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Stability Analysis of Bund Feeder Channels, During Desilting and Estimation

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ABSTRACT
Water conservation is important in present days. Due to global warming temperatures are increasing, and rainfall is also not occurring in monsoon season. Because of this in Rayalaseema many areas became draught prone areas. In order to avoid this situation government is making policy to store water in rainy season. when the structures (dams, checkdams, perculation tanks) are not present so the rainfall water will runoff and join in rivers, sea, so that it is not beneficial to local area when the rain water is not storing. So we have to construct water conservation structures and store water so that ground water resources will increase. So we perform surveying so we can find that how many tank (cheruvu) structures are present in one stream and what the rainfall data is and we can suggest and how to store water, how to calculate, silt, how to desilt the tank, how to strength the bund, any new structures are required by calculating the yield. In this project we will take any one mandal and find the number of tanks and do necessary surveying in the field, calculate the quantities, estimate the quantity and amount required for the desilting, transport the silt to bunds or fields. We also can estimate the required structures (wiers, sluices, feeder channels).

1. INTRODUCTION
Irrigation tank
An irrigation tank or tank is an artificial reservoir of any size, mainly in India. (The word sagar refers to a large lake, usually man-made). It can also have a natural or man-made spring included as part of a structure. Tanks are part of an ancient tradition of harvesting and preserving the local rainfall and water from streams and rivers for later use, primarily for agriculture and drinking water, but also for sacred bathing and ritual. Often a tank was constructed across a slope so to collect and store water by taking advantage of local mounds and depressions. Tank use is especially critical in parts of South India without perennial rainfall where water supply replenishment is dependent on a cycle of dry seasons alternating with monsoon seasons.

1.1 Reasons for why Tank irrigation more common in South India
1.The undulating relief and hard rock's make it difficult to dig canals and wells.

2.There is little percolation of rain water due to hard rock structure and ground water is not available in large quantity.

3.Most of the rivers of this region are seasonal and dry up in summer season. Therefore, they cannot supply water to canals throughout the year.

4.There are several streams which become torrential during rainy season. The only way to make best use of this water is to impound it by constructing bunds and building tanks. Otherwise this water would go waste to the sea.

5.The scattered nature of population and agricultural fields also favours tank irrigation

1.1.1Merits of Tank Irrigation
Most of the tanks are natural and do not involve heavy cost for their construction. Even an individual farmer can have his own tank. Tanks are generally constructed on rocky bed and have longer life span. In many tanks, fishing is also carried on. This supplements both the food resources and income of the farmer.

1.1.2 Demerits of Tank Irrigation
Many tanks dry up during the dry season and fail to provide irrigation when it is needed the most. Silting of the tank bed is a serious problem and it requires desilting of the tank at regular intervals.

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Much water is evaporated from the large expanse of shallow water and is thus not available for irrigation. Tanks cover large areas of cultivable land. In many areas, other sources of irrigation have been adopted and the dry beds of tanks have been reclaimed for agriculture. Moreover, lifting of water from tanks and carrying it to the fields is a strenuous and costly exercise which discourages the use of tanks as a source of irrigation.

1.2 Tank Design

Water is considered a purifying and regenerative element in India, and is an essential element of prayer and ritual. Water is also revered because of its scarcity in western India where dry and monsoon seasons alternate and failure of the monsoon season means famine and death while plentiful water replacing irrigations sources is a time of rejoicing. This resulted in building water storage tanks that combined the practical and sacred. Since ancient times, the design of water storage has been important in Indian architecture. As early as 3000 BC, sophisticated systems of drains, wells and tanks were built to conserve and utilise water. Tank building as an art form began with the Hindus and developed under Muslim rule.

1.3 Village Tanks

Ralegaon Siddhi is an example of a village that revitalised its ancient tank system. In 1975 the village was drought-stricken. The village tank could not hold water as the earthen embankment dam wall leaked. Work began with the percolation tank construction by the villagers who donated their labor to repair the embankment. Once this was fixed, the village's seven wells below the tank filled with water in the summer for the first time in memory. Now the village has a supply of water throughout the year.

1.4 Tank Wells

Tanks known as "Pushkarni" or "Kalyani" also known as "Kund" in Hindi are reservoirs with steps leading down to the water, generally found in South India, and sometimes constructed within the walls of a temple complex. Bathing in the sacred waters of a temple tank was believed to cure worshippers of afflictions such as leprosy and blindness. Many temple tanks are decaying and drying up today.

1.5 Step Wells

Step wells, also called are wells in which the water can be reached by descending a set of steps. They are most common in the west of India. Stepwells were often used for leisure, providing relief from daytime heat. This led to the building of some significant ornamental and architectural features, often associated with dwellings and in urban areas. It also ensured their survival as monuments.

1.6 Modern Tank Management

The development of large-scale water management methods and hydroelectric generation have replaced much of the local efforts and community management of water. For example, the state of Karnataka has about 44,000 artificial wetlands locally constructed over many centuries. At least 328 are threatened today.

However, recently a tank regeneration movement initiated by communities and non-governmental organisations (NGO) has arisen. Today, there are approximately 120,000 small-scale tanks, irrigating about 41,200 km² in semi-arid areas of India. This constitutes about one third of the total irrigated land in South India. Chingleput, North Arcot and South Arcot have high intensity of tank irrigation. Tanks comprise an important source of irrigation in the Karnataka Plateau, eastern Madhya Pradesh, eastern Maharashtra, interior Orissa and Kerala. Outside the Peninsular plateau, West Bengal, Bihar, Bundelkhand area of Uttar Pradesh, Rajasthan and Gujarat have tank irrigation (Fig. 17.2). The tank irrigation is practiced mainly in peninsular India due to the following reasons.

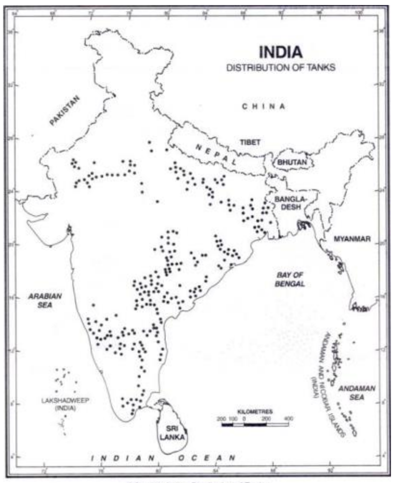

FIG. 17.2. India : Distribution of Tanks

fig1: Tanks in india

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2. LITERATURE REVIEW

2.1 INTRODUCTION

As the time progresses the approach towards the research too varies. Hence, it becomes important to trace the nature and techniques adopted for undertaking the research activities. It also becomes noteworthy to understand the development of tools and methodologies for ascertaining the approaches for a research problem. Therefore, reviewing the earlier literatures enables the investigator to formulate the aim, objectives and methodologies. An attempt has been made here to contradict certain methodologies with substantial background. This chapter is classified broadly into five sections namely tank rehabilitation, multiple uses of tank, water and land productivity, non-farm activities and ground water market.

2.2 TANK REHABILITATION

Tank irrigation has been a dominant component of Tamil Nadu agriculture. It is as much as one third of the net irrigated area in the State.A tank is a small storage reservoir used to impound the runoff from themonsoon rains which occur during a few months of the year and to regulate the supply of water mainly for agriculture use. Bulk of the irrigation tanks inSouth India are very old. They were built hundreds of years ago. Their wateruse efficiency has come to almost as low as 25 to 35% in many cases. This isdue to inadequate maintenance, operational inefficiency and lack of controlover the regulation and excessive use of water at the farm level. Modernization of tank irrigation system has become necessary to utilize thealready developed irrigation potential with greater efficiency.

2.3 MULTIPLE USES OF TANK

The collection of papers in this special section examines the multiple uses of water in irrigation systems, and the implications of these multiple uses for various aspects of irrigation and water management policy. Particular attention is paid to how recognizing multiple use can change the valuation of water in irrigation systems, how systems are managed to maxi mize productivity and environmental sustainability and equity in involving multiple stake holders with due attention to the needs and rights of each. An initial study led by International Water Management Institute and International Food Policy Research Institute revealed many faceted natures of multiple uses of water including human health, environment, productivity, gender and water rights. Pilot research was conducted in KrindiOye Irrigation system in Sri Lanka to develop a methodology for investigating these many dimensions (Bakker et al 1999

2.4 WATER AND LAND PRODUCTIVITY

Water productivity is defined as 'crop production' per 'unit of water used' (Molden 1997). Concept of water productivity in agricultural production is focused on 'producing more food with the same amount of water' or 'producing the same amount of food with less water'. Initially, irrigation efficiency or water use efficiency was used to describe the performance of irrigation systems. However, the used terminology 'water use efficiency' does not follow the classical concept of 'efficiency', which uses the same units for input and output. Therefore, International Water Management Institute (IWMI) has proposed a change of the nomenclature from 'water use efficiency' to 'water productivity'. Water productivity can be further defined in several ways according to the purpose, scale and domain of analysis (Molden et al 2001; Bastiaanssen et al 2003).

2.5 NON-FARM AND OFF-FARM ACTIVITIES

The literature on income diversification is thwarted with definitional problems and inconsistencies. Here 'non-farm' refers to those activities that are not primary agriculture or forestry or fisheries. However, non-farm does include trade or processing of agricultural products (even if, in the case of micro-processing activities, they take place on the farm). Barrettand Reardon (2001) stress that this definition is sectoral, i.e. it follows the convention used in national accounting systems where a distinction is made between primary production, secondary (manufactu ring) activities, and tertiary (service) activities.

3. IRRIGATION REQUIREMENTS

INTRODUCTION TO IRRIGATION

- Major Irrigation project …. above 10,000 Ha ayacut
- Medium Irrigation project ….2000 to10,000 Ha ayacut
- Minor Irrigation project …. below 2,000 Ha ayacut

3.1Minor Irrigation Schemes

- Diversion works- Direct Irrigation
- Diversion Works- Indirect Irrigation
  - Filling tanks
- Storage tanks
- Lift irrigation schemes

3.1.1Diversion works- Direct Irrigation

Direct irrigation is proposed in any uncut scheme. Guaged data observing the floods during the proposed crop periods. Minimum flows are to be found for ascertaining that the required demands are met with the stream should not dry up continuously for seven days during the crop period

Rainfall data of the catchment area is to be studied thoroughly. The rainfall data in the command area is also to be analyzed critically during the crop period. Ground water potential is to be evaluated to examine the possibility for conjunctive use of surface water and ground water

3.1.2 Diversion works- indirect irrigation(filling tanks)

- for filling tanks, the following tables may be taken for guidance to divert the flood waters

Catchment area in Sq.Km (Free + 1/5th intercepted)	Percentage diversion for filling tanks(Max)
2.5 to 40	20%
40 to 130	25%
Above 130	30%

Table 3.1 diversion requirements

3.2 Flood days

Capacity of flood flow channel. If rainfall is 2.5 cm or more in a day, the day may be taken as flood day.If rain fall is ¾ '' to 1 ", the day be may be treated as ½ flood day. The flood days may be calculated for 40 years and 75% dependable flood days worked out the diversion flood flow channel capacity determined for the quantity to be diverted.

3.2.1 Storage tanks

Storage tanks are proposed at sites where the catchment area is more than 1.3 Sq.Km(roughly 0.5 Sq.Miles).In tribal areas, M.I. schemes can be proposed even the catchment area is less than 1.3 Sq.Km. Under special component for S.C and S.T programe and also under special circumstances of rainfall occurrence etc. No forest land should be involved either for submergence or for canals

3.2.2 Computation of yields

Assume the whole catchment area as free catchment and deduct the actual upper utilizations (Master plans were also prepared similarly).The upper and lower utilizations are calculated on the basis as indicated

3.2.3 Estimation of runoff & yield

Runoff is estimated based on the amount of rainfall in a year or monsoon season and the nature of the catchment. Yield is the quantity of water expected from the catchment at a specified location

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3.2.4 Nature of catchment

Good catchment: hills or plains with little cultivation and moderately absorbent soil. Average catchment: Flat partly cultivated gravely/sandy absorbent soil. Bad catchment: Flat and cultivated sandy soils.

3.3 Catchment area factors

- Area of the basin/catchment
- Shape
- Slope
- Land use
- Type of soil
- Drainage net-work etc

3.3.1Formulae computing maximum flood discha rge

Dickens formula

$Q=CM^{3/4}$

Where,

Q= Maximum flood discharge in cusecs

C=Constant

M=Catchment area in sq. miles

Ryve's formula

$Q= CM^{2/3}$

Where,

Q=Max.flood discharge in cusecs

C=constant (varies from 750 to 1000)

M=CA in sq.miles

3.3.2 Recommended Method

The following is the terminology adopted in this procedure

A : Catchment area in Km^2

L : Length of the stream in Km

W : width of the catchment area in Km

P : Maximum rainfall in a day in mm

Q : Direct run off in mm

Tp : Time to reach peak in hours

(Concentration time)

q : maximum flood discharge in m^3/s

3.3.3 Calculate the maximum flood discharge

Calculate the maximum flood discharge for making necessary surplus arrangements for a proposed tank as shown in the S.I.Sheet

3.4Land& Water Resources of India

- Share of total World's Resources:
- Land 2.4%
- Water 4.0%
- Population 16%
- Livestock 15%
- Projected population (2050) 1640 Million
- Current production of food 200 Million tons
- Projected Food grain reqt. 450 Million tons
- How to meet the Projected Food grain reqts?

3.4.1 Challenges

- Improvement in Irrigation structures efficiency.
- More crop & income per Drop of Water.

Means : Improved Performance from Water resource Projects. Creating more storage Capacity.

3.4.2 Water and climate change

- The hydrological cycle is predicted to be more intense, with higher annual average rainfall as well increased drought.
- Predicted increase in extreme rainfall and intensity.
- The Godavari basin is projected to have higher precipitation than Krishna & Ganga.
- Changes in the number of rainy days increases over most parts of the Godavari and Krishna basins.
- Water scarcity may also become more prevalent.

3.4.3 Changes in Annual Number of Rainy Days

River Basin	Baseline (1961-1990)		Future (2071-2100)	
	Annual Rainfall (cm)	Annual Flow (km^3)	Annual Rainfall (cm)	Annual Flow (km^3)
Krishna	91	60	112	67
Godavari	166	98	201	116
Ganga	134	482	150	543

table 4.1 number of rainy days in different basins

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4.TANKS

Types of Tank

Three types of tanks are normally reffered

1. Spring tanks
2.Very deep tanks
3.Ponds in the jungle
4. Large tanks

Tanks as Ecosystems

The second largest manmade wetland Ecosystem in the world. Centuries of Service and a History: Beyond concept of sustainability. Still functioning and thriving. Used by Humans, Plants, animals and other species for economic value. Used for irrigation, freshwater fishing, washing, bathing and replenishing the flora and fauna that surround it including GWR. Life line of the village economies and human well-being. There are about 208,000 tanks in India, and 120,000 are found in southern peninsula (Andhra Pradesh, Telangana Karnataka Tamil Nadu and Pondicherry). Andhra Pradesh is the largest state of tank irrigation

- About 727 000 hectares are irrigated by tanks.
- About 28.8 per cent of tank irrigated area of India.
- About 16 per cent of the total irrigated area by tanks.

4.1Ecological implications of Tank Cascade Systems

TCSs makes up interwoven irrigation network. Tanks, paddy fields, watersheds and canals are integrated with the natural environment. Natural wetland ecosystems other than Rivers in the dry zone

Irrigation Tanks in India

Earthen bunded small water harvesting structures formed in natural depressions of land to catch and store surface run-off during intensive spells of monsoon rainfall are known as "tanks" in South India.

- Distribution of Tanks in India
- Comparison of Irrigated Area Different Sources AP
- Status of Tanks not in Use

Status	***No. of Tanks***
Temporarily not in use	24,170
Abandoned	448
Dried up	2,384
Silted	982
Other reasons	1,203
Total	29,187

4.2 TYPICAL CASCADE SYSTEM

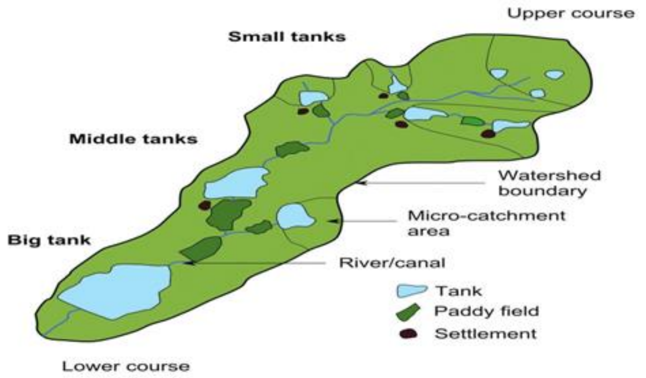

Fig 2 cascade system

4.3 Attributes of Tank Cascade

A tank cascade is a series of tanks connected together within the catchment. The configuration of physical system of tank cascade is considered as a node-link system of configuration that can delineate relative positions of tanks &their interconnections.

The nodes indicate tanks and the links indicate the interconnection between tanks without any physical link. Each tank is assigned a node number and tank type depending on its relative Position

- Start tank (ST - a tank with no inflow from upstream tanks)
- Normal tank (NT- a tank with inflow from one upstream tank)
- Confluence tank (CT- a tank with inflow from more than one upstream tank).

4.4 Village Tanks to Cascades

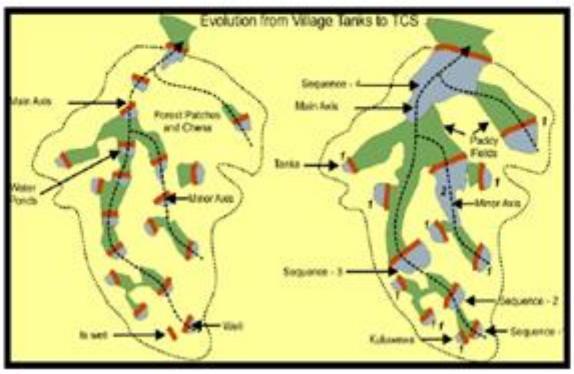

Fig 3 village tanks cascade system

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5. PROCEDURE FOR GROUPING

5.1 Plotting on SOI Sheet

We will find the exact location on SOI sheet by plotting according to obtained GPS coordinates.

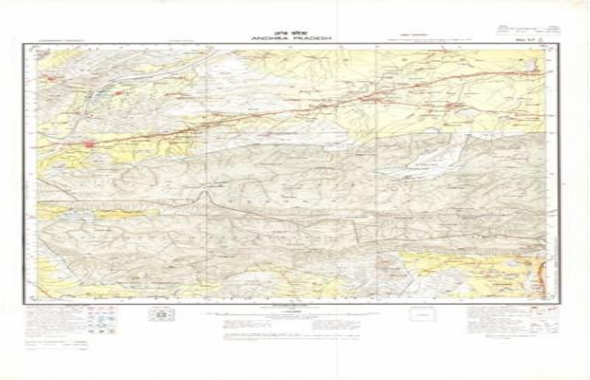
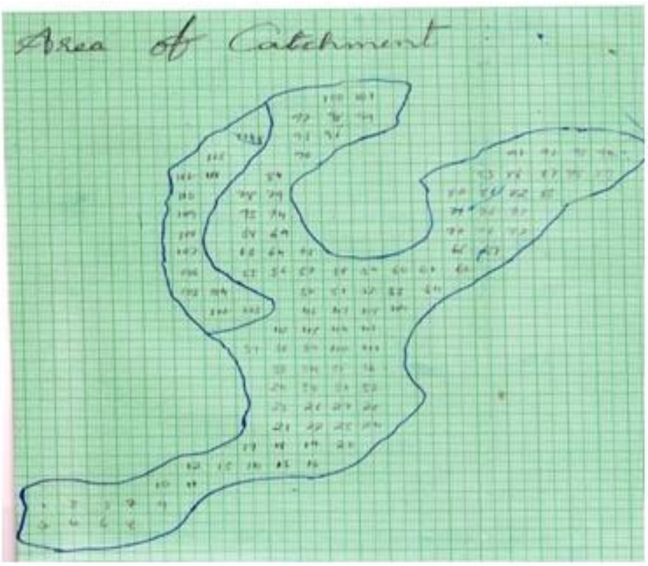


Fig 4.1 soi sheet

5.2 Calculating the catchment area

Calculating the catchment area by plotting the boundaries on the SOI sheet and transfer it to the graph sheet so that we can find the catchment area.



TOTAL CATCHMENT AREA

Scale:1 cm = 0.5 km,1 cm^2 = 0.25 sq.km,Q = $cm^{3/4}$

M=164*0.25

M=41SQ.KM

Q=900*(15.83)

Q=7142.54846cumecs

CATCHMENT AREA OF KOPPARTHY

Q=$cm^{3/4}$

m=2*0.25/2.59=0.4826sq.miles

Q=900*(0.4826)3/4

Q=521.1345cumecs CATCHMENT

AREA OF THADIGOTLA

Q=$cm^{3/4}$

m=2*0.5/2.59=0.3861sq.miles

Q=900*(0.3861)3/4

Q=440.82cumecs

5.3 Rainfall data

Rainfall data for the last 40 years and we will average fall data for the proposed Mandal.

Monsoon Rainfall Year	Rainfall monsoon rainfall in mm	rainfall in descending order Year	monsoon Rainfall in mm	Remarks
1975	1007.6	1996	1123.00	
1976	461.9	1975	1007.60	
1977	537.2	1983	911.80	
1978	737.9	2007	889.00	
1979	585.4	2013	927.00	
1980	552.1	2005	921.20	
1981	747.3	2000	817.80	
1982	546.8	1988	817.30	
1983	911.8	2003	788.80	
1984	346.7	2010	766.20	
1985	393.8	1991	760.60	
1986	360.9	1981	747.30	
1987	556.6	1997	739.80	
1988	817.3	1978	737.30	
1989	726.8	1989	726.80	
1990	567.2	1998	683.20	
1991	760.6	2011	641.00	
1992	324.5	2001	629.40	
1993	601	1995	622.10	
1994	307.3	1993	601.00	50%CL
1995	622.1	1979	585.40	
1996	1123	1990	567.20	
1997	739.8	209	559.40	
1998	683.2	1987	556.60	
1999	314.4	1980	552.10	
2000	817.8	1982	546.80	
2001	629.4	1977	537.20	
2002	414.6	2012	462.40	
2003	788.8	1976	461.90	
2004	351	2008	453.80	75%CL
2005	821.2	2014	427.20	
2006	367.8	2002	414.60	
2007	889	1985	393.80	
2008	453.8	2006	367.80	
2009	559.4	1986	360.90	

5.3.1 Yield :

Yield is calculated based on the rainfall and nature of the catchment as per strange'stable.From the historical data of 40 years, 75% confidential limit of rainfall and there by the yield is consideredIf the catchment area is influenced by two or more rain-gauge stations if the

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yields are calculated separately for each catchment and 75% C.L.so arrived, is summed up, the total value of yield gives lower compared to the value calculated for the combined catchment.

The procedure to be followed:
Continuous monsoon rainfall data of 40 years or more for all the rain-gauge stations having influence on the catchment may be collected.Year-wise yields for each of the raingage influencing area(as per strange's tables and Thiesson Polygon method as adopted in Master Plan records) may be calculatedThe above year-wise yields may be summed up so as to obtain the yield of the entire catchment in each year.Yields may be tabulated as per above in descending order and the 75% confidence value may be considered as the yield of the basin for estimation purposes.

Hydrological parameters

- Rainfall
- Catchment area
- Runoff

5.4 Differential leveling

The operation of leveling to determine the elevation of points at some distance apart is called differential leveling and is usually accomplished by direct leveling, when two points are at such a distance from each other that they cannot both be within range of the level at the same time, the difference in the elevation is not found by single setting but the distance between points is divided in two or more stages by turning points on which the staff is held and the difference of the elevation of each of succeeding pair of such turning points is found by separate setting up of the level.

5.5 Reducing the levels (RL)

Two methods are in general use, they are,

1. Height of instrument method
2. Rise and fall method

The latter reduce levels relative to the instrument height. As it has inferior in built checks it should not be used and will not be covered here. The Rise and fall method shall be used for reduction of all sites leveling. Reduction shall be carried out on site before packing up to ensure that the leveling has been done correctly. Height of instrument method gives more accurate results than Rise and fall method and it is a widely used method for the calculation of reduced levels.

5.6 Height of Instrument Method

In this method, the height of the instrument (HI) is calculated for each setting of the instrument by adding back sight to the elevation of the bench mark. The elevation of reduced level of the turning point is then calculated by subtracting from HI the fore sight. For the next setting of the instrument, the HI is obtained by adding the BS taken on TP to its RL. The process continues till the RL of the last point is obtained by subtracting the staff reading from height of the last setting of the instrument. If there are some intermediate points, the RL of those points is calculated by subtracting the intermediate sight from the height of the instrument for that setting.

Arithmetic Check: The difference between the sum of back sight and the sum of fore sight should be equal to the difference between the last RL and first RL.
Σ BS – Σ FS = Last RL – First RL

5.7 Longitudinal Section of canal

Longitudinal sectioning is the process of determining the elevations of points at short measured intervals along a fixed line such as the center line of a railway, highway. The fixed line may be single straight line or it may be composed of a succession of straight lines or of a series of straight lines connected by curves

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6. CONCLUSION

Kadapa is the one of the drought prone area in Andhra Pradesh we have done this project in C.K.Dinne Mandal, kopparthy and Tadigotla villages.With minimum cost required for inter connecting these tanks there will be maximum benefits for around 6 villages around these two panchayats. This project helps to know how useful is the grouping of tanks to store water and utilize the two crops with one time feeding per annum. It is important for the Government to consider the stability of the tanks i.e., bund strength, sluice, weir repairs if necessary in this project we have estimated the cost required for the desilting of feeder channels,tanks,bund strengthening. So finally we concluded that with the grouping of the tanks and finding the stability analysis we can make the source easy for public to do safe storage of water and stability of the bund will be useful for safety of the village also in flood season.

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