

Changes in the cropping pattern occur in the Cauvery delta for the past 15 years, slowly. 127 out of 448 farmers taken for the study have changed their cropping pattern either frequently or occasionally. Traditional paddy cultivators have two alternative crops, sugarcane (57 per cent farmers) and cotton (37 per cent farmers) largely in the wet land. Remaining farmers cultivate soya bean, palm oil, sunflower as alternative crops. We can classify the changes in the cropping pattern during the study period into three. First, sub-marginal and marginal farmers change their

cropping pattern in favour of cotton, because of water uncertainty and higher water charge prevailing in the water market for paddy crop. They go for cotton as an alternative crop relatively in larger area. Paddy requires more water than the cotton crop. Only limited number of farmers in these two groups goes for sugarcane as an alternative crop. Secondly, in reverse, farmers of middle and large land owning groups also shift their crop pattern in favour of sugarcane, because of attractive profitability (except few years) and reduce the burden of labour shortage. They seek more profit by cultivating sugarcane. At the same time, they mitigate the labour shortage by reducing paddy area and increasing sugarcane area. Finally, farmers of small land holding group act both ways. Farmers of this group with ground water sources go in favour of sugarcane cultivation and farmers without ground water sources go for cotton cultivation. Some of the farmers in small, medium and large income group try to cultivate alternative crops like soya bean, sunflower, and oil palm. So, water uncertainty plays a crucial role shifting the crop pattern largely among the sub-marginal, marginal and part of the small land holders in the delta villages.

Irrigation

In this section, the source of irrigation of farmers of different land size owning groups, canal water status and changes in it, causes for reduction in the water supply apart from uncertain water supply from the Mettur Reservoir, farmers' purchase of ground water, bore well erection, and related issues are analysed.

Source of Irrigation

Source of irrigation in the study year is presented in Table 7. Farmers get three types of irrigation: canal water alone, bore well water alone and conjective use bore well water with canal water. Percentage of farmers depending exclusively on canal water is none for large farm group and 11 for sub-marginal group. Farmers exclusively depending on bore well water ranges between 20 per cent for sub-marginal group and 30 per cent for large farm group. Around 70 per cent of farmers from each group use ground water conjectively with canal water. Farmers of marginal, sub-marginal and most small land holders use bore well water conjectively with canal water. For this farmers depend on water market.

Table 7: Source of Irrigation

(No. of farmers)

Particulars	Sub-marginal	Marginal	Small	Medium	Large	All Farms
Exclusively canal water	13	8	3	1	-	25
Exclusively bore well water	23	33	26	13	9	104
Canal water and bore well water	76	78	95	49	21	319

Inadequacy of the Canal Water

The farmers are asked whether the canal water is adequate for the crops. One-fourth of the farmers alone reported that the canal water is adequate for the entire crops which depend on

it. Remaining three-fourth of the farmers who received canal water for the crop say that the water availability is inadequate and the percentages of shortage varies from 20 to 100 per cent.

Main causes for reduction in the canal water apart from delayed opening of Mettur reservoir are encroachment in the water canals and field channels, improper maintenance of canals and field channels. For more than 15-20 years, farmers are facing this kind of problem.

Water Purchase

In order to meet the canal water shortage, farmers go either for sinking a new bore well or depend on the water market. Sinking bore well and erecting water lifting devices require more time and money. So, farmers normally take part in the water market. They arrange water immediately for starving crops. Many farmers pay water charges for whole paddy season even though water for the crop is received one or two intermittent water supply, when canal water fails to supply adequately. Farmers mostly receive water from the water market for more than 10 years, and the number of farmers involved in it has increased considerably during the period under study.

Table 8: Water purchase by the Farmers

Particulars	Sub-marginal	Marginal	Small	Medium	Large	All Farms
Number of farmers purchase water	96	76	66	18	4	260
Percentage to the total farmers	86	64	53	29	13	58
Area under cultivation with purchased water	0.85	1.75	3.24	3.78	1.50	1.93

Table 8 furnishes details on water purchase by the farmers. In the survey year, 58 per cent of the farmers depend on water market. The percentage of farmers depending on water market sharply varies according to farm size groups. It varies 13 per cent for large farm group to 86 per cent for sub-marginal group. A significant portion of the farmers in medium and large farm groups also depend on water market. This is due to the fact that they have land at different locations. If a small piece of land of a particular medium or large farmer is located in an isolated place, he will depend naturally on water market for irrigation. Average area irrigated through the purchased water ranges between 0.85 acres for sub-marginal group and 3.78 acres for medium group, and it is 1.50 acres for large farm group. When we take all group farmers together, the area irrigated through purchased water becomes 2 acres.

Bore Well Irrigation

As a coping strategy, many farmers erect bore wells in order to meet uncertainty in the canal water. Farmers generally erect one or two bore wells in their land. Number of bore wells erected in the farms depend on many factors like, size of land holding, cropping intensity, nature of the crops cultivated, profitability of the farm, participation in the water market, availability of new power connection for the bore well motor, method of water lifting, scattered land holding,

etc. In the study, farmers are having number of wells from one to four. Two farmers have four wells, 25 farmers have three wells, 72 farmers have two wells and 221 farmers have single well.

Table 9: Details on the First Bore Well of the Farmers

Particulars	Sub-marginal	Marginal	Small	Medium	Large
No. of farmers	27	22	28	11	6
Percentage to the total farmers	9	45	75	62	30
Age of the well (years)	14	14	14	18	22
Average depth (in feet)	66	109	84	81	104
Width range (inches)	4	4-7	4-7	4-7	4-8
No. of electric motors	3	25	58	50	26
No. of diesel engines	6	20	17	12	4
Average amount of investment (Rs.)	22,328	28,259	45,011	38,536	44,405

Table 10: Details on the Second Bore Well of the Farmers

Particulars	Marginal	Small	Medium	Large
No. of farmers	2	16	28	26
Percentage to the total farmers	2	13	44	87
Age of the well (years)	13	9	11	12
Average depth (in feet)	60	67	70	112
Width range (inches)	4	4-7	4-8	4-8
No. of electric motors	1	10	27	26
No. of diesel engines	1	6	1	-
Average amount of investment (Rs.)	19,900	40,133	49,104	60,500

Tables through 9 to 11 provide details on the bore wells of the farmers. As mentioned in the previous paragraph, half of the total farmers taken for the study have own bore wells which are energized either by electric motor (73 per cent) or diesel engine (27 per cent). Horse power of the motors ranges between 5 and 7.5. The proportion of the farmers having first bore well ranges between 5 for sub-marginal group to 100 for large group. Age of the first well also varies considerably across the farm groups, and it varies from 14 years for sub-marginal group to more than 22 years for large farm group. It indicates that, large farm groups erected bore well in the early years when compared to other farmers. Average depth of the well also higher for large land owning group and it varies from 66 feet for sub-marginal to more than 100 for marginal and large group. The diameter of the well is relatively larger for higher land owning groups. Cost of

the wells erected also positively moves with farm size from Rs.22 thousands for sub-marginal farmers to Rs.44 thousands for large farmers.

Tables 11: Details on the Third and Fourth Well of the Farmers

Particulars	Small	Medium	Large		Large
No. of farmers	1	10	14		2
Percentage to the total farmers	1	16	47		7
Age of the well (years)	11	8	14		7
Average depth (in feet)	40	65	102	Fourth Well	160
Width range (inches)	4	4	4-8		8
No. of electric motors	1	9	14		2
No. of diesel engines	-	-	-		-
Average amount of investment (Rs.)	33,000	30,450	47,312		81,250

Second well is available for only 16 per cent of the all farmers taken together for the study. Percentage of farmers having second well varies from zero for sub-marginal, 2 for marginal, 13 for small, 44 for medium and 87 for large farm groups. Average age of the well narrowly varies from 9 to 13 years. The depth and width of the bore wells erected directly varies with farm size. Almost 85 per cent of the bore wells are energized with electric power. Remaining farmers have diesel engines to lift water from the wells. Investment in the second well ranges from Rs.20 thousand for marginal farmers to Rs.61 thousand for large farmers.

25 out of 448 sample farmers have third well. The percentage of farmers having third well accounts one for small farmers, 16 for medium farmers and 47 for large farmers. Age of the well ranges between 7 and 11 years. Average depth of the well also ranges between 40 feet and 102 feet. Almost all the motors in the third bore well are energized by electricity. Cost of the well ranges between Rs.33 thousands and Rs.47 thousands. Two of the large farmers have fourth well in their land. Average age of these wells is 14 years and average depth is 160 feet and cost incurred is Rs.81 thousands.

Water Market

As reported previously 58 per cent of the farmers are engaged in water buying for their paddy, pulses and cotton crops. In the normal years, if canals and field channels are maintained properly then there is no need for water purchase for samba paddy. Canal water supply is enough to irrigate this paddy crop. But, if the farmers without bore wells cultivate either *kuruvai* or thaladi, he wants to purchase water. Regarding the *kuruvai* season, nursery preparation starts in the month of mid-May. The Mettur Reservoir will be opened normally on June 12th. Water will reach the delta cultivation in full swing at the end of June. So, these farmers need water for one and half month for *kuruvai* cultivation. It forces the farmers to buy water. If canals are not

maintained properly in particular area, then water will not reach the tail end. Then farmers' water need is extended till the end of *kuruvai* cultivation.

Similarly, *thaladi* or *late thaladi* paddy cultivation requires water for more than 15 days at the end of cultivation. Because, the cropping practices of this season come to an end on mid-February. But, the reservoir will be closed normally 28th January ever year. So, farmers need irrigation up to mid-February for this paddy crop. Thus, farmers rely upon water market.

Pulses, particularly black and green gram, are cultivated in February in the rice fallow land. Seeds will be sown before harvesting the thaladi/samba crop. Moisture in the paddy field is good enough for sprouting of the seed. After that, one or two wetting is needed for harvesting the pulses. So, farmers without bore well will depend on water market. Cotton is cultivated as alternate crop of *kuruvai* paddy. The crop is cultivated in the months January/February and it will last till September. In this period the cotton crop requires 4 to 6 wetting. So, farmers depend on water market.

Generally, water charges for paddy crop paid in the kind form. Sellers charge 4 to 6 bags per season. If water is required for very limited period then the sellers will charge on hourly basis and it ranges from Rs.15 to Rs.50 per hour. The charges of water depend upon the number of sellers around the buyers, volume of supply, and demand for water. Eventhough water market is an unauthorized and unorganized one, rates are revised periodically according to the demand and supply conditions. Sometimes water is sold on lump sum basis for cotton and paddy crops. This rate varies from Rs.500 to Rs.3000 per acre, per season, according to the crops cultivated.

Encroachment in the canals, improper canal maintenance, variation in opening and closing dates of reservoir, shortages in the reservoir supply give boost for water market. Most of the medium and large farmers are water sellers, and at the same time most of the sub-marginal, marginal and small farmers are water buyers. Water buyers mostly feel that the current water charges are normal one.

Crop Reduction

Most of the farmers give up the *kuruvai* and summer crops due to canal water uncertainty. Paddy and pulses production of these farmers are affected by the canal water uncertainty. In the survey six farmers – five from sub-marginal farm group and one from small farm group completely give up the crops, because of canal water uncertainty.

Ground Water Depletion

Ground has depleted sharply because of excessive use of ground in the delta villages. It is evident from the opinion of the farmers, the ground water depletion occurs from 20 to 60 feet in the last 20 years period. It is also confirmed by observing the changes in the average depth and width of bore wells erected in over a period of time.

Alternative Land Use

Farmers give up the land occasionally for brickworks. When the land gets silted, then farmers use it for brickworks. But, farmers are not ready to give up their land for this purpose due to canal water uncertainty.

Natural Calamities and Crop Insurance

Many farmers are unaware of crop insurance scheme. Even though some of them may be aware of the scheme, they are not ready to participate in it because of the practical difficulties and the farmers feel that the scheme is not farmers-friendly. Some of the farmers getting loan from cooperative societies participate in the insurance scheme. But, many farmers are not compensated properly when they face natural calamities like floods, droughts, winds, widespread pest attack or any other man-made losses.

Alternative Crops

Most of the farmers suggest alternative crops for the future to reduce water usage in the delta like, sugarcane, cotton, oilseeds like gingelly and sunflower, soya bean, etc. According to the farmers, these crops are highly suitable for many villages in the delta, and introducing these crops as an alternative to paddy will considerably reduce the water demand.

From the above analysis the extent of water uncertainty in the canal commands, the extent to which the farmers are affected differently by water uncertainty, and alternative measures taken by them to cope up the situation are understood.

FINDINGS OF THE STUDY

Followings are the main observations made on the basis of analyses carried out on secondary and primary data collected for the study. Date of opening and closing of *Mettur Reservior*, which regulates water supply for the Cauvery Delta System, is highly erratic against the normal dates opening and closing on June 12th and January 28th, respectively. This makes canal water supply highly uncertain for the farmers of the Cauvery Delta. As continuation, farmers of the system follow different strategies to manage the situation. Paddy is major crop in the delta area, and lesser scope for other crops. Previously paddy is cultivated in three different seasons viz. *kuruvai* (by 54 per cent of the farmers), *thaladi/samba* (90 per cent) and summer (8 per cent). Pulses also cultivated during the summer after *thaladi/samba* season. Other crops like cotton, sugarcane and banana are also cultivated. Rate of land lease-out is more in the cases sub-marginal and marginal when compared to other groups. Nearly 30 per cent of the farmers adopt crop pattern changes frequently and more frequently to manage the water scarcity. Poor farmers - mostly belong to sub-marginal and marginal groups - leave the land as fallow during *kuruvai* and summer seasons. Many of the farmers of these groups along with small farmers depend on water market to assure the crop harvesting in the *thaladi/samba* season. They rely upon the medium and large farmers for water purchase. Cropping pattern and irrigation intensity are not affected for these groups for medium and large groups. They sink number of additional wells, increase the depth of the wells and switch over high-powered pumps in order to meet the canal water shortages. They also make money by selling water for sub-marginal, marginal and small land owning groups. Farmers of medium and large group continuously engaged in extracting more water at the cost of all lower land owing groups. It gives pressure on the sustainability of water resources of the region concerned. Cost of cultivation of the poor farmers increased significantly and land resources kept unproductive for one or two seasons in a year.

SUGGESTIONS

The study offers following policy suggestions to improve the conditions of sub-marginal, marginal and small land holders, who suffered from uncertain canal water supply, inequitable access of ground water and lesser investment opportunities.

- **Construction of Community Bore Wells** will be a suitable solution to the farmers of marginal and small holdings, provided lands of them are located in a close circle. Farmers of these groups are unable to construct separate bore wells in their farms, since they have small and uneconomic land holdings. Government and non-governmental organizations may give their hands to such farmers to construct community bore wells. By using the local knowledge, existing field channels and proper planning may avoid technical problems that will be raised at the time of construction of community bore wells as well as distribution of ground water.
- **Government should regulate the existing unauthentic irrigation water market in the farm sector.** Mostly farmers, relatively larger land holdings, are engaged in water selling (since their deep bore wells deliver sufficient water and further their wells that are mostly energized by electric pumping). Every farmer has equal right to access ground water, since the ground water aquifer is a common property. Government's duty is inevitable to safeguard the interest of marginal and small farmers who purchase water at higher rates from landlords and spending a considerable proportion of farm revenue as water price. Further, the State Government provides free electricity to farm sector. So, it has ample right to control the unauthentic and exploitative ground water market.
- Farmers of smallholdings have reasonable size of land and they are willing to construct bore well for crop husbandry. However, they are unable to construct wells since the non-availability of credit from institutional sources. So, the **Government and financial institutions should give priorities in provision of loan to the farmers who are willing to construct bore well in the delta region.** This measure can help them face the uncertain canal water supply.
- A reasonable number of farmers, particularly from small farmers group, already sunk bore wells that either inoperative (waiting for power connection for them) or under-operative with the help of diesel pump set (since, the running cost of diesel pump set is very high compared to electrified one). **Priority in the provision of power connections** to the bore wells of these farmers may reduce their burden born out of uncertain canal water supply.
- **Periodical removal of encroachment in the canals and field channels** help the farmers to get adequate water during the canal water supply periods. Further, removal of encroachment and periodical desilting may be helpful in arresting depletion and improving the ground water level. Government machineries should be geared up in this direction.

- As a demand side measure, intensive campaigns are needed **to create awareness among the farmers to drive them in favour of shifting crop pattern from high water-intensive to low water-intensive.** Government supports are needed in the forms of provision of basic inputs like quality seeds, technical know-how, and marketing facilities for the sustainability of alternative crops will be introduced.

CONCLUSION

Even though there is a slackening in the share, the role of agriculture sector in the national economy is important one. India is a country with large number of small and marginal peasants. They supply food for people, satisfy the food needs of their households, provide fodder to their own cattle, create purchasing powers to buy industrial commodities as well as services, and so on. We can't simply ignore economic contributions provided by them. Inter-sectoral competition and inter-state disputes over sharing the water resources, and changing political-economic policies are gradually affecting the farming communities, particularly the small peasants. At the same time, capable farmers are maximizing the welfare at the cost of welfare lost by marginal and small farmers, in an exploitative manner. So, timely, effective and proper distributive mechanisms and processes are needed to reduce the widening disparities in the disintegrated society.

References:

Bhatia, R., and Falkenmark, M. 1992. Water resource policies and the urban poor: innovative approaches and policy imperatives. Background paper prepared for the ICWE, Dublin, 26-31 January 1992.

Bhatia, R., Cestti, R., and Winpenny, J. 1994. Policies for water conservation and re-allocation: good practice cases in improving efficiency and equity. World Bank Technical Paper, World Bank, Washington, DC.

Comeau, A. 1993. Water for a sustainable human nutrition: inputs and resources analysis in arid areas. A Summary. Internal paper, FAO, Rome.

Dixon, J., *et al.* 1988. *Economic analysis of environmental impacts of development projects.* London: Earthscan.

Environment Agency . 2001. *Water resources for the future: A strategy for England and Wales.* Available online.

FAO. 1993. *The State of Food and Agriculture.* FAO, Rome.

ICWE. 1992. *Development Issues for the 21st Century.* The Dublin Statement and Report of the Conference, Dublin, Ireland, 26-31 January 1992. Geneva: World Meteorological Organization.

Kulshreshtha, S.N. 1993. *World water resources and regional vulnerability: impact of future changes.* International Institute for Applied Systems Analysis, Laxenburg, Austria.

Mallick, Jgannath. 2009. "Trends and Patterns of Private Investment in India". Working Paper 226, Institute for Social and Economic Change. Banglore.

Munasinghe, M. 1990. Managing water resources to avoid environmental degradation: policy analysis and application. *[World Bank] Environment Working Paper,* No. 41.

Rogers, P. 1992. Comprehensive water resources management: a concept paper. World Bank, Washington DC.

Sampath, R.K. 1992. Issues in irrigation pricing in developing countries. *World Development* 20(7): UN [United Nations]. 1992. *Agenda 21.* United Nations, New York.

Shiklomanov's. "World fresh water resources" in Peter H. Gleick (ed.), 1993. Water in Crisis: A Guide to the World's Fresh Water Resources. Oxford University Press. New York.

Status of Cauvery Delta Agriculture – Constraints and Solution. 2006. Report of the Federation of Farmers Association, Thanjavur, Nagapattinam and Thanjavur.

United Nations World Water Development Report. 2009. Water in a Changing World.

World Bank. 1992. *World Development Report: Development and the Environment.* Washington DC: World Bank.

World Bank. 1993. Water Resources Management: a policy paper. World Bank, Washington DC.

World Commission on Dams .2000. *Dams and Development: A New Framework for Decision-Making*, Earthscan, London, [last accessed December 2004].