CHAPTER I

INTRODUCTION AND RESEARCH PLAN
CHAPTER I
INTRODUCTION AND RESEARCH PLAN

1.1 INTRODUCTION:

The history of human civilization is marked by a series of landmark innovations from time to time, which have acted as primary factors in moulding the path for human evolution. Developing knowledge and know-how of producing food is supposed to be the most prominent among these landmark innovations, and this has come to be known as Agriculture. Evidences found from Neolithic sites in Iran, Iraq and Jordan establish that agriculture was invented approximately in 6500 to 7000 BC.¹ It is said that as man began to live in groups and settle at a place, he felt the need for growing larger quantities of food crops from limited land area, and he then invented Irrigated Agriculture sometimes during period between 3000 to 1000 BC. Evidences still found in the valleys of Mesopotamian civilization and on the banks of Tigris and Euphrates reveal that irrigated agriculture was practised by races settled there. Certain structures traced in these settlements also support the hypothesis that floodwaters were stored in earthen embankments, and channels were dug from them to carry water to nearby fields.

The irrigation in modern era has assumed even greater role and it has been used as a powerful tool to produce increased agricultural production, to

meet demands of rapidly growing world population. At places, where climatic conditions are less favourable and where there are scanty rainfalls, the irrigation has now been able to provide assured supply of water for agricultural production. In many countries in the world, it has become a means to alleviate sufferings, preserve life and avert famines. In countries as diverse as China, Egypt, Indonesia, Mexico, Philippines, Sudan and Thailand, to name but some, the irrigation is a major part of rural and national economies. In fact, in many of these countries, development of extensive irrigation networks has been considered as a main thrust of poverty eradication. As a result, there has been an amazing increase in the development of irrigation in the past two hundred years. The total irrigated land in the world, which was just 8 million hectares in the year 1800, increased to 48 million hectares in 1900, to 94 million hectares in 1950, and to about 250 million hectares in the beginning of 1990s. Its growth in some of the countries has also been phenomenal. For example, 100% of agricultural land is irrigated in Egypt; while 77% and 63% of agricultural lands are irrigated in Pakistan and Japan respectively.

Particularly in a country like India with geographical area of 329 million hectares and predominant occupation of agriculture, the irrigation has assumed a major role in the economic development of country. As pointed out by Sir Charles Trevelyan, "Irrigation is everything in India". Similarly, Dr. Knowles observed the role played by irrigation in India as, "The irrigation works have provided security of life, .... They have lessened the cost of famine relief and have helped to civilize whole region".

5 Ibid.
assumed an increased importance, particularly in view of erratic pattern of rainfall in the country. Nearly 75% of rainfall is contributed by South West monsoon and it is confined to only four months of rainy season from June to September. Very few regions in the country receive rainfall during winter and summer seasons. Even during months of monsoon, the rainfall is widespread and scanty. Under such uncertainties of rainfall, the irrigation has become a main source of water for successful raising of crops both during khariff as well as rabi season in the country.

In the light of above significances, considerable importance has been given for development of irrigation, particularly in the planning era of country. While there were only 74 major and 143 medium irrigation projects during pre-plan period, 158 major and 768 medium projects were taken up and completed during plan period upto 1997. In addition, 119 major and 176 medium projects which were taken up during this period are also at different stages of completion. The total irrigated land has increased from 22.6 million hectares at the time of Independence to 89.5 million hectares by the end of 1996-97. This represents around 79% of ultimate irrigation potential of the country, which is estimated to be as 113.5 million hectares. In financial terms, it is estimated that about Rs. 860 billion has been invested in irrigation during plan period from First Five Year Plan to Eighth Five Year Plan (1992-1997).

---

6 According to classification made by Planning Commission, Government of India, projects having CCA (Culturable Command Area) of more than 10 thousand hectares are classified as Major Projects, those having CCA between 2 thousand hectares and 10 thousand hectares as Medium Projects, and those having 2 thousand hectares or less are classified as Minor Irrigation Schemes.


8 Ibid.
The agriculture has also been the main occupation of people in the State of Karnataka. The State is situated in the southern part of India, with a geographical area of 19.04 million hectares. Two third of the State receives less than 700 mm of annual rainfall, and therefore most part of it is always under threat of drought. In this context, Government of Karnataka has given considerable importance to irrigation and has been taking up development of irrigation projects in a big way. The investment, which was just Rs. 414.2 million in First Five Year Plan (1951-56) was increased to Rs. 2.37 billion in Eighth Plan (1992-97). Correspondingly, irrigation potential created in the State has also increased from meagre 0.78 million hectares at the end of First Plan, to 3.1 million hectares at the end of 1994-95, as against the ultimate irrigation potential of 5.5 million hectares.9

1.2 SIGNIFICANCE OF STUDY:

Inspite of massive investments being made in the development of Irrigation Projects, experience in developing countries including India reveals that performance of many of these projects is far below their expectations, and very few of them have been able to achieve their objectives effectively. In most of the projects, distribution of water is not assured to all farmers. The irrigation water is let into distribution system in most arbitrary manner and its deliveries rarely match to requirements. The tail-end deprivation is very common in most of the projects. The area actually getting irrigation water is also far less than planned. Most of the projects are also affected by severe waterlogging and salinization.

The situation is best explained by World Bank in its Development Report of 1992 as, "Hard on the heels of rapid expansion of irrigation over the past forty years have come growing problems with salinization and waterlogging that are eating away at the productivity of irrigation investments. ... Globally, perhaps about 950 million hectares, or nearly one-third of arable land, are affected by elevated salt concentrations. Most of these salinizations occur naturally. But about 60 million hectares, or some 24 percent of all irrigated land, suffer from salinization caused by bad irrigation practices. Severe declines in productivity affect, according to some estimates, about 24 million hectares, or about one-tenth of irrigated land. Despite awareness of this problem, and despite several decades of reclamation efforts, new areas are being degraded faster than other soils being rehabilitated.¹⁰

The problem of poor performance of irrigation systems is also very common in India; there are very few examples of irrigation projects functioning as planned and expected in the country. According to a study conducted by Sastry,¹¹ the average water use efficiency in the existing irrigation projects of country arrives to about 40%. The overall agricultural productivity in case of cereals is as low as about 1.65 tonnes per hectare (1992-93) as compared to other countries like China, South Korea and USA which are having overall productivity of 4.0, 6.0 and 4.5 tonnes per hectare respectively. It is also very low as compared to global average of 2.7 tonnes per hectare.

Majority of irrigation projects in the State of Karnataka too have been performing below their expectations. An Expert Committee constituted by Government of Karnataka in 1985 to evaluate performance of irrigation

projects, reviewed ten major and medium irrigation projects in the State and found that overall actual utilisation was only 74.7% of potential created. It also observed that there has been a gross violation of cropping pattern envisaged for the projects and tail-end deprivation is most common in all projects\textsuperscript{12}.

Upper Krishna Project is one of such irrigation projects in the State. It is an ambitious project undertaken by Government of Karnataka to provide benefits of irrigation to about 6,22,120 hectares of draught prone areas in the northern districts of State. The maps showing location of project and details of its command area are presented in figures 1.1 and 1.2. The project is being implemented in stages and phases, but experience in already developed command area reveals that there is no effective distribution of water and tail-end deprivation is very severe. According to World Bank which provided assistance to Phase-I and Phase-II of project, the canal systems in the command area of project are rarely operated according to design, but on the other hand they are allowed to flow virtually all the time. There is poor operation and maintenance leading to rapid deterioration of irrigation systems. The lining is damaged at several places, and gates at many locations are either damaged or missing. The Field Irrigation Channels(FIC) which are supposed to be maintained by farmers, are also not in good shape. It observed that failure to operate canals as designed and farmer’s lack of incentive to conserve water, have combined with presence of soluble salts in bedrock below soils to produce crop-killing salinization in only five years after initiation of irrigation in the command area of project. The World Bank rated project as unsatisfactory; its sustainability uncertain at best.\textsuperscript{13}

Though majority of irrigation projects in the State have been performing very poor, it is observed that very few efforts have been made to study their deficiencies and take up necessary corrective measures. On the other hand, same age-old policies are not only continued with existing projects, but they are blindly pushed into new projects also. A general study of irrigation projects broadly reveals that they are planned and designed without visualising real operational problems at field levels. As a result, the developed projects have become totally unmanageable by authorities. The situations prevailing in the irrigation projects demand a thorough review of all the basic concepts of their planning and management in totality, and effect modifications in policies concerning their designs.

The present study is an attempt in this direction, to analyze various concepts adopted in the planning and management of Upper Krishna Project and to identify different factors which have been responsible for its poor performance. The study finds that the project has been developed based on a concept to irrigate only certain portions of land holdings in different seasons. Based on the concept, its canals have been designed to irrigate maximum of 60.5% of individual landholdings. But in actual practice, farmers have been irrigating their entire land holdings, due to which a scarcity of water is experienced in the tail ends of canals. It has been found that it is totally impossible to implement concepts adopted in the project. Therefore, an attempt is also made in the study to formulate an ideal irrigation system, which is termed as **Rotational Blocks Irrigation System**, for effective distribution of water in the project. In the system, the command area of a canal is divided into two equal blocks and irrigation is extended to entire land holdings of farmers in each block on rotation. As the system proposes to provide irrigation to entire land holdings, it is expected that it can be easily implemented and an efficient distribution of water can be achieved in the command area of project.
1.3 OBJECTIVES:

The study has been conducted with following objectives.

1. To examine Planning and Management aspects in Upper Krishna Irrigation Project of Karnataka State.
2. To assess impact of project on agricultural income, employment and human poverty of farmers.
3. To study operational challenges in the equitable distribution of water in the command area of project.
4. To formulate an ideal system for distribution of water in the project.
   and
5. To suggest suitable policy measures.

1.4 HYPOTHESES:

The following hypotheses have been formulated to be tested in the study,

1. Upper Krishna Irrigation Project has resulted in equitable distribution of water among the farmers.
   and
2. Upper Krishna Irrigation Project has reduced human poverty of farmers in the command area.
1.5 RESEARCH PLAN:

The study basically intended to examine deficiencies in planning and management of Upper Krishna Project, and to evolve an ideal system for efficient and equitable distribution of water in the command area. For the purpose, following research plan was employed.

i. One branch canal viz., Hunasgi Branch Canal of the project was selected, which was being irrigated since 1984. The branch canal consisted of 5 distributaries and comprised of all typical characteristics of irrigation distribution system in the project. The details of branch canal have been presented in figure 1.3. The total notified command area of the branch canal was 21,707 hectares and it formed about 10% of total command area irrigated in the project during year 1996-97.

ii. The details of concepts adopted for planning and management of irrigation distribution systems in the project were collected from various sources in the department. A complete data regarding both irrigated and non-irrigated areas in the command area of branch canal was collected for a study period of 5 years between 1992-93 and 1996-97, from the office of the Executive Engineer, Operation and Maintenance Division, Narayanpur. Similarly, water releases in the branch canal and its distributaries during the study period were collected from various gauging stations situated at their starting points. The field data as collected above were analysed and studied in the light of designed cropping pattern and planned release of water.

iii. A sample of 225 farmers was selected from study area by stratified sampling method. In first stage, 9 villages were selected, three each from initial, middle and tail reach areas of branch canal respectively, and it was
FIGURE 1.3: COMMAND AREA OF HUNASGI BRANCH CANAL
proposed to select 75 farmers in each reach. In second stage, the landholding pattern of farmers in study area was obtained, and the number of sample farmers to be selected proportionately from each category of farmers was decided. In third stage, farmers were randomly selected from the three villages of each reach and in proportion of land holding classification.

iv. The sample farmers were interviewed with the help of a schedule, which consisted of questions on water management, performance of project, and on its impact on farm economy, employment and human poverty of farmers. A ranking method was employed in the study to elicit information regarding causes to various issues. The income from irrigated and non-irrigated areas in the command area of project were analyzed with the help of regression method. The Z test was employed for analysing significance of difference in human poverty index and its indicators, before and after irrigation.

v. Similarly, a sample of 25 irrigation officials consisting of Junior/Assistant Engineers, Assistant Executive and Executive Engineers in charge of water distribution management was selected, and they were interviewed with a separate schedule. Their views on cropping pattern, irrigation intensity, canal operations, implementation of warabandi, etc were obtained and studied.

vi. Finally, the deficiencies in existing system of planning and management were analysed and an attempt is made to evolve an ideal water distribution system for the project.
1.6 SAMPLE DESIGN:

A. Sample of Farmers: A three stage stratified sampling method was employed to select a sample of farmers as described below,

i. In first stage, a total number of 9 villages were selected from the command area of Hunasgi Branch Canal, 3 villages in the initial reach of command area (Head reach), 3 villages in the middle reach (Middle reach) and 3 villages in the end reach (Tail reach). The villages which were randomly selected from the command areas of different distributaries are shown in figure 1.4. It was proposed to equally divide 225 sample farmers among the three reaches and thus select 75 farmers from each reach.

ii. In second stage, the pattern of land holding in the command area of branch canal (Gulburga district) was obtained, which is as shown in table 1.1. And, the total number of different categories of farmers to be selected in each reach of canal was arrived as shown in table 1.2.

<table>
<thead>
<tr>
<th>Category of Farmers</th>
<th>Size of Land Holding</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Marginal</td>
<td>Less than 1 Ha.</td>
<td>15%</td>
</tr>
<tr>
<td>2. Small</td>
<td>1-2 Ha.</td>
<td>31%</td>
</tr>
<tr>
<td>3. Semi-Medium</td>
<td>2-4 Ha.</td>
<td>30%</td>
</tr>
<tr>
<td>4. Medium</td>
<td>4-10 Ha.</td>
<td>19%</td>
</tr>
<tr>
<td>5. Large</td>
<td>More than 10 Ha.</td>
<td>5%</td>
</tr>
</tbody>
</table>

100%

Source: State Agricultural Census Commissioner (1992), Agriculture Census 1990-91 - Provisional Results, Government of Karnataka, Bangalore.
### TABLE 1.2: DESIGN OF SAMPLE OF FARMERS

<table>
<thead>
<tr>
<th>CATEGORY OF FARMERS</th>
<th>HEAD REACH</th>
<th>MIDDLE REACH</th>
<th>END REACH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. MARGINAL</td>
<td>11 (15%)</td>
<td>11 (15%)</td>
<td>11 (15%)</td>
</tr>
<tr>
<td>2. SMALL</td>
<td>23 (31%)</td>
<td>23 (31%)</td>
<td>23 (31%)</td>
</tr>
<tr>
<td>3. SEMI MEDIUM</td>
<td>23 (30%)</td>
<td>23 (30%)</td>
<td>23 (30%)</td>
</tr>
<tr>
<td>4. MEDIUM</td>
<td>14 (19%)</td>
<td>14 (19%)</td>
<td>14 (19%)</td>
</tr>
<tr>
<td>5. LARGE</td>
<td>4 (5%)</td>
<td>4 (5%)</td>
<td>4 (5%)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>75 (100%)</td>
<td>75 (100%)</td>
<td>75 (100%)</td>
</tr>
</tbody>
</table>

*Note: The figures in parenthesis are percentages.*

*Source: Adapted from table 1.1.*

v. In third stage, farmers were randomly selected from three villages in each reach and in ratio of land holding pattern as arrived in table 1.2. The list of villages selected and the number of farmers surveyed in different villages are exhibited in table 1.3.

### TABLE 1.3: DETAILS OF SAMPLE OF FARMERS

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Reach</th>
<th>Name of Village</th>
<th>Name of Distributary</th>
<th>CATEGORY OF FARMERS</th>
<th>MARGINAL</th>
<th>SMALL</th>
<th>SEMI-MEDIUM</th>
<th>MEDIUM</th>
<th>LARGE</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Head Reach</td>
<td>Rajankolur</td>
<td>D2 of HBC</td>
<td>MARGINAL</td>
<td>3</td>
<td>6</td>
<td>9</td>
<td>7</td>
<td>2</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Manjalapur</td>
<td>D5 of HBC</td>
<td>SMALL</td>
<td>3</td>
<td>8</td>
<td>5</td>
<td>5</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hunasagi</td>
<td>D6 of HBC</td>
<td>SEMI MEDIUM</td>
<td>5</td>
<td>9</td>
<td>9</td>
<td>2</td>
<td>2</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Sub-Total</td>
<td></td>
<td></td>
<td></td>
<td>11</td>
<td>23</td>
<td>23</td>
<td>14</td>
<td>4</td>
<td>75</td>
</tr>
<tr>
<td>II</td>
<td>Middle Reach</td>
<td>Gomagudda</td>
<td>D2 of HBC</td>
<td>MARGINAL</td>
<td>4</td>
<td>7</td>
<td>7</td>
<td>5</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kakkera</td>
<td>D5 of HBC</td>
<td>SMALL</td>
<td>3</td>
<td>8</td>
<td>7</td>
<td>5</td>
<td>1</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wajjal</td>
<td>D6 of HBC</td>
<td>SEMI MEDIUM</td>
<td>4</td>
<td>8</td>
<td>9</td>
<td>4</td>
<td>3</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>Sub-Total</td>
<td></td>
<td></td>
<td></td>
<td>11</td>
<td>23</td>
<td>23</td>
<td>14</td>
<td>4</td>
<td>75</td>
</tr>
<tr>
<td>III</td>
<td>Tail Reach</td>
<td>Gaddalamari</td>
<td>D3 of HBC</td>
<td>MARGINAL</td>
<td>2</td>
<td>8</td>
<td>8</td>
<td>5</td>
<td>1</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hunasiholi</td>
<td>D5 of HBC</td>
<td>SMALL</td>
<td>5</td>
<td>6</td>
<td>8</td>
<td>3</td>
<td>1</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Devathkal</td>
<td>D6 of HBC</td>
<td>SEMI MEDIUM</td>
<td>4</td>
<td>9</td>
<td>7</td>
<td>6</td>
<td>2</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>Sub-Total</td>
<td></td>
<td></td>
<td></td>
<td>11</td>
<td>23</td>
<td>23</td>
<td>14</td>
<td>4</td>
<td>75</td>
</tr>
<tr>
<td><strong>GRAND TOTAL (I+II+III)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>33</td>
<td>69</td>
<td>69</td>
<td>42</td>
<td>12</td>
<td>225</td>
</tr>
</tbody>
</table>

v. In third stage, farmers were randomly selected from three villages in each reach and in ratio of land holding pattern as arrived in table 1.2. The list of villages selected and the number of farmers surveyed in different villages are exhibited in table 1.3.
B. Sample of Irrigation Officials: The list of various officials in charge of irrigation management in the command area of branch canal was obtained from department, and a sample of irrigation officials was designed as follows. There were two Executive Engineers and two Assistant Executive Engineers, and all of them were included in sample. The remaining 21 officials were randomly selected from Assistant Engineers and Junior Engineers in equal proportions. The sample represented about 80% of total officials in charge of irrigation management in the study area. The details of irrigation officials selected and interviewed are presented in table 1.4.

<table>
<thead>
<tr>
<th>Designation</th>
<th>Number of officials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Executive Engineer</td>
<td>2</td>
</tr>
<tr>
<td>2. Assistant Executive Engineer</td>
<td>2</td>
</tr>
<tr>
<td>3. Assistant Engineer</td>
<td>10</td>
</tr>
<tr>
<td>4. Junior Engineer</td>
<td>11</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>25</strong></td>
</tr>
</tbody>
</table>

1.7 ANALYTICAL TOOLS

A method of ranking various reasons was employed in the study. All possible answers to a question were listed in schedules, and respondents were requested to rank various answers/reasons according to their significances. The data obtained are analysed by calculating Ranking scores, as follows,

i. The first ranking was given highest weightage points equal to total number of possible answers, and the subsequent rankings were given one
weightage point lesser, e.g. if a particular question has 5 possible options, a
weightage of 5 points is given to first ranking. Similarly a weightage of 4 points
is given to second ranking and so on, until last ranking gets a weightage of
one point.

ii. The maximum possible ranking points for an option is calculated by
multiplying total number of respondents with weightage points given to first
rank, as in the following equation. These are maximum possible points that an
option can obtain, if all respondents assign first rank to same option.

Maximum ranking points =
Total number of respondents X Weightage given to first rank.

iii. The different rankings given by different respondents are multiplied
with their respective weightage points, and total ranking points to each answer
are calculated.

iv. The Ranking score obtained by an option is arrived at by
converting total ranking points given to option by respondents as percentage
of maximum ranking points as follows,

\[
\text{Ranking Score} = \frac{\text{Total ranking points to option}}{\text{Maximum ranking points}} \times 100
\]

v. The different options are given ranks according to ranking scores
assigned to them by respondents. The first rank is given to option with highest
ranking score, the second rank to next highest ranking score and the other in
order.
vi. A particular rank to an option represents the importance assigned to it by respondents collectively. For example, first rank to a particular option signifies that respondents give highest importance to it as compared to other options which get second and subsequent ranks. Therefore, different options/answers are studied in the light of ranks obtained by them and views of respondents are analyzed.

The ranking score method is employed in fourth and fifth chapters in pages 123-142 and 151-154 respectively.

1.8 DESIGN OF DESSERTATION:

The dissertation has been organised into eight Chapters.

In the beginning of first Chapter, the role of irrigation in the economic development of countries is described. The problems faced by major irrigation projects particularly in developing countries like India are analysed and significance of present study is highlighted. The objectives and hypothesis are framed, and research plan, sample design and analytical tools employed in the study are described.

An extensive review of literature available on the research subject is carried out in Chapter II. Both micro level studies of individual researchers and macro level studies of various national and international bodies, irrigation and agriculture commissions, etc. are reviewed in the Chapter.

In Chapter III, theoretical aspects of planning and management of irrigation projects are studied. An attempt is made to identify different stages in the development of irrigation projects in Indian context and various issues
involved in their operation and management. Efforts made in the field of participatory irrigation are also studied in the chapter.

An extensive study of planning and management in Upper Krishna Project is made in Chapter IV. A brief history and salient features of project are presented in the beginning of chapter. An attempt is then made to study how various stages of planning and development of an irrigation project as discussed in third chapter are applied in the project. The details of various concepts with regard to cropping pattern, estimation of crop water requirements and design of canals adopted in the project are studied. The observations and findings of field study carried out on the operation of canals, release of water, intensity of irrigation and actual cropping pattern are presented. The views of farmers and irrigation officials on adequacy of water supply, implementation of warabandi and performance of project are analysed at the end of Chapter.

The findings of field study carried out on the impact of irrigation project on agricultural income, employment and human poverty of farmers are presented in Chapter V. A comparative study of agricultural income from irrigated and non-irrigated lands in the command area of project, and its variation in different reaches and in the different categories of farmers is made. The human poverty prevailing among the farmers of command area before and after irrigation was studied and the impact of project is analyzed.

The various possible challenges in the implementation of cropping pattern, release of water and equitable distribution of water in the command area of project are analyzed in Chapter VI. The actual storage requirement with prevailing system of water distribution management is studied, and at the
end of Chapter, an attempt is made to analyze constraints in the development of water users associations in the project.

In Chapter VII, an attempt is made to evolve an ideal water distribution system for the irrigation project, which is named as "Rotational Blocks Irrigation System". The details of cropping pattern, estimation of crop water requirements, design and operation of canals are explained. The storage requirement and total utilisation in the project with proposed system are also studied in the Chapter.

In the last Chapter, major findings of the study are summarized. The deficiencies in planning and management of irrigation projects in the State of Karnataka are highlighted and comprehensive recommendations are made with regard to structural changes to be brought about in the design of irrigation projects in the State.

1.9 DISCLAIMER:

The views expressed by the researcher in the study are only in his personal capacity as a research student and not in the official capacity as an Assistant Engineer in Upper Krishna Project.