CHAPTER I

“Water is probably the only natural resource to touch all aspects of human civilization for agricultural and industrial development to cultural and religious values embedded in society”.

-Koichiro Matsuura, Director General, UNESCO.

1.1. INTRODUCTION

Irrigation is one of the major factors in the growth of agricultural production in many developing countries, especially in the South and South East Asian Countries. Likewise, India is one of the Asian countries facing this resource constraint. The problem of water scarcity in the agriculture and allied activities is questionable. As per the Indian topography the north India having perennial rivers has better perennial water resource than South India which does not have a perennial river. When India started the planning process (1950 – 51), the share of agriculture in the GDP was 55.3 per cent due to emphasis placed on the development of secondary and territory sectors during successive Five Year Plans, the share of agriculture in the GDP has declined to 37.9 per cent in 1980 – 81 and to 14 per cent in 2011 – 12.

Irrigation is quite vital for the agriculture of all countries located in the tropical region. There are over 250 million hectares of irrigated land in the world representing more than 17 per cent of the total cultivated area. In India irrigation

---


plays an important role in the agriculture sector currently, nearly 45 per cent of the
175 million hectare of the country’s cropped area is irrigated\(^3\).

India has different types of irrigation systems namely canals, tanks, wells
and others. The regional analysis of state-wise data reveals that tank irrigation is
more prevalent in the southern regions like Tamil Nadu, Andhra Pradesh and
Karnataka. These tanks are the traditional sources of irrigation in Tamil Nadu; in
which a few tanks are more than 1000 years old. 80 per cent of irrigation in
Sivagangai, Madurai and Ramanathapuram districts depends on tank irrigation
source\(^4\).

The development of tank irrigation system in Tamil Nadu concentrates on
modernization of the existing systems with a view to increase the area under
irrigation and intensity of irrigation. Tank irrigation is economically profitable. At
present, the condition of many tanks is deteriorating rapidly. The tank irrigation
authority may fix higher water rates because it can provide better service for
upgrading the performance of irrigation tanks for the benefits of rural community.
Traditional methods of irrigation create conflicts among the water users while the
modern methods promote optimum utilization of water. Besides, it increases the
storage capacity of tanks that can be used to irrigate additional land area which may
require additional input such as labour, manures, fertilizers, pesticides, etc., but
many tanks are not in good condition in South India particularly in Tamil Nadu.

---

\(^3\) Kaushik Basu, “The Oxford Companion to Economics in India”, *Oxford University Press*,
New Delhi, 2007, p.316.

Irrigation is one of the key factors in agricultural development and its impact on cropping pattern, farm income and employment in Indian agriculture has been extensively studied. The role of irrigation in expanding crop output in reducing output instability and in providing considerable protection to the farm sector against periodic drought has emerged in good measure. Irrigation and cropping patterns follow the same old patterns in spite of various technologies available and hence the wastage of water with less productivity.

Several studies indicate that the improved water availability of irrigation brings a positive change in the land use pattern, cropping pattern and cropping intensity as well as increase in the land productivity substantially. It was rightly points out by Dhawan (1991) the growth of crop depends on various sources of irrigation. It helps to create more employment opportunities to the rural people. It is now widely acknowledged that agricultural water management can have positive impacts far beyond the economics of crop production.

---


9 www.unesco.org/water/wwap
Asian continent is highly populated in the world. It has 60 per cent of the world population followed by Africa with 12 per cent of the world population. These two continents facing the problem of growing population have to meet out their food and water. Irrigation is stagnant across the Asian continent. Instead, Africa has received a sufficient irrigation potential\textsuperscript{10}.

The world population growing at the rate of 80 million people per year necessitates freshwater demands of about 64 million cubic meters per year. An estimated 90 per cent of the 3 billion people who are expected to be added to the population by 2050. They will be in developing countries and several regions where the current population does not have sustainable access to potable drinking water and adequate sanitation\textsuperscript{11}.

As demand for water increases in order to satisfy rising agricultural, industrial and residential needs, aquatic ecosystems struggle to respond. Countless communities depend heavily on rivers, both for direct water use and as a source of energy. But as upstream populations increase their demands, downstream communities have less water available to them. In some cases, rivers become so overexploited that they cease to exist altogether.

South Indian states like Andhra Pradesh, Karnataka, Maharashtra and Tamil Nadu have 1.6 million hectares of area irrigated by tank irrigation, out of 3.2 million hectares in India. The growth of area under tank irrigation in Tamil Nadu

\textsuperscript{10} www.iwmi.org/publications.

has declined from in 16.35 per cent to 15.23 per cent from 1990-91 to 2000-01. India has 1869 cubic km. of total natural runoff. Out of which only 690 cubic km. of surface water resources and 432 cubic km. of ground water resources are in the form of utilizable resources. Around 16 per cent of the world population residing in India possesses only 4 per cent of world water resources. Therefore the pressure on water resources in India is very high\(^\text{12}\).

The National water policy 2002, envisaged integrated water resources, water conservation demand; like quantity and quality aspects, resettlement and rehabilitation aspects project under affected persons. It is encouraged to private participation with development of water use in efficient manner, wherever feasible with view to introducing innovative ideas and introducing corporate management. The irrigation potential through major, medium and minor irrigation projects has increased from 22.6 million hectares to 102.77 million hectares from 1951 to 2007.

India has the second largest irrigated area in the world, but due to rapid expansion of irrigation, with its emphasis on new construction of irrigation performance and irrigation management needs have not yet had adequate attention. The public sector irrigation failed to get its potential, which is largely due to under investment in the maintenance of infrastructure, rehabilitation as well as major investment to invest in the management capacity\(^\text{13}\). It clearly indicates that from 1990-91 to 2006-07, per annum growth in net area under irrigation was negative for


canals (-1.3 per cent) and tanks (-3.5 per cent), and positive for tube wells and other wells (2.3 per cent), and other sources (4.7 per cent). In 2006 – 07, nearly 60 per cent of area under irrigation was through wells/borewells. In 1999-2000 prices public gross fixed capital formation in agriculture as a per cent of agricultural gross domestic product declined from 5.3 per cent in the Ninth Plan (1997-98 to 2001-02), and then increased to 3.0 per cent in Tenth Plan (2002-03 to 2006 – 07). Despite revival in recent years, inadequate public investment in bore wells and along with a tragedy of the commons, having implications on indebtedness.\textsuperscript{14}

Several methods were followed to reform irrigation system, often in combination with each other. Nearly fifty countries including Australia, India, Mexico, Philippines and Turkey suggest decentralization, devaluation, privatization and the development of public private partnerships for irrigation managements in all possible ways to be introduced.

To increase crop yield, proper development and management of irrigation is of paramount importance since the success and efficiency of their inputs are dependent on the quantity, quality and timing of water supply and the control over it. The role of irrigation has been significant in increasing the crop yields. The five-year plans have assigned higher importance for building dams across the big rivers in the country. The introduction of hybrid and high yielding varieties received the required support from irrigation in achieving the goal of green revolution to feed the ever increasing population.

In the 10th Five Year Plan India has given emphasis to agriculture by allotting major share of water resources to agriculture. Agriculture sector accounted for 83 per cent followed by domestic use 4.5 per cent, industrial use 2.7 per cent and energy 1.8 per cent the remaining 8 per cent of water for other uses of environmental requirements during 1990. The plan intended to bring down the total demand for water 74 to 75 per cent, as well as 10 per cent of level to increase the efficiency an additional 14 million hectares could be brought under irrigation with existing capacities. The recent plans stresses on participatory irrigation management program as the key element of strategy.

According to the Eleventh Five Year Plan (2007-2012), India has 2.4 per cent of the world’s total area; it has 16 per cent of world population; but she has 4 per cent of the total fresh water available. That is why it clearly indicates that the need for water resource development, conservations and optimum use. Even though the country’s population had increased manifold, growth of water resources has remained stagnant for the last many years and without increase in water supply so higher Gross Domestic Product could not be achieved, it is important for us to recharge our water bodies15

In India, the scope for horizontal expansion of land virtually exhausted for increasing agricultural production. Therefore, to investigate on multiple sequences is required. The intensity of crop components in the crop sequence also influences the productivity and economic returns, increases the optimal productivity by means

of multiple cropping is alternative one, similarly which is also possible through expansion of irrigation facilities.

Economic and social development, to a great extent, depends upon the creation of surplus agricultural produce. This often requires extension of agriculture through new irrigation projects or the improvement of existing irrigation systems and practices to ensure optimum land utilization through efficient water use. Improved Water Management can probably do more towards increasing agricultural production, both of food and non-food crops in the irrigated areas of the world than any other agricultural practice.

The water use efficiency in most Indian irrigation system is low in the range of 30-40 per cent against an ideal value of 60 per cent. Low water use efficiency leads to lower productivity, inequity in supplies to tail-enders and water logging and salinity. Major reasons attributed to this low water use efficiency are basically due to low water rates and poor participator irrigation management. All these are interrelated and need to be tackled as a package of measures to improve the water use efficiency. The package should include modernization, conjunctive use of water, provision of tamper-proof outlets, promotion of water saving devices and back ended subsidy-cum-loan scheme.

In India, utilization of water in agriculture varies considerably across states and between seasons depending upon the availability of supply. The availability of water from various sources also makes differences in its utilization. For instance, when water is provided through canals and it is not measured by volumetric basis, it is likely that more water is used for the specified crop than it is provided through
pumping source like, well irrigation. This difference is mainly due to cost factor in availing of water from the specified source. However, it should be noted that even though water is used from different sources with specified quantity there has been wide variations in the productivity of same crop.

Tank rehabilitation, raising the tank bund, desilt, repair of sluices and weirs which will improve the water storage. For proper utilization of water resources, these tank structures should be maintained by avoiding encroachment, reducing the siltation of tanks and proper water distribution among the command area farmers as a result it promotes equity in terms of income and wealth.

According to the Agricultural Census of India, 40 per cent of small farmers (less than 1 ha) and medium farmers (1 ha to 2 ha) depend on tank irrigation in 1970–71 which, further increased to nearly 55 per cent in 1990 – 91. Therefore, it is accounts for two-thirds of the tank irrigated area. On the other hand, the share of the large farmers (more than 2 ha) 13.59 per cent to 6 per cent declined during the same period. It reveals that the small farmers cannot afford, cost intensive irrigation systems like ground water. Even today tank irrigation plays a crucial role in small, medium and large farmers farming activity.

The Tamil Nadu Public Works Department estimated 80 per cent of ground water or well water is recharged from tanks and remaining is recharged from canals and water courses. It clearly indicates that the irrigations are entirely depending on tanks\textsuperscript{16}.

Sengupta’s study indicates that tank irrigation is an attractive proposition to farmers because it is estimated that the average net returns from tank irrigation in terms of food grain production is about three times higher than that of un-irrigated lands. Similarly irrigation has made a major contribution to the increase in agricultural and food grains production in India. So, water resources must be utilized and conserved rationally and efficiently. About 40 per cent of the gross cropped area under tank irrigation; the productivity of one hectare of gross irrigated area is reported to be 2.75 times of productivity of un-irrigated area.

In modern days irrigation constitutes the main use of water, its accounted of 84 per cent of total water withdrawals. The comparison on share of per capita withdrawals between the developing country like India and developed country like China by domestic and industrial is 59 m$^3$ per persons and 132 m$^3$ per persons respectively. However, with increasing urbanization and growing population of per capita demand in domestic needs, industrial requirements and other sectors are expected to increase and become competitive with irrigation. Contribution in public surface irrigation is declining, due to inadequate big reservoir of dams and small reservoir of tanks storage capacities and poor maintenance of public irrigation infrastructures.

---


Irrigation is used to reduce dependence on rainfall for agriculture and to inject dynamism in India’s agriculture by providing secured water supply to the crop. It increases the agriculture production through multiple cropping and also helps to attain self-sufficiency, to avoid import of food grain. Irrigation helps small and medium farmers with adequate water supply for intensive cultivation. It ensures proper and sustained growth in dry wet areas. Appropriate irrigation methods increase the productivity of land. At the same time, suitable irrigation facilities reduce regional disparities, income inequalities, and improve purchasing power of rural community to maintain price stability.

Pressure on water resources is particularly acute in arid regions that support agricultural production or large populations-regions where water use is high relating to water availability. The Middle East, Central Asia, North Africa, South Asia, China, Australia, the water United States and Mexico are especially prone to water shortages.

Falling water tables are less obvious indicators of global water shortages than disappearing lakes and dry riverbeds. Yet groundwater reserves are becoming increasingly depleted at end use of Paleolithic age reserve, due in large part to the rise in irrigated area and the growing use of water for industrial purposes. Fossil aquifers which supply irrigation water to some of the world’s major grain producers are of particular concern because they cannot be replenished.

Aquifers are being overexploited in major food producing regions, including the North China Plain, a region that yields half of China’s wheat and
one-thirds of its corn; Punjab, Haryana and other highly productive agricultural states in northern India; and the southern Great Plains of the United States, a major grain producing region. Together China, India and the United States produce nearly half the world’s grain, and these three countries plus Pakistan collectively account for over three fourths of the world’s reported groundwater extraction for agricultural purposes.

Global freshwater that used to triple during the second half of the twentieth century as population more than doubled and as technological advances let farmers and other water users pump groundwater from greater depths and harness river water with more and larger dams. As global demand soars, pressures on the world’s water resources are staining aquatic systems worldwide. Rivers are running dry, lakes are disappearing and water tables are dropping, nearly 70 per cent of global water withdrawals from rivers, lakes and aquifers are used for irrigation, while industry and households account for 20 and 10 per cent respectively.

The crucial role of water can be gauged from the MIT prediction that “if at all there is going to be third world war, it would be for the sake of water”. The world is passing through a critical phase with regard to water and looking the future trends, the picture regarding water is very gloomy.

**1.2. STATEMENT OF THE PROBLEM**

The present study investigates the growth of tank irrigation, household income and expenditure, impact on employment pattern, cropping pattern, cropping intensity and investment by different categories of farms.
In Ramanathapuram district the R.S. Mangalam Big Tank (RSMBT) receives water from Sarugani River, Vaigai River and Suriankottai River. Since there is frequent failure of monsoon, the availability of water from the rivers and reservoirs is not sufficient as well as it’s like a rain fed tank.

The main issue of tank irrigation is silting of tank, even though during summer season raining also cannot capture in the tank bed. The siltation and open sluices have reduced the storing capacity of the tank. This problem has become very pronounced in the study area.

The tank irrigation has common problems like encroachment of tank bed area. The encroachers also reduce the storage capacity of tanks, because those people also cultivate in tank bed areas. Encroachers illegally open the sluices to avoid submerging of their crops in tank bed; this problem has become very pronounced in RSMBT.

The tank irrigation potential is under-utilized due to lack of tank management and poor maintenance. The shortage of power, exorbitant rate of electricity charges, scarcity of diesel, uncertain rainfall, lack of technology, instability of Government also induce the problems of the farmers and therefore there are many questions pertaining to these sources which need to be answered.

Encroachment is a common problem relating to tank irrigation. Many farmers are practicing unauthorized cultivation by utilizing the water from the tank for irrigation purposes. This practice results in reducing the supply of water to the authorized areas, moreover the next tank does not get an adequate supply of water.
The chain reaction that sets in makes the management of the tank irrigation more difficult and troublesome.

The functioning of tank irrigation is influenced by physical features such as encroachment, silt accumulation, inadequate and irregular supply of water to tanks and institution factors such as distribution of land development of well irrigation and lack of farmers involvement in the managing the tank. Hence, interactions of physical and institutional factors are to be considered to improve the performance of tank irrigation system. The problem therefore should be studied, thoroughly with a view to finding a practical solution for it.

The main issue of RSMBT could not keep common property rights to the villages. It consists of 20 sluices from which several villages directly and indirectly benefited by this tank. Maravar community people are dominant in this region, who play a vital role in tank activities. The Scheduled caste people are settled in upper land, that is why they cannot receive irrigation facilities easily; these farmers who relied on well irrigation. The RSMBT has not equally distributed. Similarly, the distribution of water also varies from sluice to sluice. Hence, sharing of water differs from sluice to sluice. As a result, it leads to conflict among the farmers.

As farmers mainly depend on tank irrigation, the failure of crop is unavoidable, due to low rainfall throughout the year. Well-irrigations are also absent in this region, due to the salinity of ground water. During heavy rainfall, the tank is over-flowed with flood. Heavy discharge often happens which creates heavy
soil erosion, damage to crops and wastage of precious water also. Water supply is obstructed as supply channels are encroached.

Keeping this in view, the present study is intended to analyses the RSMBT irrigation in Ramanathapuram district of Tamil Nadu.

1.3. OBJECTIVES

The main objectives of the study are:

1. To examine the socio economic conditions of sample farmers under tank irrigation.

2. To know the cropping pattern, cropping intensity and employment pattern under three categories of sluice system,

3. To examine the cost and return of various crops under RSMBT irrigation system during the period of study

4. To estimate the resources use efficiency of different categories of sample farmers

5. To suggest remedial measures for improving the existing system of irrigation in the study area.

1.4. DESIGN OF THE STUDY

Designing a suitable methodology and the selection of the appropriate analytical tools is very important for a meaningful analysis of any research problem that is undertaken. This section is devoted to a description of the methodology which includes the selection of state, district and taluk, selection of tank and selection of sample farmers’ collection of data and tools of analysis.
1.4.1. Selection of State, District and Taluk

The researcher has selected Tamil Nadu due to physical proximity and easy environment to access the collecting of relevant data, enough scope for future development of tank irrigation system, net irrigated area as well as irrigated area is high under tank irrigation system.

District and taluks were taken into account because the highest proportion of net irrigated area and the irrigated area under tank irrigation. R.S. Mangalam, Tiruvadanai taluk in Ramanathapuram District represent the highest proportion of net irrigated area as well as area irrigated under tank irrigation system is high.

1.4.2. Selection of Tank

For the purpose of an in-depth study, researcher has selected R.S. Mangalam big tank located in Tiruvadanai taluk. It covers an area is 5225.66 acres the length of tank bund is 19.80 km, the capacity of the tank at Full Tank Level (FTL) is 1205 mcf. As the ground water is salinity and alkalinity in nature, a study on R.S. Mangalam of Ramanathapuram district tank irrigation is very much essential.

1.4.3. Selection of Sample Farmers

The total number of farmers in RSMBT is 4676. The sample size is 300 farmers and these farmers (more than 6 per cent) are proportionately divided into three categories viz., first come seven sluices considered as a head sluices (87 sample farmers out of 1314 farmers), from eight up to fourteen sluices considered as middle sluices (105 sample farmers out of 1675 farmers) and remaining sluices
considered as tail-end sluices (108 sample farmers out of 1687 farmers). Spreading of sample size classes divided into three categories such as small farmers, medium farmers and large farmers.
1.4.4. Collection of Data

The design of the study reveals that the primary data were collected through a survey of 300 sample farmers from 20 sluices spread across RSMBT of Ramanathapuram district during the agricultural year 2011 – 2012. A field survey was undertaken to know and understand the process and activities involved in tank irrigation.

Personal interview method was undertaken to collect various of information like cropping pattern, cropping intensity, yield, employment, input-output etc., and other aspects relating to the objective of the present study. Secondary data relating to rainfall, land utilization and population data were collected from various governmental reports and websites.

1.5. THE ANALYSIS OF THE STUDY

Separate production functions (log linear) were estimated for measuring the change in farm productivity within the group of the head, medium and tail-end sample farmers under tank irrigation.

The head farmers tank irrigation methods {Equation 1}

\[
\ln Y_1 = \ln a_1 + b_{11} \ln X_{12} + \ldots + b_{1n} \ln X_{1n} + e_1 \quad \ldots (1)
\]

For medium farmers tank irrigation methods {Equation 2}

\[
\ln Y_2 = \ln a_2 + b_{21} \ln X_{21} + b_{22} \ln X_{22} + \ldots + b_{2n} \ln X_{2n} + e_2 \quad \ldots (2)
\]

For tail-end farmers tank irrigation methods {Equation 3}

\[
\ln Y_3 = \ln a_3 + b_{31} \ln X_{31} + b_{32} \ln X_{32} + b_{33} \ln X_{33} + \ldots + b_{3n} \ln X_{3n} + e_3 \quad \ldots (3)
\]

\(Y_1=\)Gross value of output obtained with head farmers method of tank irrigation (₹)

\(Y_2=\)Gross value of output obtained in medium farmers method of tank irrigation (₹)
$Y_3 =$ Gross value of output obtained in tail-end farmers method of tank irrigation (\textcurrency)

$a_1, a_2$ and $a_3 = \text{the intercepts of head, medium and tail-end tank method of tank irrigation respectively.}$

$b_i =$ Output elasticity co-efficient of the $i^{th}$ input.

$X_{1n} =$ Independent variables in head farmers method of irrigation,

$X_{2n} =$ Independent variables in medium farmers method of irrigation and

$X_{3n} =$ Independent variable in tail-end farmers method of irrigation.

Independent variables were expressed in monetary terms (\textcurrency).

These were: human labour [$X_1$], bullock labour [$X_2$], seed [$X_3$], manure [$X_4$], fertilizer [$X_5$], plant protection chemicals [$X_6$] and irrigation expenses [$X_7$].

Cobb - Douglas type of production function was fitted to input – output data to estimate the resource use efficiency. Cobb – Douglas production was preferred for its computational easy. The regression equation has been derived by using the method of Least Squares. To find out resource use efficiency of factor inputs, the marginal value productivities of each of the input variables for small, large, medium and overall groups have been compared and equated acquisition cost and have been calculated at the geometric mean levels of independent variables by using the formula.

$$\text{Marginal value product of } i^{th} \text{ input variable} = \alpha_i \frac{Y}{X_i}$$

Where,

$Y = \text{Geometric mean level of gross returns of respective sluice}$

$X = \text{Geometric mean level of } i^{th} \text{ independent variable,}$

$\alpha_i = \text{the regression coefficient of } i^{th} \text{ independent variable.}$
1.5.1. Factor Analysis

Factor analysis is often used in data reduction to identify a small number of factors that explains most of the variance observed in a much larger number of manifest variables. Factor analysis can also be used to generate hypotheses regarding causal relationship between two more variables or to screen variables for subsequent analysis.

1.5.2. Eigen Values

Eigen values measure the variance in all the variables corresponding to the factor. Eigen values are calculated by adding the squares of factor loading of all the variables in the factor. It explains the importance of the factor with respect to variables. Generally factors with Eigen values more than 1.0 are considered stable. The factors that have low Eigen values (<1.0) may not explain the variance in the variables related to that factor.

1.5.3. KMO and Bartlett’s Test

Two tests namely, Kaiser-Meyer-Olkin measures of sampling adequacy (KMO) & Bartlett’s Test of Sphericity have been applied to test whether the relationship among the variables has been significant or not: If KMO value is greater than 7 means variables are highly reliable and factor analysis should be applied. If the KMO value is more than 5 means factor analysis may be applied. If the KMO value is less than 5 means it is not advisable to apply Factor analysis.
1.5.4. Measurement of Productivity of Resources

Measuring productivity of resources is a complex issue. Yet, economists and researchers have attempted to study productivity of resources and resource-use efficiency because such measures provide useful insights into the relationship between inputs and outputs.

There are two measures to calculate the productivity of a resource. They are:

1. Conventional measure and
2. Production function approach.

In the present study, the researcher has used the production function approach to find out the marginal value productivity of major agricultural crops in the sample farmers under RSMBT of Ramanathapuram District.

1.5.4. A Production Function Approach

In order to study resource use efficiency, that is how resources are used in select agricultural commodities under cultivation, production function analysis was adopted. Cobb-Douglas production function has been the most popular in empirical research. This algebraic model provides a compromise between (a) adequate fit of the data, (b) computational feasibility and (c) sufficient degree of freedom unused to allow for statistical testing. As there were differences in major selected agricultural commodities in the terms of yield per acre in sample farmers of Ramanathapuram district, separate production function was fitted for each crop under RSMBT of different sluice system.
1.5.5. Measurement of Variables

A) Dependent Variable

a) Gross Income [Y]

It was defined as the per acre gross returns obtained by the sale of main products and by products in rupees.

B) Independent Variables

a) Value of Human labour [X_1]

Human labour was measured in man-day units of eight hours of work for each man-day. All the permanent family and hired labour were considered alike and the value was calculated as per existing wage rates. In the present study, male and female labourers each of eight hours of work were considered as one man-day units as the basis of prevailing wage rates. The wage rates were ₹250 and ₹150/ day for male and female labour respectively.

b) Value of Bullock labour [X_2]

The value of bullock service was computed at the prevailing market rate. The value of human labour was deducted from it. Bullock labour was calculated as one unit for eight hours of work per day. Machine labour was included in bullock labour on the basis of the cost incurred in the use of machine labour. It was expressed in cost per acre basis.

c) Value of Seed [X_3]

Expenditure incurred on cost of purchase of seeds. In the case of farm produced seed, calculated by value at prevailing market rates.
d) Value of Manure [$X_4$]

Farm produced manure was valued at the prevailing market rate; whereas purchased manures were valued at their actual cost of purchase. In case of shifting manures at the rate of ₹ 250 per cart load was accepted.

e) Value of Fertilizers [$X_5$]

Fertilizers were valued by the quantity of fertilizers purchased per acres at market rate.

f) Value of plant protection chemicals [$X_6$]

Expenditure incurred on plant protection chemicals per acres.

g) Value of irrigation Expenses [$X_7$]

Irrigation expenses like wires cleaning, kudimaramathu and tank maintenances are calculated annually.

h) Depreciation

Depreciation was calculated by straight line method. Ten-year old building and Irrigation structure are 2 per cent, and others 5 per cent. The implements of minor and major depreciations constitute of 20 per cent and 10 per cent respectively.

i) Interest on Fixed Capital and Working Capital

Interest on fixed capital was worked out at 10 per cent per annum and interest on working capital was also worked out at 10 per cent per annum.

j) Land Revenue, Cess and other Taxes

The actual payments made were considered.

k) Yield

It was measured in terms of the physical quantity of produced in Kilos as well as in terms of its monetary value prevailing at the harvest time.
l) Net Revenue

It was obtained by deducting total cost (Cost C) from the total income.

m) Cost ‘A’

It includes value of hired human labour, value of bullock labour (owned and hired), value of seed (both home-produced and purchased), value of manures (both owned and purchased), value of pesticides, irrigation charges, land revenue, depreciation (implements and machinery), marketing and transport, and interest on working capital.

n) Cost ‘B’

It includes cost ‘A’ + rental value of land + interest on fixed capital.

o) Cost ‘C’

It covers Cost ‘A’ + Cost ‘B’ + value of family labour.

p) Family Labour income (Returns to Family Labour Management)

Family labour income was obtained by subtracting Cost ‘B’ from the gross income.

q) Net Income

Net Income was obtained by subtracting cost ‘C’ from the gross income.

1.6. CROPPING INTENSITY

The cropping intensity was measured in per cent term. It is measured as follows:

\[
C_i = \frac{\text{Gross Cropped area}}{\text{Net cultivated area}} \times 100
\]
1.6.1. Cropping Pattern

The term ‘cropping pattern’ denotes the distribution of crop in a given area of a farm, a village, a district or an agricultural region for a given period.

1.6.2. Farm Business Income

Farm business income was obtained by subtracting Cost ‘A’ defined in the various Farm Management studies, from the gross income.

1.7. SCOPE AND COVERAGE

The study focuses on three categories of farmers namely head, middle and tail-end, under tank irrigation. It covers RSMBT of Ramanathapuram district in Tamil Nadu for the purpose of an in-depth analysis and makes use of mainly primary sources of data. The reference year for the purpose of the primary data is 2012-13. Information and data were collected from small, medium and large farmers in twenty sluices of R.S. Mangalam block.

1.8. LIMITATIONS

The majority of the sample farmers are illiterate. They might have either over-reported or under-reported the extent of employment pattern, cost of cultivation and production of the farmers.

The tank-irrigation is restricted, particularly during the summer season. This has resulted in partial failure of crops and therefore, the employment pattern of farmer may not always be actual. The extent of employment pattern of harvesting, threshing and processing of agricultural products and allied activities would not be
estimated, due to non-availability of data or machine involvement. But attempts have been made to collect accurate data on employment pattern by cross checking and recalling the memory of the farmers from the farm sample farmers.

It may be recognized that the findings of the study should not be generalized beyond the boundaries of the area under investigation and they are applicable only to such other areas having similar agro climatic and socio economic conditions. Since, the data were collected from the small area, there was no significant difference among the farmers of tank irrigation.

1.9. ORGANISATION OF THE THESIS

The first chapter explains with introduction, covers the statement of the problems, objectives, design of the study, limitations and organization of the thesis.

The second chapter reviews the earlier literature pertaining to the study.

The third chapter presents an over view of the development of irrigation in Tamil Nadu.

The fourth chapter explains the profile of the Ramanathapuram district and salient feature of the RSMBT.

The fifth chapter presents the socio-economic status of sample farmers.

The sixth chapter is devoted to study cost and return, cropping pattern and employment under RSMBT.

The seventh chapter deals with resource use efficiency within group of farmers, and the eighth chapter provides the summary of major findings of the study, policy implications and conclusions.